

Evaluation of Diabetes Management Software

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When the term *diabetes management* is typed into the Internet search engine Google, 781 000 responses are returned. A small portion of these hits are computer programs that have been developed for the management of diabetes. Such computer programs can be Web based or Windows®-operated software programs for the personal computer. The purposes of this

and complex: progressive deterioration of β -cell function, patient and physician reluctance to initiate insulin treatment, avoidance of hypoglycemia, concern about the atherogenic effects of insulin use, imprecise guidelines for numerical goals of A1C, weight gain, physical and mental inability to follow the prescribed self-care regimen, and limitations in currently available technology.³ Colin and colleagues⁴ noted that the patient's participation in

professional development

paper are to evaluate Web-based or Windows®-operated software programs on the management of diabetes and to develop guidelines for this evaluation.

Seventeen million Americans have diabetes mellitus and they need medical management to properly control their disease.¹ Managing diabetes can be difficult and costly. Tight management can assist in the prevention of comorbidities such as coronary heart disease, kidney failure, lower-extremity amputation, blindness, and stroke. It is estimated that only 65% of persons who have diabetes have been diagnosed, and 3% of those persons treated achieve the American Diabetes Association goal of a hemoglobin A1C (A1C) value of less than 7%.² Reasons for poor control of diabetes are many

adherence to diabetes self-care is very important, and that one's health beliefs and desires for participation impact adherence.

Web-based or Windows®-operated programs can assist persons with diabetes in their self-care regimen. The programs provide more than information about diabetes; they also assist in the management of the disease. The programs can record, measure, monitor, manage, and deliver health care for persons with diabetes. Some of the programs provide a link between the healthcare provider and the patient. A metaanalysis of 16 papers was conducted to evaluate whether the use of computer-based systems improves the metabolic control of patients with diabetes.⁵ The review concluded that the use of computer-based systems could be an effective means of improving metabolic

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control; recommendations for additional investigation also were provided. Balas and colleagues⁶ concurred with these findings based on their evaluation of computerized management of diabetes and noted significant improvements in A1C, blood glucose, and hypoglycemic events.

Mazzi and Kidd⁷ designed an evaluation framework for diabetes management programs. They illustrate the use of this framework with 2 Web-based programs, *myDiabetes* and *LifeMasters*. The only drawback is that their framework is designed to evaluate top-ranked Web-based programs and may not be a suitable framework for all software programs.

No systematic guidelines or criteria for evaluating computer-based diabetes management programs were found in the literature. Therefore, the objectives of this project were to (1) evaluate all available diabetes management software and (2) develop an evaluation tool. A serendipitous result was the opportunity to work with Rick Mendoza, a freelance medical writer and consultant specializing in diabetes who runs his own home page providing updated information about diabetes software programs. This work with Mr. Mendoza entailed the use of the scoring form developed for this project to evaluate the programs listed on Mr. Mendoza's Web page at www.mendoza.com (written communication R. Mendoza, July 2002).

METHODS

A search for diabetes software programs was conducted at the following search engine sites: Google, MSN, Yahoo, Ask Jeeves, and Altavista. These sites were chosen because they are commonly used by the 114 million Internet users.⁸ In addition, 2 medical information sites, Medical Matrix and MD-Consult, were reviewed for possible diabetes management programs. Links related to diabetes within these Web sites were explored, including the Rick Mendoza Web site, Google Web directory, Diabetesnet.com, Childrenwithdiabetes.com, Dmoz directory, and diabetes.about.com. Web sites or software programs were identified using the following key words: diabetes, program, computer, Internet, software, and monitor. The first 40 Web sites in each search were reviewed. Searches were based on the following AND/OR combinations:

- Diabetes + program AND/OR computer
- Diabetes + program AND/OR monitor
- Diabetes + internet AND/OR monitor
- Diabetes + software

Forty-seven diabetes management software programs were identified; 33 were Windows® based and 14 were Web based (Table 1). Programs that were educational or informational only were not included in this evaluation.

