Med Sci Monit, 2001; 7(3): 504-515

The freeware AIDA interactive educational diabetes simulator – http://www.2aida.org – (1) A download survey for AIDA v4.0

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key words: computers, information technology, diabetes education, audit, interactive simulation, diabetes mellitus

SUMMARY

The purpose of this paper is to report a survey of 1,360 downloads of the AIDA interactive educational diabetes simulator. AIDA is a diabetes computer program which permits the interactive simulation of plasma insulin and blood glucose profiles for educational, demonstration and self-learning purposes. It has been made freely available, without charge, on the Internet as a non-commercial contribution to continuing diabetes education. Since its launch in 1996 over 74,000 visits have been logged at the AIDA Website – http://www.2aida.org – and over 20,000 copies of the AIDA program have been downloaded free-of-charge. This report documents a preliminary survey of downloaders of the software. The intended goals of the study were: (i) to establish the feasibility of using the Internet for auditing and surveying diabetes software users; (ii) to identify the proportion of patients with diabetes and their relatives who are actually making use of the program; and (iii) to establish certain technical details about downloaders' computer setups to facilitate the distribution of upgrades to the software. Results: The Internet-based survey methodology was found to be robust and reliable. 1,360 responses were received over an 8 month period (from November 1999 to July 2000). During the corresponding period 3,821 actual downloads of the software were independently logged at the Website – giving a response rate to this survey of 35.6%. Responses were received from participants in 67 countries – although over half of these (n=730, 54%) originated from the USA and UK. 762 responses (56%) were received from patients with diabetes and 184 (13.5%) from relatives of patients, with lesser numbers from doctors, students, diabetes educators, nurses, pharmacists, and other end users. Useful technical information about computers and operating systems being used were also obtained. This study has established the feasibility of using the Internet to survey, at no real cost, a large number of medical software downloaders/users. In addition it has yielded interesting data in terms of who are the main downloaders of the AIDA program, and has also provided technical (computer) information which has aided the recent release of a freeware upgrade to the software (AIDA v4.3).

BACKGROUND

There is increasing interest in the application of information technology (IT) in diabetes care [1]. The rationale underlying this interest is the hope that computer systems may offer a way of improving the therapy offered to patients with diabetes – permitting more patients to be managed more intensively, in line with the experience of the Diabetes Control and Complications Trial (DCCT) [2]. In addition to database systems and decision support prototypes [3], an area of clinical diabetes care in which computers may have a great deal to offer is education [4].

Received: 2001.03.12
Accepted: 2001.04.11

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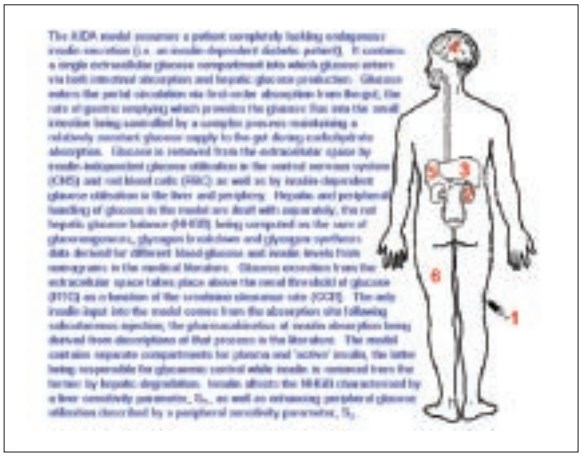

Figure 1a. Interactive representation of the AIDA model, accessible from within the AIDA v4 PC program. Modified from Lehmann et al. [11]. Published by the British Diabetic Association, London, UK. Selecting '1 = Insulin' on this display yields Figure 1b.

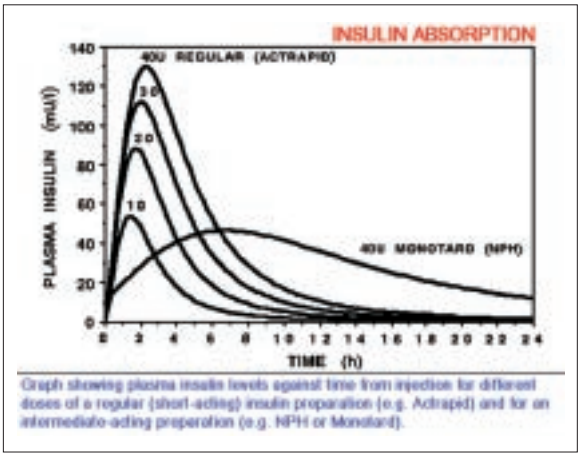

Figure 1b. Graphical representation of plasma insulin level against time from injection for different doses of a regular (short-acting) insulin preparation (e.g. Actrapid) and an intermediate-acting preparation (e.g. NPH / Monotard). Modified from Lehmann et al. [11]. Published by the British Diabetic Association, London, UK.

