Evaluation of Computer-based Diet Education in Persons with Diabetes Mellitus and Limited Educational Background

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A study was conducted to determine whether computer-based techniques for meal planning and diet education could be an effective supplement to diabetes diet counseling in a group of inner-city subjects with limited educational background. Sixteen individuals with diabetes mellitus who were newly referred to an inner-city outpatient diet clinic and who demonstrated ninth-grade reading ability were given computer-based nutritional education. They received meal planning information through use of individualized computer-planned menus and education about the diabetes diet by computer-assisted instruction (CAI) combined with an interactive videodisc system (VIDEO). Total contact time was 180 min of CAI/VIDEO, 50 min of dietitian/patient education, and 20 min of dietitian/patient computer time (the last function could have been performed by a clerk). At the end of 4 wk, the group performance was improved in Exchange Lists knowledge ($P < 0.001$), recognition of foods containing concentrated carbohydrate ($P < 0.05$), and reduction of reported fat intake ($P < 0.05$). In addition, average group weight declined by 4.6 lb ($P < 0.005$). No improvement was found in food-measuring skills or in calorie-consumption compliance during a standardized buffet lunch. It appears that computer-based techniques are an acceptable supplement to traditional methods of education in this patient group and can improve the effectiveness of diabetes education programs without a significant increase in dietitian time. DIABETES CARE 1985; 8:537–44.

Diet has always been an important part of the treatment of persons with diabetes. Traditionally, in the educational component of diabetic nutritional care, the dietitian helps the individual formulate a meal plan, provides information that will help him/her to follow the meal plan, and encourages compliance by defining diet restrictions and assisting the person to overcome them.[1] By their nature, computers are well suited to assist in the first two parts of this educational process; they can perform the complex calculations involved in meal planning and support interactive learning. The use of computers to perform these functions should permit the dietitian to focus more time toward dealing with individual problem areas.

To assist the dietitian in the computational process of meal planning, a large number of computerized nutrient-analysis programs have been developed.[2] Many of these programs have the option of menu planning (developing a day's menu or meal pattern that is individualized and meets diet prescription constraints); however, with one exception, these programs cannot automatically select foods and it is therefore very time consuming to plan weeks of varied menus.[3] Only one program has been developed to produce a meal pattern based on diet prescription, individual food preferences, and any number of days of varied menus.[4] To date, none of these programs have been evaluated in the context of their ability to change knowledge, behavior, and/or physical parameters.

In addition, few computer-assisted instruction (CAI) programs have been developed for patient education[5–11] and only two have been evaluated in terms of the effectiveness of the CAI approach. Lefebvre et al.[7] reported the development of seven computer lessons designed to teach basic diabetes information to individuals. Fifty type I diabetic children who completed the first four lessons improved significantly in knowledge, based on tests given before and after each lesson. Fisher et al.[5] used three different (oral, written, and computer-based) methods of instructing women about the collection of a clean, voided urine specimen. The group receiving computer instruction was the most uniform in its performance, reported the fewest procedural problems, and had fewer contaminating bacteria than did the other groups.

The present study, one of a series applying computer technology in the area of nutrition education,[4,10,12] was designed to determine whether computer-based nutrition programs could be effectively integrated into diet counseling of a group of educationally disadvantaged inner-city individuals with diabetes mellitus. To do this, an educational program incorporating computer-planned menus and CAI was evaluated in a metropolitan county hospital, outpatient diet clinic.

METHODS

Subject Selection

All patients diagnosed as having diabetes mellitus and newly referred to the outpatient diet clinic during a 6-mo period were considered. Each of the 57 subjects was screened to determine ability to read and comprehend the CAI material (written at the ninth grade level[13]). Forty-nine individuals were able to read at this level and were asked to participate. Seventeen refused for the following reasons: work schedule (7), not interested (8), age (1), and babysitting problems (1). Thirty-two individuals signed informed consent and were then randomly assigned to computer education (CE) or traditional education (TE). The individuals in both groups were similar in many respects (Table 1) and were predominantly obese, older women. By patient history, the average grade completed in school was 10th, with a range of from 3 to 15.

Study Design

The study included an initial evaluation of the subjects' nutritional knowledge, skills, and performance (assessment), an educational intervention (either traditional or computer), and a final evaluation (reassessment). The TE group was to receive the standard outpatient nutritional education, which consisted of two 30-min sessions with a dietitian. It was intended that both of these sessions would take place during the 1-mo study period. Unfortunately, due to patient scheduling practices, which were outside of the control of the study team, only three TE subjects received the second educational session within this period of time.

The CE subjects were scheduled for two educational interventions, which included a combination of dietitian instruction and computer-based instruction. The CE subjects were scheduled by the study team so that they all received both educational sessions.

The fact that the TE subjects received somewhat less direct interaction time with the dietitian than did the CE group prohibits a comparison of the groups' performances to determine if computer-based education can replace some dietitian interaction. The study provides information only on the effectiveness of a nutritional program that includes computer-based education components.

