Use of a Plastic Insulin Dosage Guide to Correct Blood Glucose Levels out of the Target Range and for Carbohydrate Counting in Subjects With Type 1 Diabetes

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OBJECTIVE — To improve glycemic control, a hand-held plastic Insulin Dosage Guide was developed to correct blood glucose levels outside of the target range.

RESEARCH DESIGN AND METHODS — Protocol 1: Some 40 children (mean age 10.6 ± 4.6 years) were randomly assigned for 3 months to use a written-on-paper algorithm or the Insulin Dosage Guide to correct abnormal blood glucose levels. Mean HbA_{1c} and blood glucose levels and time to teach insulin dosage correction were compared. Protocol 2: The Insulin Dosage Guide was used by 83 subjects (mean age 11.4 ± 4.3 years) for 1 year, and mean HbA_{1c} levels, blood glucose levels, and number of consecutive high blood glucose values taken before and after the year were compared. Protocol 3: Some 20 patients (mean age 10.1 ± 3.7 years) using rapid-acting insulin and 64 patients (mean age 15.9 ± 3.6 years) using an insulin pump and rapid-acting insulin used the Insulin Dosage Guide and had mean blood glucose levels, HbA_{1c}, and percentage of blood glucose levels outside of the target range determined.

RESULTS — Protocol 1: There was a significant reduction in mean HbA_{1c} ($P = 0.04$) and blood glucose levels ($P = 0.05$) and in the time needed to teach how to correct blood glucose values using the Insulin Dosage Guide compared with the paper algorithm. Protocol 2: There was a decrease in mean HbA_{1c} levels ($P = 0.0001$) and a decrease in the mean number of consecutive blood glucose levels ($P = 0.001$) over the 1-year time period. Protocol 3: With rapid-acting insulin, there was a significant increase in the percentage of blood glucose levels within the target range (1 month, $P = 0.04$; at 3 months, $P = 0.03$). With the insulin pump, there was a high rate (90%) of blood glucose levels in the target range during pump initiation when the Insulin Dosage Guide was used.

CONCLUSIONS — This inexpensive hand-held plastic card, which is portable and easy to use, may help patients improve glycemia and successfully manage diabetes.

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One of the main goals of the management of type 1 diabetes in the pediatric population is to avoid extremes of glycemic excursion (1,2). By treating blood glucose levels that are outside of a predetermined age-specific target range with supplemental oral glucose or extra insulin, children and teenagers can minimize the episodes of both hypoglycemia and hyperglycemia that can impair judgment and learning and lead to coma, convulsions, recurrent ketoacidosis, and the long-term microcirculatory and neuropathic complications of this disease (3–5). However, while it is not very difficult to instruct patients and families in how to correct hypoglycemia with oral glucose (6), it is challenging to teach insulin dosage adjustment algorithms designed to normalize elevated blood glucose levels and to compensate for alternations in carbohydrate intake (7). Even with instruction, many families feel uneasy adjusting insulin dosages on their own because of the complexities of these adjustment algorithms, and they often persist in believing that they must have prior contact with a health care provider to ensure accuracy.

To address these concerns, we developed a hand-held plastic Insulin Dosage Guide for patients to use with both short- and rapid-acting insulin in a variety of insulin regimens, including continuous subcutaneous insulin infusion (CSII). It was designed to enable patients to correct abnormal blood glucose levels in a standard consistent fashion and to determine how much insulin to take if they are practicing carbohydrate counting. This article evaluates the effectiveness of this hand-held Insulin Dosage Guide as a means of improving blood glucose excursion and HbA_{1c} levels in type 1 subjects.

RESEARCH DESIGN AND METHODS

Study subjects

Children, teenagers, and young adults with type 1 diabetes were selected to participate in the studies involving the Insulin Dosage Guide if they were patients at the Comprehensive Childhood Diabetes Center at Childrens Hospital Los Angeles and its satellite centers in Southern California and if they met the following criteria: *1*) They routinely received at least two insulin injections per day and used short- and/or rapid-acting insulin, intermediate- and/or long-acting insulin, or used CSII; *2*) they

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Abbreviations: CSII, continuous subcutaneous insulin infusion; MDI, multiple daily injections.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

performed a minimum of three premeal and bedtime blood tests per day (90% of subjects did four blood tests per day); 3) they or their parents had mastered our center's safety and basic diabetes competencies (7) and were willing to increase their home management skills to learn how to correct blood glucose levels outside of the target range at a minimum at breakfast and dinner; and 4) they had diabetes for >1 year. Informed consent was obtained from the patients and/or their families before entry into these studies.