Some people may question – is diabetes education already not widely available? However the simple answer is 'no'. In a nationwide survey of over 2,400 patients to determine the proportion of adults with diabetes in the U.S.A. who had received diabetes education, it was found that over 41% of patients with insulin-dependent (type 1) diabetes mellitus had never attended a class or program about diabetes [5]. Furthermore it is a common experience that even when education is made available, physicians can often tend to explain the disease rather than ensure that patients acquire the expertise that will genuinely enable them to manage their diabetes [6]. Therefore there is clearly room for improvement, and perhaps IT can help [1,3,7].

There are many different aspects to diabetes education, however learning facts is only one of these. The ability to gain experience is also of great importance. It is well recognised that it is not ideal for patients to learn about diabetes control solely from real life experiences because of the long time frames involved, aside from the possible very real dangers of hypo- or hyperglycaemia [8]. For this reason, it has been suggested that an interactive simulation of a diabetic patient might offer one solution [9]. In the same way that aircraft pilots and air traffic controllers are trained on airplane and air traffic simulators, it should be possible for diabetic patients and health-care students to be trained to make appropriate responses to everyday situations using a diabetes simulator [8].

In this respect education is clearly difficult if based only on verbal and written presentations of dry facts [10]; therefore teaching materials using multi-media presentations may provide a partial solution. However, the aim should also be to teach diabetes self-management in an intuitive, interactive and enjoyable way, so that the knowledge can be enduring.

AIDA background

AIDA is a freeware computer program which permits the interactive simulation of plasma insulin and blood glucose profiles for demonstration, teaching and self-learning purposes. It has been made freely available, without charge, on the World Wide Web as a non-commercial contribution to continuing diabetes education. In the 4+ years since its original Internet launch over 74,000 people have visited the AIDA Web pages at http://www.2aida.org and over 20,000 copies of the program have been downloaded, gratis. Further copies have been made available, in the past, on diskette by the system developers and from the British Diabetic Association, London, U.K. [11]

The original AIDA v4.0 software has been described in detail elsewhere [12,13]. Briefly it incorporates a compartmental model which describes glucose-insulin interaction in patients completely lacking endogenous insulin secretion. It contains a single extracellular glucose compartment into which glucose enters via both intestinal absorption

and hepatic glucose production. The AIDA model also contains separate compartments for plasma and 'active' insulin [14,15], the latter being responsible for glycaemic control while insulin is removed from the former by hepatic degradation. Figure 1 highlights the anatomical basis of the AIDA model, with separate functions being shown for different organ systems within the body [11]. Should users wish to investigate the model further, to obtain a deeper understanding of how the simulations are generated, this facility is also offered via access to graphical representations of the individual model functions (Figure 1b). The actual mathematics underlying the model have been documented elsewhere [14]. Full details of the AIDA model are also accessible from within the AIDA software package, and can be viewed and printed separately via the Internet (from: http://www.2aida.org/technical).

While other interactive simulators of glucose-insulin interaction in diabetes have been described in the literature [15–19] to date these do not seem to have been distributed widely via the Internet, or been made particularly widely available.

Incidentally, it is important to note that AIDA, like other model-based approaches, is not sufficiently accurate to be used for individual patient simulation or glycaemic prediction [20–22]. Therefore, as the program and Website make clear, AIDA is not intended for therapy planning and can only be used for teaching, self-learning or demonstration purposes.

AIDA CASE STUDY

AIDA comes with forty educational case scenarios as standard, each of which represents a 'snapshot' of the metabolic status of a typical patient with respect to insulin-dependent (type 1) diabetes mellitus. It is easy for users to add or create further case scenarios, as required.

To give some idea of what AIDA can do – Figure 2a shows a baseline simulation for 'Steven Jones', a 'virtual diabetic patient' included in the AIDA database. The clinical information that the user is provided about this 'virtual patient' is that: 'This man is a relatively newly diagnosed insulin-dependent (type 1) diabetic patient. He has had problems maintaining his blood glucose profile on two and more recently three injections per day; so currently he is controlled on four injections per day. He tends to quite high blood glucose levels in the middle of the day, despite not eating excessively.

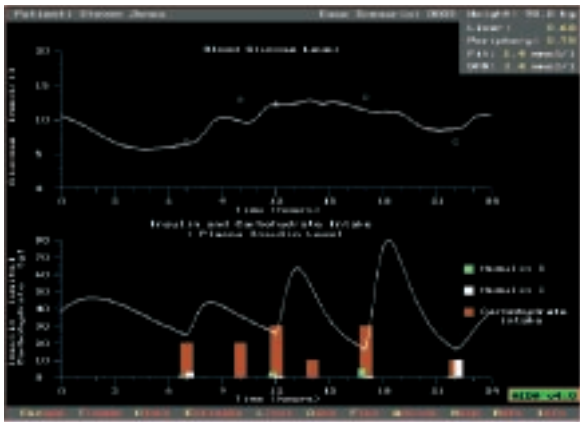

Figure 2a. Baseline 24 hour simulation from the AIDA system for an example patient with insulin-dependent (type 1) diabetes mellitus on a four times daily short-acting, regular (Humulin S) and intermediate acting (Humulin I) insulin regimen. Lower panel: insulin and carbohydrate intake with predicted 24 hour plasma insulin curve. Upper panel: predicted 24 hour blood glucose profile computed on the basis of the insulin and carbohydrate intake.