DEVELOPMENT OF AN EVALUATION GUIDELINE

After reviewing the Web-based programs online, a preliminary list was developed of items that are important in the evaluation of a diabetes management program. Content validity was verified by sending the list to all staff physicians in the Department of Family Medicine at the University of Iowa. Of the 30 questionnaires that were distributed, 6 were returned and revisions were made. A conference with the research group of physicians, nurses, and pharmacists in the Department of Family Medicine yielded additional input to help determine factors important in the evaluation of a diabetes management program. After this input was reviewed, a final list was generated of criteria that should be included in a comprehensive diabetes management program. This list included lab work, medications, vital signs, meal intake, exercise, medical history, communication between patient and physician, and schedule reminder. Each item was then given an arbitrary score of 1 point per item. For example, 4 tests were included in the laboratory section. If a program included 1 of the tests, 1 point was given; whereas if 4 tests were included, then 4 points were given. A total of 22 points was possible using this scoring system (Table 2).

In addition to these management criteria, other factors were evaluated when reviewing these programs, including (1) ease of program use, (2) automatic upload of glucometer data, (3) food lists, and (4) fee

Table 1.**Diabetes Management Programs**

| Name of Program | URL |
|------------------------------|---|
| Windows®-based | |
| CliniPro | http://www.numedics.com |
| DiaTrends | http://overlooksoftware.com |
| Diabetes Management System | http://www.harborsoft.com/Diabetes/System_Features/system_features.html |
| Balance PC | http://www.proactivemetabolics.com |
| LifeHealthy | http://www.lifehealthy.com |
| DIABASS | http://www.diabtrends.com/db4eng.htm |
| Dia-Log | http://www.transitech.com/cs-solutions/dia-log.html |
| Diabetes Partner PC | http://www.numedics.com |
| Managing Diabetes | http://members.aol.com/nutrigenie/home.html |
| Diabetes Diary | http://www.tricalico.com/diabetes.html |
| I.D.F.o.C.S* | http://www.arbsoftinc.com |
| The Diabetic Daily Log | http://members.aol.com/kennzo/tddl.htm |
| EzManager | http://www.animascorp.com/products/pr_ezmanager.shtml |
| Glucograph | http://www.bryansoftware.com |
| Accu-Chek Compass* | http://www.accu-chek.com/products/products/mn_accucheck_compass.cfm |
| Diabetes Works* | http://www.diabetesonline.com |
| Diabetes Level Monitoring | http://www.lad.co.za/dlm.html |
| Diabetes Mentor | http://www.vigora.com |
| CheckLink | http://www.queststarmedical.com |
| Diabetes HomeCare Center | http://www.homecarecenter.com |
| Novo Nordisk* | http://www.diabetesdiary.com/health/dwk/info/diary/diary.asp |
| Glucocom* | http://www.glucom.com |
| Glucose Journal and Database | http://www.mindspring.com/~nellaware/glujodat.html |
| Diabetes Tracker | http://www.prihar.com |
| Glucose Manager | http://www.proaxis.com/~rwi/glumgr.htm |
| In Touch | http://www.lifescan.com/lsoftouch/us_new_download.html |
| Precision Link | http://www.abbottdiagnostics.com/systems_tests/system.cfm?syscat_id=3&sys_id=15 |
| WinGlucofacts | http://www.glucometerdex.com/Sftwre.htm |
| Glucose32.exe | http://gcr.med.s.cwru.edu/gluclpage.htm |
| Glucose Data Manager | http://www.clic.net/~programa/glucom_an.html |
| Grafiek | http://httpd.chello.nl/j.creusen |
| QuickLog | http://www.webcreations.ca/~quicklog/download.htm |
| Two Touch | http://www.sci.fi/~keytech/twotouch.html |
| Web-based | |
| MediCompass | http://www.MediCompass.com |
| MyDiabetes | http://www.mydiabetes.com |
| LifeMasters | http://www.lifemasters.com/Patients/GeneralHomepage.asp |
| Lifeclinic | https://www.lifeclinic.com |
| HealthAtoZ | http://www.healthatoz.com/atoz/diabetes2/diabetesindex2.asp |
| DiabetesPhysicians | http://www.wiredcare.com |
| Ecivon | http://www.ecivon.info/index.php |
| Glucovance Log | http://www.glucovance.com |
| Lifetoolz | http://www.lifetoolz.com |
| DiasNet* | http://www.miba.auc.dk/~spp/index.html |
| Bayer Care | http://www.bayercarediabetes.com/diabcare/aboutdiab/index.asp |
| HomeCare Center | http://www.homecarecenter.com |
| Dia-Log.com | http://www.dia-log.com |
| DiabetEASE | http://www.diabetease.com/index.html |