TABLE 1
Characteristics of subjects at entry

	Computer education group (N = 16)	Traditional education group (N = 16)
Age (yr, range)	53 (24–69)	52 (21–75)
Sex (M/F)	6/10	4/12
% Ideal body wt		
(IBW %, range)	152 (100–212)	155 (88–223)
No. >120% IBW	15	12
Duration of diabetes		
(yr, range)	6 (0–30)	4 (0–12)
Treatment		
Diet only	8	9
Oral agent	3	2
Insulin	5	5
School grade completed		
(range)	10 (3–15)	10 (5–14)

Assessment

An assessment of body weight, nutritional knowledge, portion control skills, diet recall, and food choices during a buffet lunch was carried out for CE and TE subjects immediately after entry into the study and again, as the reassessment, 4 wk later.

Body weight was determined to the nearest one-quarter of a pound using a balance scale and having the subject without shoes and in light-weight clothing. Knowledge of exchange lists concepts was determined by use of a self-administered test. This test consisted of 12 problem-solving and information-gathering exercises containing 50 individual choices.[14] Portion control skills were determined through demonstration. With a number of measuring utensils, a small scale, and foods and food models within reach, subjects were asked to perform five skill demonstrations.[14] These included liquid (orange juice) and solid food (rice, margarine) volume measurements, weight measurements (imitation hamburger patties), and numbers interpretation (cracker squares). A 24-h recall was performed following standard procedures.[15] Probing followed the end of the subject's description of the previous day's food intake. Portion sizes were determined using the skills assessment equipment, actual food, and food models. The 24-h recall was analyzed for calories and macronutrients based on Exchange Lists values.[16,17] In cases where foods did not fit into Exchange Lists categories, actual calorie content was calculated and used.[18–21]

The last part of the assessment involved a buffet in a home-type kitchen. Lunch choices were offered from the Exchange Lists food groups (hot vegetables and tossed salad, fresh and canned fruits and fruit juices, breads and starchy vegetables, high- and low-fat meats, and margarine and salad dressings). Hot and cold beverages and condiments were included and milk was available upon request. Other types of foods (brownies, cookies, orange drink, regular soft drink, peaches packed in light syrup, and jelly) containing concentrated carbohydrate were also available. Each was labeled appropriately. Food choices and leftover amounts were unobtrusively recorded. In addition to the formal assessment, clinic records were reviewed to determine the subjects' weights ≈1 yr after the end of the 4-wk study period.

Educational Intervention

Educational programs for both groups of subjects included information about meal planning, good nutrition, Exchange Lists, portion control, food purchasing, and food preparation (discussed during the first educational intervention). Meal planning and Exchange Lists reinforcement, eating out, and recipes were included for both groups during the second intervention.

For the TE group, meal planning and information about the diabetic diet were taught by a dietitian using written and oral instruction techniques. For the CE group, these parts of the educational process were carried out using computer programs. Personal counseling, goal setting, and portion control demonstrations were educational techniques used by dietitians with both groups of subjects. Because meal planning and education about Exchange Lists was done by computer for the CE group, a greater portion of the dietitian-patient interaction time was spent in counseling areas such as contracting and skills demonstration.

Computer-planned menus. The CE group meal planning was done through the use of a computer-planned menu (CPM) program.[4] The diet prescription, the usual daily eating pattern (in terms of food groups to be used at each meal), and subject food preferences from the Exchange Lists for Meal Planning[16] were the input to the computer. The computer program used this input, an optimization algorithm, and a data base (all foods from the Exchange Lists and their nutrient composition) to choose the types and amounts of foods for each meal that would meet the diet prescription. Output was any number of days of menus (using the same pattern as was chosen for the first day, but including randomly selected subject-preferred foods each day), a grocery shopping list for each week, and a weekly average nutritional analysis of the menus. These menus were designed to serve as food diaries in which eaten foods could be checked and exchanges could be written on each page (Figure 1). The CPM program was executed on a DEC (Digital Equipment Corporation, Maynard, Massachusetts) 20 mainframe computer.

Computer-assisted instruction. Information about the diabetic diet and Exchange Lists for the CE group was presented using a CAI/VIDEO approach. The CAI/VIDEO program is divided into 11 modules, which contain sequences of concept presentation, question, and remediation if wrong answers are chosen. In addition to text on the monitor screen, information is provided through the use of still pictures, motion segments, graphics, and/or audio. The system was operated entirely by the subject, who answered questions by pressing one of three color-coded keys on the keyboard (The CAI/VIDEO program was developed as a part of this study and is more fully described in the APPENDIX.)