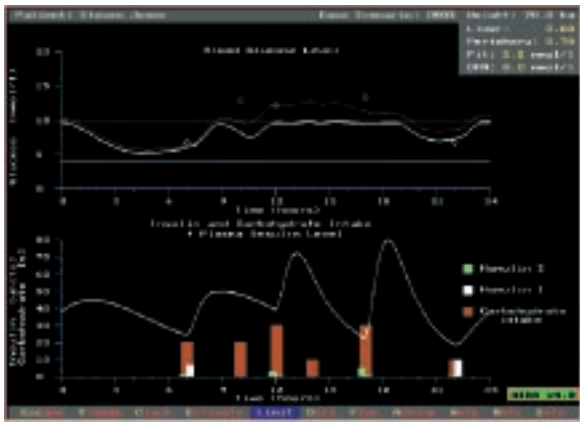

Figure 2b. Demonstrates the effect of increasing the before breakfast (7:00am) intermediate acting (Humulin I) dose from 3 units of insulin to 7 units. As can be seen such an adjustment leads to the previously raised blood glucose level during the course of the afternoon being brought more fully under control.

Try and see if you can reduce his mid-day blood glucose levels'.

The upper graph shows blood glucose information while the lower graph provides a composite display of information regarding insulin and carbohydrate intake. The distribution of the meals eaten can be seen on this graph along with the four times daily regular [short-acting] (Humulin S) and intermediate-acting (Humulin I) insulin regimen that he has been prescribed. Superimposed on these graphs

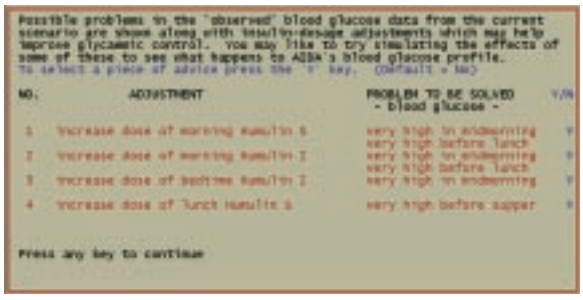

Figure 2c. Problems identified in Steven Jones' blood glucose profile and possible solutions (adjustments) suggested by the knowledge based system are shown (for data from Figure 2a). All suggestions have been selected interactively by the user.

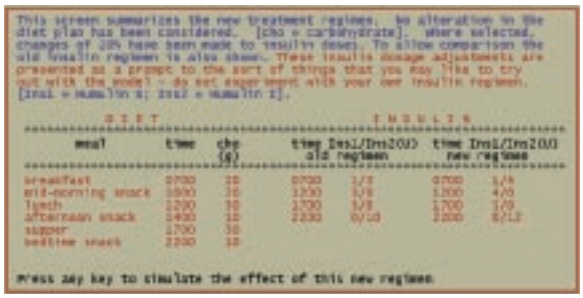

Figure 2d. Summary of the old and new therapeutic regimens following implementation of the suggestions from the knowledge based system shown in Figure 2c.

are predicted steady state blood glucose and plasma insulin profiles as calculated by the AIDA model [14].

Having performed such a baseline simulation users can change any of the input variables to simulate the glycaemic effects of such changes. For example a user could simulate what would happen to a hypothetical/virtual patient's blood glucose profile if the morning Humulin I dose was increased by 4 units, or the injection time moved earlier, or the bedtime snack shifted later, or the carbohydrate content of supper increased by 15 g. A user could transfer the patient to Humulin M2 in place of the previous short- and intermediate-acting preparations, or perhaps try the case scenario with a 'pen regimen' taking a longer-acting insulin preparation at night. The list of possibilities is endless – a near infinite number of simulations can be performed with AIDA.

As shown in Figure 2a, Steven, the example 'virtual diabetic patient', tended to have high blood glucose levels during the day. Figure 2b shows the effect on the blood glucose profile of increasing the before breakfast (7:00 am) intermediate-acting (Humulin I) dose from 3 units of insulin to 7 units. As can be seen such a change leads to the previously raised blood glucose level during the course of the afternoon being brought more fully under control.