Insulin Dosage Guide slide scale

As shown in Fig. 1, there was a separate Insulin Dosage Guide for short-acting (regular human) insulin, which was developed first and one for rapid-acting insulin (insulin lispro, Humalog; Eli Lilly, Indianapolis, IN), which was developed after the introduction of this insulin analog. The algorithm used in the Insulin Dosage Guide was based on increasing the dosage of short- or rapid-acting insulin by 0.5 U (Low Dose Guide Insert) if the dosage of insulin was <10 U, or 1 U (High Dose Guide Insert) if it was ≥10 U. This 0.5 U or 1 U of insulin was added for every 50 mg/dl that the blood glucose level was greater than the upper limit of the target range. For children ≥5 years old, the upper limit of the target range was 150 mg/dl. The upper limit of the target range was modified for children <5 years of age, so that extra insulin was not given until the blood glucose level was >200 mg/dl. In addition, for children <5 years of age, extra short- or rapid-acting insulin was not given at bedtime, while all other children took half of the dosage given on the Insulin Dosage Guide at bedtime. The Insulin Dosage Guide could be individualized to the patient by using the write-in insert on the back of the printed insert.

The Insulin Dosage Guide instructs the patient to subtract 0.5 U (Low Dose Guide Insert) or 1 U (High Dose Guide Insert) of short- or rapid-acting insulin if the blood glucose level was less than the lower limit of the target range. For children <3 years of age, the lower limit of the target range was 100 mg/dl; for children ≥3 years of age, it was 70 mg/dl.

The Insulin Dosage Guide tells subjects how much short- or rapid-acting insulin to take if they are performing carbohydrate counting. The amount of insulin for each 15 g of carbohydrate (1 carb) was written on the Insulin Dosage Guide (Fig. 1) by the Certified Diabetes Educator after it was determined for each subject who was doing carb counting.