*Programs specifically for persons who use insulin.

Table 2.*Recommended Content in Diabetes Management Program Scoring Criteria*

| Content | Components | Scoring System | Score |
|-----------------------|---|--|-------|
| Logbook | Blood glucose, medications, nutrition, exercise | Glucose only | 1 |
| | | Glucose + meds or nutrition or exercise | 2 |
| | | Glucose + meds + nutrition or exercise | 3 |
| | | Glucose + meds + nutrition + exercise | 4 |
| Vital signs | Height, weight, blood pressure | Weight or BP | 1 |
| | | Weight, BP or BMI (height) | 2 |
| | | Weight, BP + BMI (height) | 3 |
| Labs | A1C, lipids, creatinine, urine protein | A1C or lipid | 1 |
| | | A1C + lipid | 2 |
| | | A1C + lipid + Creatinine or urine protein | 3 |
| Medical history | | | 1 |
| Current medication(s) | | | 1 |
| Schedule reminder | Calendar | | 1 |
| Guideline reminder | | Lab test | 1 |
| | | Lab test + feet exam, ophthalmology or immunization | 2 |
| | | Lab test + feet exam, ophthalmology + immunization | 3 |
| | | Lab test + feet exam, ophthalmology + immunization + medication adjustment | 4 |
| Patient information | | Patient information | 1 |
| | | Personalized education | 2 |
| Communication | | Between patients: chatting, sharing experience | 1 |
| | | Between physician and patients | 2 |
| | | Between patients + between physician and patients | 3 |
| Total | | | 22 |

for use. Two additional items were studied for Web-based programs: Health on the Net Foundation (HON) code and encryption level.⁹ In 1995, a not-for-profit international organization was created to set ethical standards for medical and nonmedical Internet users to obtain reliable online medical and health information. If a Web site was evaluated as credible, a HON code icon was located on the site. For the current evaluation, each site was checked to determine if a HON code icon was present. The Webmaster for each site was asked whether the

site had 128-bit encryption, which provides a more secure data transfer method than encryption at a lower level. A rating system for ease of use was created using a score of 1 to 5 (1=very difficult, 2=difficult, 3=moderate, 4=easy, and 5=very easy) (Tables 3 and 4).

RESULTS

The 14 Web-based programs had a mean evaluation score of 9.53 (range=2-20). The *MediCompass* program received a score of 20 (Table 4). The 33 Windows®-based programs had a mean score of 5.54 (range=1-21). Three programs—

CliniPro, DiaTrends, and Diabetes Management System—each received a score of 21 (Table 3). No program received the highest possible score of 22.

The Windows®-based programs received lower evaluation scores than the Web-based programs; 21% of the Web-based programs scored 17 or higher compared with 12% of the Windows®-based programs. There was a significant correlation (-0.674) between the score for ease of use and the score for evaluation ($P=.000$). Thus, the better-scoring programs were