The clinical application of an interactive educational simulator like AIDA requires users to know what they wish to try simulating next. In practice, certainly for use by patients, such knowledge cannot be assumed. For this reason a simple knowledge-based system has been provided within AIDA to identify possible problems which might require remedy [23]. A list of suggestions which might correct some of these problems can also be generated as a prompt to the sort of insulin dosage adjustments that users might like to try simulating. The interactive application of this knowledge-based system linked to the compartmental model provides educational opportunities which might otherwise not be available to patients, their relatives, students or even health-care professionals using the software on their own [23].

For example, if the user is not quite sure how to correct the high blood glucose levels shown in Figure 2a during the course of the day, the knowledge based system built into AIDA can also be used to identify potential problems in the case scenario's 'observed' blood glucose profile, and suggest various solutions which might be worth simulating [23]. Figure 2c shows for instance the knowledge based system's suggestions for Steven's original baseline case scenario data (given in Figure 2a). In this example the user has interactively selected on the right of the screen to simulate the glycaemic effect of all the suggestions, to increase the dose of the morning Humulin S and Humulin I injections as well as increase the dose of the bedtime Humulin I injection, and the lunchtime Humulin S injection. These changes are proposed because of 'observed' very high blood glucose levels in the mid-morning, before lunch, and before supper (Figure 2a). Figure 2d shows the effects of these changes on the resultant overall insulin regimen. As can be seen, initially small changes have been made to the insulin doses. Therefore the 7:00am Humulin I dose and the 12:00-noon Humulin S dose have both been increased from 3 units to 4 units, while the 10:00pm Humulin I dose has been increased from 10 units to 12 units. Figure 3a shows the effects of all these changes being simulated. As can be seen, this substantially reduces Steven's blood glucose level during the course of the day, with much of the

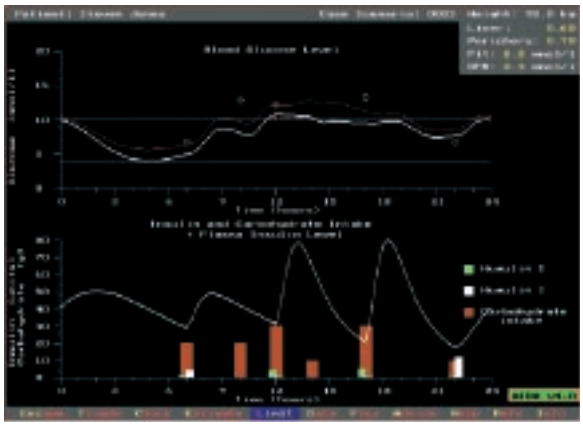

Figure 3a. Simulates the glycaemic effect of the adjustments selected interactively in Figure 2c, increasing the dose of the morning Humulin S and Humulin I injections, as well as increasing the dose of the bedtime Humulin I injection and the lunchtime Humulin S injection (as shown in Figure 2d). An improvement in the blood glucose profile results, with Steven no longer having such raised blood glucose levels in the afternoon.

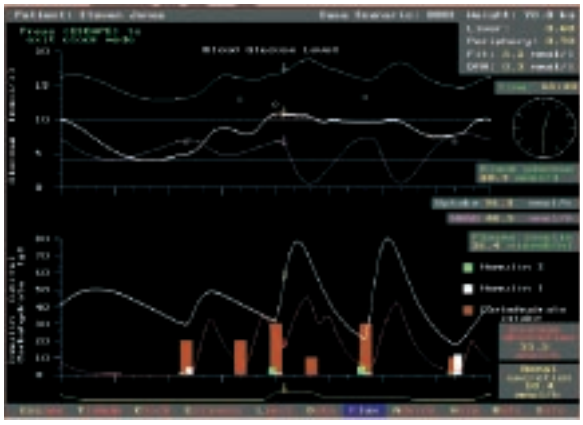

Figure 3b. Demonstrates, using the simulation shown in Figure 3a as an example, how the different glucose fluxes within the AIDA model can be displayed for medical student teaching. The light blue 'uptake' curve represents the grouped peripheral, central nervous system and red blood cell utilisation of glucose; the purple 'nhgb' curve is the net hepatic glucose balance (the production or utilisation of glucose by the liver); the red 'glucose absorption' curve is the systemic appearance of glucose from the gut; and the yellow 'renal excretion' curve is the loss of glucose via the kidneys into the urine. See main text for further explanation.

blood glucose profile now falling within an acceptable normoglycaemic range.

It is also possible to use AIDA to gain a deeper insight into the way glucose is handled in these simulations. Figure 3b demonstrates the different glucose fluxes for Steven Jones' simulation following the advice given by the knowledge based system (shown in Figure 3a). The light blue 'uptake' curve represents the grouped peripheral, central nervous system and red blood cell utilisation of glucose; the purple 'nhgb' curve is the net hepatic glucose balance (the production or utilisation of glucose by the liver); the red 'glucose absorption' curve is the systemic appearance of glucose from the gut; and the yellow 'renal excretion' curve is the loss of glucose via the kidneys into the urine. In this case, as the blood glucose level rises in the early afternoon so renal excretion of glucose into the urine is noted, reaching a peak of 10.4 mmol/h at around 12:30pm.