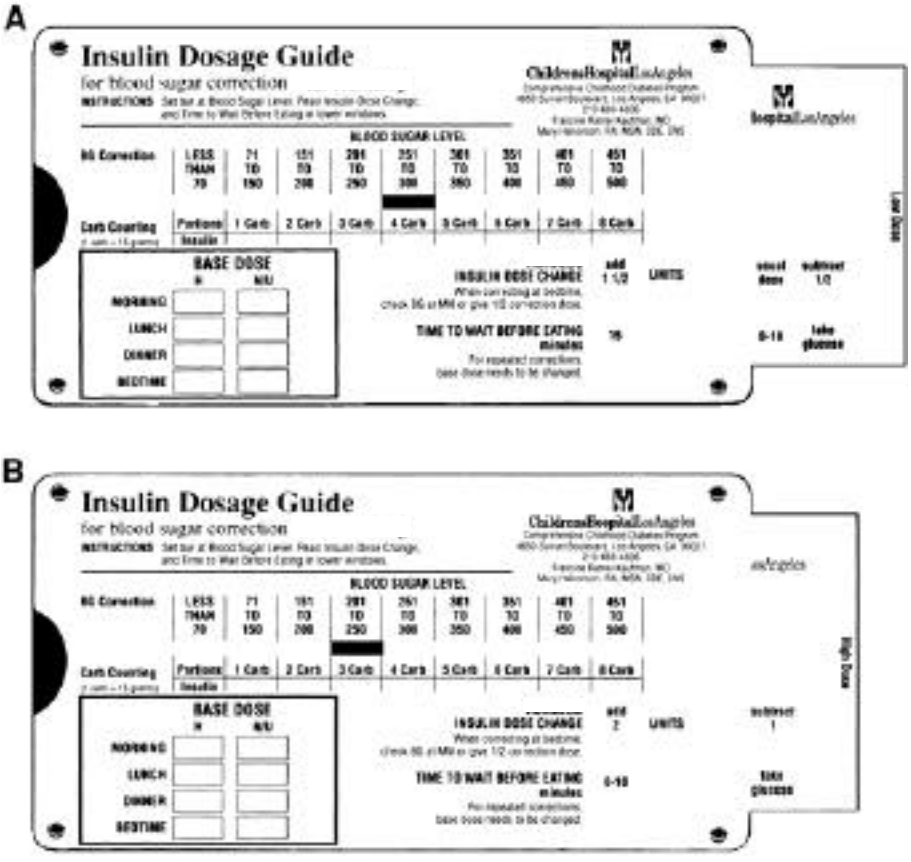

Figure 1—*Insulin Dosage Guide. A: Insulin Dosage Guide with low-dose insert; B: Insulin Dosage Guide with high-dose insert.*

For the subjects in this study, instructions on the principles of adjustment and use of the Insulin Dosage Guide were given by one of two Certified Diabetes Educators at Children's Hospital Los Angeles using a standardized course outline. The amount of time spent teaching a subject and his or her family how to use the guide was recorded. Children >9 years of age were given instruction. During the teaching period, the present base dose of insulin was written in the space provided in the box on the Insulin Dosage Guide called "Base Dose" (Fig. 1). Families were instructed in how to change this on the Insulin Dosage Guide by rewriting the base dosage if it was altered during these studies.

Patients and their families were instructed in how to use the Insulin Dosage Guide as per the instructions on the guide itself (Fig. 1). They were instructed to set the bar at the blood sugar level by sliding the insert back and forth, and to read the insulin dose change, and the time to wait before eating as shown in the windows on the Insulin Dosage Guide. The amount of short- or rapid-acting insulin indicated on the Insulin Dosage Guide in the space labeled "Regular or Humalog Insulin Dose Change" was the amount that was added to the base dosage of short- or rapid-acting insulin. If no insulin was routinely given at that time, the amount indicated on the Insulin Dosage Guide was given. If carbohydrate counting was performed, the number of insulin units needed for the amount of carbohydrate to be consumed was read on the Insulin Dosage Guide and added to the base and supplemental dose. For use with CSII, the basal infusion rates were written in the space under "Base Dose." The correction boluses, which could be given up to every 2 h, and the amount to use for carbohydrate counting were read in the same manner as when insulin was administered by injection. Four correct practice trials by the patient or the parent on how to use the guide were required before the session was concluded.

The amount of time to wait between the injection and the meal was indicated on

the Insulin Dosage Guide in the space called "Time to Wait Before Eating," as shown in Fig. 1. For short-acting insulin, if the blood glucose level was within the target range, the time interval between the injection and the meal was 30 min; between 151 and 200 mg/dl, the time interval was 45 min; and >200 mg/dl, it was 60 min. For rapid-acting insulin, the time to wait was 0–10 min if the blood glucose level was ≤300 mg/dl, and 15 min if the blood glucose level was >300 mg/dl.

Patients not using the Insulin Dosage Guide were given the same course on the principles of dosage adjustment and instructions on how to use a written-on-paper algorithm (Fig. 2). This sheet of paper included the base dose of insulin plus columns for the correction doses using the same scale as those on the plastic handheld Insulin Dosage Guide and a column for the amount of time to wait between the injection and the meal. The number of units for carbohydrate counting was also provided on the paper.

The cost of producing the Insulin Dosage Guide was $1.15 per card. The initial set-up cost was $900.

Base Dose AM_____ Lunch_____ Dinner _____ Bed Time_____

Blood glucose (mg/dl)	AM	PM	Amount to add for each 1 Carb (15 g) = 1
			Time to wait to eat after shot
<70	−1	−1	Take juice
71–150	Base dose	Base dose	30 min
151–200	+1	+1/2	30 min
201–250	+2	+1	45 min
251–300	+3	+11/2	60 min
301–350	+4	+2	60 min
351–400	+5	+21/2	60 min

Figure 2—*The written-on-paper algorithm.*

Study protocols

Protocol 1. The initial study was performed in 1995 using the Insulin Dosage Guide to determine its overall efficacy in improving the frequency and correctness of supplemental short-acting insulin injections used to normalize blood glucose levels outside of the patient's target range. Some 40 children who met entry criteria were randomly selected for either the Insulin Dosage Guide or the written-on-paper algorithm and studied over a 3-month period. None of these subjects had received formal instruction on dosage correction, nor were they practicing this management technique at home.