Table 3.*Summary of Windows®-Based Programs*

| Name of Program | Score* | Ease of Use | Auto Upload | Food List | Fee(\$) |
|--------------------------------|---------------|--------------------|--------------------|------------------|------------------|
| CliniPro | 21 | 1 | Yes | No | Several thousand |
| DiaTrends | 21 | 1 | No | No | Several thousand |
| Diabetes Management System | 21 | 1 | No | No | Several thousand |
| Balance PC | 17 | 2 | Yes | Yes | 34 |
| LifeHealthy | 11 | 3 | No | Yes | 40 |
| DIABASS | 9 | 2 | Yes | No | 57 |
| Dia-Log | 8 | 4 | No | Yes | 25 |
| Diabetes Partner PC | 7 | 3 | Yes | No | 99 |
| Managing Diabetes | 7 | 3 | No | Yes | 60 |
| Diabetes Diary | 6 | 2 | No | Yes | 30 |
| I.D.F.o.C.S [†] | 5 | 4 | No | Yes | 85 |
| The Diabetic Daily Log | 5 | 3 | No | No | 25 |
| EzManager | 4 | 4 | No | Yes | 99 |
| GlucoGraph | 4 | 5 | No | No | 50 |
| Accu-Chek Compass [†] | 4 | 5 | Yes | No | 60 |
| Diabetes Works [†] | 4 | 3 | Yes | Yes | 20 |
| Diabetes Level Monitoring | 4 | 5 | No | No | 8 |
| Diabetes Mentor | 3 | 5 | Yes | No | 55 |
| CheckLink | 3 | 4 | Yes | No | 40 |
| Diabetes HomeCare Center | 3 | 5 | Yes | No | Free |
| Novo Nordisk [†] | 2 | 5 | No | No | Free |
| Glucom [†] | 2 | 3 | Yes | No | Free |
| Glucose Journal and Database | 2 | 3 | No | No | 24 |
| Diabetes Tracker | 1 | 5 | Yes | No | 50 |
| Glucose Manager | 1 | 5 | No | No | 30 |
| In Touch | 1 | 5 | Yes | No | 20 |
| Precision Link | 1 | 5 | Yes | No | 150 |
| WinGlucofacts | 1 | 5 | Yes | No | 50 |
| Glucose32.exe | 1 | 4 | Yes | No | Free |
| Glucose Data Manager | 1 | 5 | No | No | Free |
| Grafiek | 1 | 5 | Yes | No | Free |
| QuickLog | 1 | 4 | No | No | Free |
| Two Touch | 1 | 5 | Yes | No | 25 |

*Total possible score=22.

[†]Programs specifically for persons who use insulin.

Table 4.*Summary of Web-Based Programs*

| Name of Program | Score* | Ease of Use | Auto Upload | Food List | Encryption | |
|-----------------------------|--------|-------------|-------------|-----------|------------|----------|
| | | | | | 128-Bit | HON Code |
| <i>MediCompass</i> | 20 | 4 | Yes | No | Yes | Yes |
| <i>MyDiabetes</i> | 18 | 3 | No | No | Yes | Yes |
| <i>LifeMasters</i> | 17 | 3 | No | Yes | Yes | Yes |
| <i>Lifeclinic</i> | 14 | 4 | Yes | Yes | Yes | Yes |
| <i>HealthAtoZ</i> | 13 | 4 | No | Yes | No | Yes |
| <i>DiabetesPhysicians</i> | 13 | 5 | Yes | No | No | No |
| <i>Ecivon</i> | 7 | 3 | No | No | No | Yes |
| <i>Glucovance Log</i> | 5 | 5 | No | No | No | No |
| <i>Lifetoolz</i> | 5 | 5 | No | No | No | No |
| <i>DiasNet</i> [†] | 5 | 3 | No | No | No | No |
| <i>Bayer Care</i> | 4 | 5 | No | No | No | No |
| <i>HomeCare Center</i> | 3 | 5 | Yes | No | No | No |
| <i>Dia-Log.com</i> | 3 | 5 | No | No | No | No |
| <i>DiabetEASE</i> | 2 | 5 | Yes | No | Yes | No |

*Total possible score=22.

[†]Programs specifically for persons who use insulin.

more difficult to use. The better-scoring programs also had HON codes and 128-bit encryption compared with those with lower scores (Table 4).

More of the Windows®-based programs (52%) offered the option of automatically uploaded blood glucose records than the Web-based programs (36%). Food lists were offered by 21% of the Web-based programs and 24% of the Windows®-based programs (Tables 3 and 4).