Furthermore, at 6:45 pm glucose absorption from the gut peaks in the evening at over 85.9 mmol/h following the ingestion of 30g of carbohydrate at supper. However this peak is well covered by the injection of 5 units of Humulin S taken just before supper, so the blood glucose profile during this time does not rise. Although this display may appear complicated, more user friendly views of such data are feasible [8], and may potentially be of some use as a demonstration tool for teaching health-care students about glucose homeostasis and carbohydrate metabolism in diabetes mellitus.

Further examples of the simulations that the AIDA software can provide can be found elsewhere in the literature [4,9,13], as well as on the Internet at http://www.2aida.org

RESEARCH DESIGN AND METHODS

Evaluation approaches

This simulation software may appear intuitively of benefit – but there is still a great need for such applications to be formally evaluated. There are many different ways that this may be done. These range from qualitative approaches to quantitative studies. Table 1 summarises some of the different

Table 1. Levels of evidence for clinical application.

Level 1 - formal, open, clinical randomised-controlled trials (RCTs)
Level 2 - case controlled trials (comparisons made but not randomised)
Level 3 - observational studies (including surveys and questionnaires)
Level 4 - anecdotal evidence (including independent user comments and reviews)
Level 5 - methodological verification and validation studies

sorts of studies that can be undertaken, and the different levels of evidence that can be generated to support clinical use of an application like AIDA. Level 1 studies (randomised controlled trials, RCTs) are clearly the 'gold standard' method for rigorously assessing educational/clinical utility.

Nevertheless useful information can also be obtained from less formal studies, and in many cases these can be easier to undertake and involve more subjects than RCTs. In the case of AIDA, under level 5 (methodological verification and validation studies), a quantitative assessment was reported in 1994 to document the accuracy of the blood glucose simulations in a cohort of 30 patients with diabetes [20]. While the simulations were shown to be unsuitable for individual patient glycaemic prediction and therapy planning, they have found widespread use for educational/demonstration/self-learning purposes where individual predictive accuracy is less critical [21,22].

Under level 4 (anecdotal evidence – including independent user comments and reviews) various AIDA users have written for the Website, and in print, their thoughts about the software [4,24,25] – and its sister Web-based application called 'AIDA on-line' (accessible via: http://www.2aida.org/online) [26–28]. Some short comments/'sound bites' have also recently appeared elsewhere [7,29]. While this feedback has been very encouraging, the next stage in the evaluation process, as set out in Table 1, is to undertake level 3 observational studies (including the use of surveys and questionnaires [30]).

For the current work we have sought to establish the feasibility of undertaking a diabetes survey about AIDA via the Internet. In the first instance we have focused on finding out the extent to which patients with diabetes, and their relatives, have been downloading the AIDA software for personal use.

Rationale for the survey

While a large number of downloads of the software have been logged at the AIDA Website, up to now, apart from user testimonials about the program [4,25] – and ad hoc comments received by the system developers via electronic mail [7,29] – there has been no formal assessment as to who has actually been downloading or making use of the simulator.

In this respect AIDA v4.0 was initially distributed via the Internet for beta-testing in April 1996. Following feedback from the beta-testers the software was made available on general release in June 1996. To coincide with the 4th anniversary of this Internet launch a decision was made to carry out a survey – in an effort to identify who had been taking advantage of the free availability of the program. The survey was launched prospectively at the AIDA Website (http://www.2aida.org) in mid-November 1999. We report here the results of the first 8 months of running this survey, up to mid-July 2000, just over 4 years after AIDA v4.0 went live on the Web, and just before a new version of AIDA was released.

Study Methodology

For a period of 8 months – between 17th November 1999 and 17th July 2000 – people downloading the AIDA software were invited to anonymously answer 5 simple questions about themselves. The questions are shown in Table 2 – together with the reply options that were made available for selection.

In addition to identifying the sort of end users that were downloading the program, an additional purpose of the survey was to identify what computer hardware and operating systems people were using – to facilitate distribution via the Internet of new freeware releases of AIDA v4.

Depending on the speed of the internet connection (modem, telephone line, or Ethernet link, etc)

Table 2. Questions asked of downloaders (in bold) together with possible pre-selectable responses.