The mean age of the study participants was 10.6 ± 4.6 years, the range was 4–20 years, and the mean duration of diabetes was 4.7 ± 3.5 years. There were 36 subjects who took two insulin injections per day and 4 subjects who took three injections per day; a mean of 3.3 ± 0.4 blood glucose tests per day were done during the study. Those randomized to the Insulin Dosage Guide had a mean age of 9.6 ± 4.5 years and a mean duration of diabetes of 4.1 ± 3.2 years and took a mean of 2.4 ± 0.4 insulin injections per day compared with those in the written-on-paper algorithm group, who had a mean age of 11.5 ± 4.5 years and a mean duration of diabetes of 5.3 ± 3.7 years and took a mean of 2.6 ± 0.4 insulin injections per day (NS for comparisons).

Subjects were evaluated at entry and after 3 months of using the Insulin Dosage Guide or the written-on-paper algorithm. Comparisons were made for mean blood glucose levels over the 3-month study period as determined from computer analysis of the patient's home blood glucose meter(s) and for HbA_{1c} levels. The subjects and/or their parents were given a questionnaire using a Likert Scale (0–5 scale) after the 3-month period to determine acceptability of the Insulin Dosage Guide by ease of use and satisfaction. Comparisons were made between the time to teach the concepts of insulin dosage adjustment and to achieve competency as determined by four correct return demonstrations with the Insulin Dosage Scale versus the paper algorithm.

Protocol 2. The second study, involving 83 children and teenagers, was conducted in 1996 and was designed to enroll the first 100 eligible patients in our center to use the Insulin Dosage Guide in a longitudinal pre- and post-treatment design for 1 year. This design was chosen to determine whether the Insulin Dosage Guide would have long-term benefit and was done after the initial study showed efficacy in lowering HbA_{1c} levels and in reducing the time to teach insulin dosage adjustment.

The mean age of the subjects was 11.4 ± 4.3 years, the range was 4–28 years, and the mean duration of diabetes was 4.4 ± 3.1 years. There were 38 subjects who took two injections per day, and 45 subjects took three injections per day. Of these patients, 28 were performing carbohydrate counting.

Patients were seen at entry and at 3-month intervals for 1 year, at which times HbA_{1c} and mean blood glucose levels were determined. From computer printouts of the stored blood glucose meter data and from home blood glucose logbook records, the number of consecutive blood glucose levels above the target range was analyzed for the 1-month period before entry and the month before completion of the study. The incidence of severe hypoglycemia was determined for the study group during the 2 years before and during the 1-year study period by interviewing patients with a standard set of questions at every 3-month clinic visit.

Protocol 3. The third study was completed in 1998 and was designed to determine the effectiveness of the Insulin Dosage Guide for rapid-acting insulin analogue and insulin lispro (Humalog; Eli Lilly) and for subjects on the insulin pump. The first 20 patients followed in our center who were placed on rapid-acting insulin by injection were evaluated specifically to ensure that patients would not have an excess of blood glucose values below the target range with rapid-acting insulin. The mean age of these subjects was 10.1 ± 3.7 years, the range was 4–17 years, and the duration of diabetes was 3.1 ± 1.8 years. Of these patients, 14 were originally using the Insulin Dosage Guide with short-acting insulin before switching to rapid-acting insulin, and 6 had been using a paper algorithm. There were 6 subjects taking two injections per

Table 1—*Results of protocol 1: comparisons of mean HbA_{1C} of blood glucose levels, Likert scale, and time to teach for the Insulin Dosage Guide vs. written algorithm in 40 patients*