All of the Web-based programs were free to use. Fees for the Windows®-based programs ranged from being free to several thousand dollars (Tables 3 and 4). The exact price for the expensive programs could not be determined because the cost is for a total electronic medical record and is based on the infrastructure of a healthcare facility. The range of fees for the other programs was \$8 to \$150 (mean=\$49).

DISCUSSION

The advantage of using a Web-based program is that a software program does not have to be installed on your personal computer. With an Internet connection, the program can be used with any personal computer at any time, and all of the diabetes management programs are free. A main concern about using this type of computer program is the security of each patient's individual information. A program that is Windows® based can be implemented without an Internet connection; personal information is safer with this type of program. A disadvantage, however, is that the program must be installed on a specific computer.

There are fewer Web-based programs than Windows®-based for diabetes management. Overall, the Web-based programs received higher evaluation scores and were more difficult to use than the Windows®-based programs.

Despite their difficulty of use, these programs provide more options are available for the consumer, and more components in the programs increase the ease-of-use score.

All of the Web-based programs were free to use, even those that automatically upload the blood glucose levels. In comparison, only 7 of the Windows®-based programs were free. The 3 top-scoring Windows®-based programs were costly (eg, thousands of dollars). Those Windows®-based programs that had a set fee scored from 1 to 17 (mean=4). Even though these programs were more expensive, they did not provide the consumer with many components.

Consumers and healthcare professionals need to be aware of the HON code and its purpose. Less than half of the Web-based programs held this distinction, although those programs with the highest

scores had the HON code. For security reasons, encryption is important; 128-bit encryption is better than 64-bit encryption. Again, less than half of the Web-based programs had 128-bit encryption, but those with the highest scores did have the encryption.

Although a high score represents a comprehensive program, programs with lower scores may be appropriate for the needs of certain people. Those who want to simply have a logbook of their blood glucose readings may choose to use a program that has a low score. Such a program would be easy to use and meet that person's need. The program rankings that are provided in this article will assist the consumer or healthcare provider in choosing the appropriate program. Having the additional information about the type of program (Windows®-based or Web-based), the total possible score, automatic upload function, food lists, fee, security level, and HON code can facilitate more effective decision making.

Programs that have an automatic upload function for specific glucometer models include *DiabetesPhysicians*, *Two Touch*, *Precision Link*, *In Touch*, *WinGlucofacts*, and *CheckLink*. Some programs will not allow manual input of blood glucose data, including *DiabetEASE*, *Diabetes Tracker*, *Grafiek*, and *Two Touch*. Some programs are more focused on blood glucose monitoring, while the *Managing Diabetes* program is more nutrition oriented. *Accu-Chek Compass*, *I.D.F.o.C.S.*, *Diabetes Works*, *Novo Nordisk*, *Glucom*, and *DiasNet* are programs specifically for insulin users.

The guideline reminder function is an important component of a diabetes management program. A variety of reminders are available from the different programs. Among the Web-based programs, *DiabetesPhysicians* received a total score of 4 points; *MyDiabetes*, *HealthAtoZ*, *Lifeclinic*, *MediCompass* received 3 points; and *LifeMasters* received 2 points. Among the Windows®-based programs, only the expensive programs received 4 points: *CliniPro*,

DiaTrends, and *Diabetes Management System*. *Balance PC* received 2 points. The other programs did not have a guideline reminder function.

CONCLUSIONS

This paper presents a practical evaluation guide for Web-based or Windows®-based diabetes management programs. This evaluation guide is beneficial for healthcare providers and individuals who have diabetes because it describes the variety of components that may comprise a program and provides criteria for evaluating the different types of programs.

Information technology is an emerging and changing field, and it has been demonstrated that computer-patient interactions lead to improved outcomes in diabetes management.⁶ These systems can be implemented in a variety of ways: in a physician's office for all persons who have diabetes, for persons living in rural areas with a physician specialist connection at a distance, or for inpatients in a hospital setting. Healthcare professionals need to be aware of what is available for the patient and implement a diabetes management program when appropriate.

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