(i)	**What operating system are you currently using?**
	- Windows 3.1 / 3.11 / '95 / '98 / 'NT / '2000
	- OS/2 / Virtual PC (Apple Mac) / SoftWindows (Apple Mac)
	- DOS / Other
(ii)	**What type of computer are you currently using?**
	- Pentium I / II / III PC
	- 286 / 386 / 486 PC
	- Apple Mac / Unix server / Other
(iii)	**Where did you first hear about AIDA?** (free text)
(iv)	**Where are you from?**
	- Country selector (237 countries to choose from)
(v)	**Which of the following categories best describes you?**
	- A patient with diabetes / a relative of a patient
	- A student / a doctor / a nurse / a diabetes educator
	- A pharmacist / none of the above

```
From: AIDA_user_response
<AIDA_user_response_www@2aida.org>
To: www@2aida.org <www@2aida.org>
Subject: AIDA user response
Date: Saturday, April 29, 2000 09:49

Below is the result of your feedback form.
It was submitted by
 (AIDA_user_response_www@2aida.org) on
Saturday, April 29, 2000 at 09:46:21

a, Their operating system is: 4, Windows '98

b, Their computer is: 2, Pentium II PC

c, They first heard about AIDA from:
chilrenwithdiabetes.com

d, Their country is: 235, Yugoslavia

e, They are: 2, A relative of a patient
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Figure 4. Electronic mail (email) note showing how the survey information for each individual response is received at the main email account for AIDA-related queries (www@2aida.org). The answer to four of the five questions have each been automatically, numerically coded by the dispatching software. E. g. Answer (a) category 4 is the code for the Windows '98 operating system; and answer (e) category 2 is the code for a relative of a patient with diabetes. This coding facility assists subsequent semi-automated data analysis.

– it can take around 5 minutes to download the AIDA program. While this download is taking place it is possible for visitors to be asked questions, and answer them, without interfering with the actual download process.

For the current study we took advantage of this 5 minute 'window of opportunity' to ask the 5 questions for which we were seeking answers. We also took advantage of the fact that Internet Common Gateway Interfaces (CGI-BINs) provide an easy way for people to offer responses via the Internet. The use of such CGI-BINs does not require the respondents to have an email address, and importantly permits their answers to be submitted completely anonymously.

It was felt to be important to allow the responses to be given confidentially – as some Internet users are not keen to identify themselves on the Web. Therefore by keeping the survey anonymous it was

Figure 5. Shows the download Web page at the AIDA Website (http://www.2aida.org) where downloaders can provide their survey responses. Four of the five questions make use of pull down menus with pre-selected answers to reduce the need for free text typing.

expected that the response rate could be increased; the expectation being that this would reduce the likelihood of people being inhibited about actually answering the questions.

Responses submitted by end users were each individually delivered automatically, via electronic mail (usually within a matter of seconds), to the main email account for AIDA-related enquiries (www@2aida.org). Figure 4 shows how this information is received. Data are provided as free text as well as with each category of preset response automatically numerically coded by the HyperText Markup Language (HTML) / CGI-BIN software. This automatic data coding assisted later analysis.

These codes and the free text comments were automatically extracted from the electronic mail notes using proprietary software, and the resulting data were imported into Microsoft Excel™ for summarising and analysis.

The questions selected were intentionally chosen to be straightforward – and therefore hopefully easy for people to answer. Judging by the large number of responses received during the survey period (n = 1,360) this has proved to be the case. Also it was arranged so that four out of the five questions could be answered simply by clicking on the entry and selecting the desired response using a pointing device, e. g. a computer mouse (Figure 5). Therefore typing was only required to answer one of the questions ('Where did you first hear about AIDA?').

Table 3. Summarises the number of responses per country ⩾ 10.

Country	Number of responses*	Percentage (of 1,360 total)
USA	481	35.4
United Kingdom	249	18.3
Italy	55	4.0
Germany	53	3.9
Canada	52	3.8
Brazil	43	3.2
Spain	39	2.9
Poland	31	2.3
Australia	27	2.0
Netherlands	27	2.0
Korea	26	1.9
Greece	17	1.3
Sweden	14	1.0
India	13	1.0
Norway	12	0.9
Mexico	12	0.9
France	11	0.8
Malaysia	11	0.8
Turkey	11	0.8
Argentina	10	0.7

* 1,194 responses (87.8%) from 20 countries. Remaining 166 responses (12.2%) from 47 other countries (⩽ 9 per country) not shown.

Table 4. Summarises where respondents first heard about the AIDA v4 diabetes simulation software. 953 people answered this particular question.

Where did you first hear about AIDA?	Number	% of replies (n = 953)
Just browsing/surfing the Web	239	25.1
Found via a search engine	179	18.8
From a linked/referring Website	145	15.2
From a diabetes newsgroup/diabetes discussion list	80	8.4
By electronic mail	46	4.8
From Diabetes Insight (a closely linked diabetes Website)	35	3.7
From a journal/newspaper article	32	3.4
From a friend/relative	31	3.3
Through my school/college/university	29	3.0
From my doctor/nurse/hospital/clinic/a colleague	29	3.0
Through this Website (www.2aida.org)	27	2.8
Through my National Diabetes Association	26	2.7
Through web search for diabetes software	9	0.9
Other (none of the above)	46	4.8

While the questions are simple, the power of such a survey comes from the large number of responses that can be received over a period of time.

RESULTS