	HbA_{1c} %		Mean blood glucose (mg/dl)		Mean Likert scale, ease of use (0–5 scale)	Mean time to teach (min)
	Before	After	Before	After		
Insulin Dosage Guide	8.9 ± 2.0	7.8 ± 1.3*	197 ± 35	166 ± 22†	5.0	18
Written algorithm†	8.1 ± 1.4	8.7 ± 2.1‡	195 ± 32	212 ± 28‡	3.4	43

Data are means ± SD, unless otherwise indicated. *P = 0.04; †P = 0.05; ‡NS.

day, 11 taking three injections per day, and 3 using multiple daily injections (MDI). The Insulin Dosage Guide was also evaluated in 64 subjects, mean age 15.9 ± 3.6 years (range 9–20), on CSII using insulin lispro during 1997–1998. For study participants, a mean of 3.6 ± 0.3 blood glucose levels were done daily.

Subjects were evaluated at entry and after 1 and 3 months to determine mean blood glucose and HbA_{1c} levels. Blood glucose meters were analyzed to determine percentage of blood glucose levels within, above, and below the target range at the same time intervals. The percentage of time that a correction dosage of insulin resulted in the subsequent blood glucose level being within the target range was also determined from blood glucose meter analysis. For patients on CSII using insulin lispro, it was determined whether accurate bolus insulin administration, which accounted for carbohydrate intake and correction of preprandial blood glucose levels, could be achieved during pump initiation. This was done by evaluating the 2-h postprandial blood glucose level during the first 24 h after initiating CSII. For this purpose, blood glucose levels that were obtained after the second and third meal after starting CSII were analyzed.

Finger-stick blood glucose testing was done with one of two glucose meters (One Touch II or One Touch Profile; Lifescan, Milpitas, CA). HbA_{1c} was measured with the DCA 2000 (Miles, Tarrytown, NY) (normal range 3–6%).

Statistical analyses included descriptive statistics, means, and percentages, and *t* test comparisons were made between time periods and groups.

RESULTS — Table 1 compares mean blood glucose and mean HbA_{1c} levels, Likert Scale for ease of use, and the time to teach dosage adjustment for the subjects in the initial study using the Insulin Dosage Guide or the written-on-paper algorithm at entry and 3 months from protocol 1. As shown, there was a significant reduction in the HbA_{1c} level (8.9 ± 2.0 vs. 7.8 ± 1.3%, P = 0.04) for the subjects using the Insulin Dosage Guide and no change in the mean HbA_{1c} level (8.1 ± 1.4 vs. 8.7 ± 2.1%, P = 0.27) for those using the paper algorithm. Similarly, there was a significant reduction in the mean blood glucose level (197 ± 35 vs. 166 ± 22 mg/dl, P = 0.05) for subjects using the Insulin Dosage Guide, but not for those using the paper algorithm (195 ± 32 vs. 212 ± 28 mg/dl, P = 0.2). In addition, the Likert Scale was higher (5.0), and the time to teach shorter (18 min), for those using the Insulin Dosage Guide compared with those using the paper algorithm (3.4 and 43 min, respectively). During the study, there was no difference in the number of phone contacts per month (mean 3.9 ± 0.6 for Insulin Dosage Guide vs. 4.3 ± 0.7 for the paper algorithm, P = 0.11) and no difference in the number of changes in the base dose of insulin per month (mean 2.4 ± 1.1 for Insulin Dosage Group vs. 2.5 ± 1.1 for the paper algorithm group, P = 0.89) for the two groups.

The results of protocol 2 are illustrated in Table 2. As shown, there was a significant decrease in the mean HbA_{1c} level at 3 months (9.5 ± 2.0 vs. 8.4 ± 1.5%, P = 0.0002) using the Insulin Dosage Guide, and this improvement was sustained for the 12-month period (6 months, 8.5 ± 1.4%, P = 0.0004; 9 months, 8.5 ± 1.7%, P = 0.003; and 12 months, 8.3 ± 1.4%, P = 0.0001), with further improvement at that time. There was no significant change in the mean blood glucose levels between entry and 12 months (188 ± 40 vs. 176 ± 42 mg/dl, P = 0.19). However, there was a significant decrease in the mean number of consecutive blood glucose levels greater than the target range for the month before entry and the month before completion of this study protocol (53 ± 45 vs. 32 ± 28, P = 0.001).