1,360 user survey responses were received during the 8 months between 17th November 1999 and 17th July 2000. During this period 3,821 actual downloads of the software were independently logged at the AIDA Website, giving a response rate to this survey of 35.6%.

Who are you?

762 responses (56.0%) were received from patients with diabetes, 184 (13.5%) from relatives of patients, 177 (13.0%) from doctors, 89 (6.5%) from students, 57 (4.2%) from diabetes educators, 22 (1.6%) from nurses, 15 (1.1%) from pharmacists, and 54 (4.0%) from other end users (who regarded themselves as none of the above).

Which country are you from?

Responses were received from end users in 67 countries, including: Algeria, Argentina, Aruba, Australia, Austria, Bahrain, Barbados, Belgium, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Canada, Chile, China, Columbia, Croatia (Hrvatska), Czech Republic, Denmark, Ecuador, Egypt, Finland, France, Germany, Ghana, Greece, Hong Kong, Hungary, India, Iran, Ireland, Israel, Italy, Japan, Korea, Kuwait, Lithuania, Malaysia, Malta, Mexico, Netherlands, New Zealand, Norway, Philippines, Poland, Portugal, Puerto Rico, Romania, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, Ukraine, United Arab Emirates, United Kingdom, United States, United States Minor Outlying Islands, Uruguay, Vatican City State (Holy See), Western Sahara, Yugoslavia.

Over half the responses (53.7%) came from the USA and UK; 481 (35.4%) and 249 (18.3%) respectively. Table 3 summarises the number of responses per country ⩾ 10.

What computer and operating system are you using?

The vast majority of respondents (1216, 89.4%) were using Pentium PCs to download AIDA, with just 53 (3.9%) using 80386/80486 PCs, 13 (1.0%) using Apple Macintosh computers, and 78 (5.7%) using other (unspecified) computers. Most of the respondents (1297, 95.4%) were also using 32-bit

Windows operating systems (Windows '95/'98/'NT or Windows '2000) with just 44 (3.2%) using the older Windows 3.1 or 3.11 operating systems, and the remaining 19 (1.4%) using DOS or other operating systems.

Where did you first hear about AIDA?

Table 4 summarises where respondents first heard about the software. 953 replies were received to this question (i. e. 407 respondents [29.9%] left this question blank). This is perhaps understandable as users would need to type something in as free text – making this particular question slightly more involved to answer.

25.1% of those who did provide a response (n = 239) reported discovering AIDA just by browsing or surfing the Web, 179 (18.8%) found AIDA via search engines, while 145 (15.2%) first heard about AIDA from a linked or referring Website (Table 4).

DISCUSSION

Novel technologies can sometimes be introduced into medical practice with little by way of assessment or evaluation. This is particularly the case with the application of computers in clinical diabetes care – where very few studies demonstrating the benefits of computer programs or computer systems are reported in the literature [10]. In many cases system developers perceive the benefits as 'self-evident', and therefore proponents consider it 'intuitive' that a computer-based approach will have advantages over a conventional pen/paper-based predecessor. However in practice often these 'advantages' are not quite so clear cut. Furthermore the science of evaluating the utility of such programs and surveying users of such software is still very much in its infancy – particularly in diabetes care. We therefore set out to address some of these issues for the AIDA interactive educational diabetes simulator.

In particular with AIDA we have been striving to learn as much as possible about what people think of the software, and how they are using it. A first step in doing this is to establish what sort of users are actually downloading the program.

Furthermore the current study has established the feasibility of using the Internet to survey users/downloaders of diabetes software. It has also provided useful and interesting information – highlighting that over two thirds of respondents (946, 69.6%) are people with diabetes or their relatives. We do not wish to over-interpret these findings – but it is illuminating that so many patients and relatives are turning to the Internet for diabetes-related information.

Clearly it can never be automatic or straightforward to extrapolate the results of a sample survey to a complete population. However it does seem reasonable to assume that the results of this survey -certainly for the question regarding who has been downloading the software – are typical for the entire period that AIDA has been available on the Internet (there appears no obvious reason why this should not be the case).

In the 4^{+} years up to mid-July 2000 there were 15,377 downloads of AIDA v4.0 independently logged at the AIDA Website. The current survey results therefore suggest that over 10,000 of these downloads are likely to have been made by patients and/or their relatives – as opposed to approximately 3,000 downloads by healthcare professionals (doctors, diabetes educators, nurses and pharmacists – but not including students and 'others'). Given the continued downloading and usage of the software – these data do offer a useful indication as to the extent to which individuals with diabetes and their relatives are accessing AIDA.

Incidentally the data presented in this report for the number of downloads of the program only refer to the main AIDA Website (http://www.2aida.org). Other Internet sites also store copies of AIDA – including the CompuServe Diabetes Forum, the CIX Balance [diabetes] archive, the Lehigh diabetes server, the Diabetic DataCentre Website, and the CNET Download archive. However downloads from these satellite sites are not all counted or logged and it is important to note that the current survey has not been run at any of these satellite Websites.

Limitations

Clearly this survey has some limitations. Most obvious is the fact that, like most surveys, it is based upon self-reported data; although the large number of responses received do go some way to off-set this. However a relatively major limitation of the current study is that while it offers an indication as to who has been downloading the software – we do not know how much these people have actually used AIDA. For instance, whether people download the install file and then do nothing with the pro-

gram – or use it a great deal – cannot be established from a survey conducted, as this one has been, at the point of download.

However we do have various other methods of assessing use of the simulator – and all these different indicators need to be considered together to compile an overall perspective.

For instance a formal, in depth/detailed survey of 200 AIDA users (patients, relatives, and healthcare professionals) from 21 different countries has recently been completed. This will offer data on the number of times these people have run the AIDA program, and the number of simulations performed (automatically logged by the software), therefore establishing amongst other things actual usage of the program.

Similarly there are other ways that we can estimate usage. 'AIDA on-line' is a mouse-controlled, Windows-based version of AIDA which can be accessed via the Internet completely free of charge at http://www.2aida.org/online

This facility permits interactive diabetes simulations to be run in a standard Web-browser window. During the period of the current survey the number of simulations logged at 'AIDA on-line' rose from 24,439 simulations (in November 1999) to over 45,932 (in July 2000). I. e. more than 21,000 simulations were run at 'AIDA on-line' during this time – suggesting considerable on-going interest and usage.

While no single indicator can offer a definitive view of continued use of the simulator – we believe it is particularly informative when a whole series of variables, from different sources, and collected in different ways – all point in the same direction.

Practical benefit – AIDA v4.3

A practical benefit of this survey has been the realisation that the vast majority (> 95%) of people downloading AIDA have 32-bit Windows operating systems (Windows '95 / '98 / 'NT or Windows '2000). As a result a decision was taken to release an updated version of the software (v4.3) with a dedicated, streamlined Windows-based setup procedure; the intention being that this would facilitate installation of the program for most users. As well as other technical / computing upgrades, this new version of the software (AIDA v4.3) also incorporates a model of glycosylated haemoglobin [31] therefore offering HbA_{1c} values for the simulations – assuming the simulated blood glucose control was typical for a 2–3 month period.

Further information about AIDA v4.3 can be found in the accompanying article [32] in this journal issue.

CONCLUSIONS

The continued download and usage of the AIDA software – years after its original release – continues to pleasantly surprise. In this respect there is a growing realisation that diabetes simulations – such as those offered by AIDA – may actually increase patient empowerment [7]. Therefore in the current study we have sought to find out what proportion of downloads of the simulator can be ascribed to patients with diabetes and/or their relatives.

Clearly a survey such as this cannot be any substitute for clinical randomised controlled trials (RCTs) to formally establish the educational utility of such diabetes simulations. Indeed such a pilot RCT has been undertaken [33], and further more extensive RCTs are planned [34]. However, as shown in Table 1, more than one sort of study is needed to formally test out a software application, and as highlighted above, the Web-based survey approach does have some particular utility especially in terms of studying a large number of subjects.

Connected with this a separate, formal, detailed survey of 200 AIDA users has just recently been completed and we hope that this will also yield some useful insight into the continued usage of the program. Furthermore we intend to repeat the current survey – and extend it with AIDA v4.3 [32] – to learn more about who is actually downloading the software; making this part of an on-going, routine audit for the program. In addition we hope that work like this will encourage other software developers to undertake similar surveys of the usage of their medical programs via the Internet.

Finally, efforts have begun to run Workshops using AIDA to help in the education of non-expert health-care professionals – e.g. primary care physicians (general practitioners) [35] – and similar Workshops are planned for nurses and student nurses, as well as possibly medical students.

System availability

The latest release of AIDA (v4.3) can be downloaded, without charge, from http://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. AIDA can also be used on Apple Macintosh computers running PC emulators such as Virtual PC or SoftWindows. People who wish to be automatically informed about updates and enhancements to the AIDA 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 applying a standardised randomised controlled trial (RCT) protocol [34] themselves in an evaluation of AIDA in their own unit(s) for clinician/specialist nurse/educator-led patient teaching sessions are invited to contact the author. Further information about the evaluation of AIDA for patient use can be found at http://www.2aida.org/evaluate on the Web.

Acknowledgements

The author would like to acknowledge the kind assistance of: Dr. Tibor Deutsch (Budapest, Hungary) and David Broad (London, UK) in the original development of the AIDA software; and Steven Sexton (Bristol, UK) for setting up and maintaining the original AIDA Web pages, and for providing statistics regarding the number of visitors to, and downloads from, the site.

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