During the 1-year study period, the incidence of severe hypoglycemia for the study population was 4%. In the same study subjects, 1 year prior, the incidence of severe hypoglycemia was 11% and 2 years before this study, the incidence of severe hypoglycemia was 10%.

Table 3 indicates results of protocol 3 determining the effect of the Dosage Guide with rapid-acting insulin. For subjects taking insulin lispro and using the Dosage Guide, there was a significant reduction in the mean blood glucose level between entry and 1 and 3 months (entry, 166 ± 34 vs. 1 month, 142 ± 28 mg/dl, and 3 months, 143 ± 24 mg/dl, P = 0.04 and 0.02, respectively). There was, however, no change in mean HbA_{1c} level (8.1 ± 1.1 vs. 8.0 ± 0.9%, P = 0.93); this was likely due to the fact that the entry level was already low, since most subjects were already using the Insulin Dosage Guide. There was a significant increase in the per-

Table 2—*Results of protocol 2: comparison of mean HbA_{1c}, and blood glucose levels before and after use of the Insulin Dosage Guide in 83 patients*

Mean HbA_{1c} (%)					Mean blood glucose (mg/dl)		Mean number of consecutive high blood glucose values	
Before	3 Months	6 Months	9 Months	12 Months	Before	12 Months	Before	12 Months
9.5 ± 2.0	8.4 ± 1.5*	8.5 ± 1.4†	8.5 ± 1.7‡	8.3 ± 1.4§	188 ± 40	176 ± 42‖	53 ± 45	32 ± 28¶

*P = 0.0002 vs. before study; †P = 0.0004 vs. before study; ‡P = 0.003 vs. before study; §P = 0.0001 vs. before study; ‖NS vs. before study; ¶P = 0.001 vs. before study.

Table 3—*Results of protocol 3: mean percent blood glucose levels within, below, and above target using rapid-acting insulin with the Insulin Dosage Guide*

	Before	1 Month	3 Month	*P*
Mean HbA_{1c}	8.1 ± 1.1	—	8.0 ± 0.9	NS
Mean blood glucose level (mg/dl)	166 ± 34	142 ± 28	143 ± 24	0.04*, 0.02†
Mean % blood glucose				
Within target	39 ± 13	49 ± 15	48 ± 12	0.04*, 0.03†
Below target	14 ± 10	15 ± 9	10.0 ± 6	NS
Above target	48 ± 17	36 ± 17	42 ± 13	NS
Percentage of correction doses with subsequent blood glucose within target	68 ± 17	75 ± 12	78 ± 17	NS

Data are means ± SD, unless otherwise indicated. *Before vs. 1 month; †Before vs. 3 months.

centage of blood glucose levels within the target range (entry, 39 ± 13 vs. 1 month, 24 ± 15, and 3 months, 48 ± 12%, $P = 0.04$ and 0.03, respectively). Although there was no significant difference in the percentage of blood glucose levels above (entry, 48 ± 17% vs. 1 month, 36 ± 17%, $P = 0.06$, and 3 months, 42 ± 13%, $P = 0.27$) or, more importantly, below the target range (entry, 14 ± 10% vs. 1 month, 15 ± 9%, $P = 0.82$, and 3 months, 10.0 ± 6%, $P = 0.11$), there was a general trend toward improvement in both parameters. There was an increase in the percentage of supplemental doses of insulin that resulted in the subsequent blood glucose level being within the target range between entry and 1 and 3 months, although statistical significance was not achieved (entry, 68 ± 17% vs. 1 month, 75 ± 12%, $P = 0.15$, and 3 months, 78 ± 17%, $P = 0.56$). Results of the effectiveness of using the Insulin Dosage Guide in patients starting on CSII with insulin lispro showed that 90% of subjects achieved accurate carbohydrate and correction insulin boluses, resulting in second and third postprandial blood glucose levels (2-h postprandial measurement) being within the target range while being monitored on the day of pump initiation.

CONCLUSIONS — These data suggest that the Insulin Dosage Guide led to a decrease in HbA_{1c} levels, mean blood glucose levels, and a number of consecutive high blood glucose levels in pediatric and young adult subjects with type 1 diabetes. This improvement in glycemia, which occurred for subjects on variable insulin regimens, including CSII, using short- and rapid-acting insulin, and for subjects performing carbohydrate counting, was sustained for up to 1 year. Improved glycemia appeared to result from an increase in the number of blood glucose levels that were within the target range, a trend toward an increase in the subsequent blood glucose value returning to the target range after dosage adjustment, and a decrease in the number of ongoing elevated blood glucose levels. In addition, this improvement occurred without an increase in the incidence of severe hypoglycemia. This would suggest that patients and families using the Insulin Dosage Guide have a reduction in their glycemic excursion, and likely their postprandial blood glucose levels, that is beneficial with regard to short- and long-term diabetes outcome.

We developed the Insulin Dosage Guide as an alternative to the previously used written-on-paper algorithms. The Insulin Dosage Guide was designed for correction of abnormal blood glucose levels, not for alteration of the base dose of insulin. Based on the Diabetes Control and Complications Trial (4) and the American Diabetes Association Standards of Care (8), as well as the "Staged Diabetes Management" of Etzwiler (9), we had used insulin correction algorithms in our center to not only improve glycated hemoglobin levels, but to allow our patients more flexibility in their day-to-day diabetes management (10). However, we found that these paper algorithms, composed of multiple columns listing the blood glucose ranges, the number of units that the insulin dosage was to be increased or decreased, and the time to wait between the injection and the meal, were not easy for our patients to use. In addition, it took our team members a lengthy time period for patient and family instruction and to ensure that subjects could accurately determine the correction insulin dosage by referring to their sheet of paper. Therefore, the development of a more user-friendly format for insulin adjustment algorithms to correct blood glucose levels outside of the target range appeared to be critical if we were to successfully promote patient advancement in diabetes management.

The data from this study showed that the Insulin Dosage Guide was accepted by patients and their families. The results revealed that the Insulin Dosage Guide was easy to use, that it was used correctly for a prolonged period of time, and that subjects were satisfied with it. These findings suggest that perhaps more type 1 diabetic patients would begin to perform dosage adjustment and that they would succeed if given the Insulin Dosage Guide as a means to facilitate diabetes management. In our own center, this has resulted in an increase from 14% of our patients doing routine dosage correction in 1994 to 96% of our patients in 1998.

It was found that it took little time to teach how to correctly use the Insulin Dosage Guide. Teaching insulin adjustment algorithms must take into account all of the components necessary to correct glycemia, such as how to change the prandial insulin dosage based on the current blood glucose level, how to determine the lag time between the injection and the meal, and how to account for food intake changes (carbohydrate counting) (10). The hand-held Insulin Dosage Guide addresses all these issues in an easy-to-use format, in which the correct insulin dosage appears in an isolated window after setting the bar at the current blood glucose level, and can be used to teach the difficult principles of dosage adjustment in a relatively short period of time. This would indicate that the Insulin Dosage Guide might result in cost savings, since there would be a reduction in time required for diabetes management training.

Other formats have been developed to help patients with dosage adjustment. For example, computerized versions of dosage

adjustment algorithms are available (11,12). Unfortunately, these require the ability to use computers, and they are expensive and not portable. Therefore, they are not available where and when insulin is taken, such as at work, at school, or in restaurants. The Insulin Dosage Guide, which can fit inside the blood glucose meter case, or with the logbook or other diabetes supplies in a purse or backpack, appears to be a much more practical alternative for patients, particularly children, to use to determine the correct dosage than are these highly technical computer-based algorithms.

Although insulin algorithms were originally developed by Skyler et al. (13), simultaneous with the introduction of home blood glucose monitoring, the widespread use of these algorithms has been hampered by many factors. When written on paper, algorithms are difficult for some patients and their families to understand and to use successfully; when computer based, they are often not available when insulin is being taken. Diabetes educators often lack the appropriate amount of time to teach how to perform dosage adjustment, and there is often insufficient reimbursement for the time spent. It appears that the hand-held plastic Insulin Dosage Guide is an inexpensive and effective device that can address these issues and allow for larger numbers of patients to appreciate the short- and long-term benefits of successful diabetes management.

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