Statistics

Statistical analyses were carried out using the SPSS package[22] and other statistical programs available on the Indiana University Computing Network. For continuous variables, tests for significance of mean changes were carried out using the paired differences *t*-test. For comparison of changes of dichotomous variables, Fisher's Exact Test for 2-×-2 tables was used.[23]

PATIENT NAME SUZIE TRIAL DIET PRESCRIPTION DIABETIC 1200 CAL WEEK 1 DAY 1
DATE MENU PREPARED 27-Aug-84

CHECK FOOD ITEMS USED		FOOD ITEM	AMOUNT TO SERVE		EXCHANGES		CALORIES
			****	BREAKFAST MENU	****		
*	*	MILK,SKIM	1	CUP(S)	1	MILK,NON-FAT	80
*	*	ORANGE JUICE	1/2	CUP(S)	1	FRUIT	40
*	*	ENGLISH MUFFIN	1	MUFFIN	2	BREAD	140
*	*	MARGARINE	2	TEASPOON(S)	2	FAT	90
			****	LUNCH MENU	****		
*	*	CAULIFLOWER	1	CUP(S)	2	VEGETABLE	50
*	*	BREAD,WHOLE WHEAT	2	SLICE(S)	2	BREAD	140
*	*	HAM,SMOKED,LEAN	2	OUNCE(S)	2	MEAT,LEAN	110
*	*	SALAD DRESSING	2	TEASPOONS	1	FAT	45
			****	EVENING MENU	****		
*	*	MILK,SKIM	1	CUP(S)	1	MILK,NON-FAT	80
*	*	MUSHROOM,FRESH	20	SMALL	2	VEGETABLE	50
*	*	PEAR	1	SMALL	1	FRUIT	40
*	*	RICE	1	CUP(S)	2	BREAD	140
*	*	CHICKEN	2	OUNCE(S)	2	MEAT,LEAN	110
*	*	MARGARINE	1	TEASPOON(S)	1	FAT	45

FIG. 1. Example of computer-planned menu.

TABLE 2
Evaluation data for computer education group

Evaluation parameters	N	Assessment	Reassessment	Difference	P-value
Body wt (lb)	15*	213.4 ± 32.0†	208.4 ± 31.3	−4.6 ± 5.9	<0.005
Exchange list score	16	34.1 ± 5.6	39.8 ± 4.2	5.7 ± 4.3	<0.001
Food portioning score	16	4.0 ± 1.0	4.1 ± 0.8	0.1 ± 1.0	NS
24-h recall fat content (% of calories)	16	44.1 ± 9.5	36.3 ± 9.2	−7.8 ± 13.7	<0.05
24-h recall minus diet prescription (%)	15*	30.3 ± 50.8	−9.2 ± 24.2	−39.4 ± 44.7	<0.005
Buffet lunch minus diet prescription (%)	15*	6.3 ± 65.9	6.7 ± 47.9	0.4 ± 38.7	NS
Recall lunch minus diet prescription (%)	15*	18.5 ± 93.7	5.4 ± 41.2	−13.1 ± 83.3	NS

*Obese subjects only.
†Mean ± standard deviation.

RESULTS

Subject instruction time. CE subject interaction with the dietitian included an average of 30 min of education during the first intervention and 20 min during the second intervention. In addition, the first intervention included 20 min of dietitian-patient computer time. This time included explaining the CAI/VIDEO equipment, checking CPM input, and explaining CPM output. (In the present study this was done by a dietitian, but would normally be done by a technician or clerk.) Average CE subject time working with the CAI/VIDEO was 120 min for the first intervention and 60 min for the second intervention, 2 wk later. Subjects displayed no reluctance to operate the computer system, although none had worked with this type of equipment before. All TE subjects came for the first intervention, which lasted an average of 30 min. Since the diet clinic policy was to schedule diet clinic visits to coincide with follow-up physician appointments, only three returned for the second 30-min intervention during the 1-mo period of the study.

The average total time spent in meal planning and education over the 1-mo period was 250 min for the CE subjects and an average of 35 min for the TE subjects. Although the CE subjects had more than seven times as much interaction as the TE subjects, the large majority of this was spent in actually using the computer and only 50 min was spent receiving instruction from the dietitian.

Since it would be necessary for the CE group to receive less dietitian nutritional instruction time than the TE group, to allow the effect of the computer-based instructional techniques to be evaluated, the study results cannot yield information on the ability of CE to replace dietitian instruction: The study can provide data on the impact of the computer-based instruction on the knowledge and performance of the CE subjects. The TE subject data may be of interest in itself and will be included, but no direct comparison of differences in performance of the two groups will be made.

Weight. During the 4-wk educational intervention period, the obese (>120% of ideal body weight) subjects in the CE group had a weight loss of 4.6 lb ($P < 0.005$, Table 2), while the TE group obese subjects had an average loss of 2.0 lb (NS, Table 3).

A review of clinic records yielded weights obtained ≈1 yr after the reassessment for 12 obese CE subjects and 7 obese TE subjects. The CE group had maintained their initial weight loss, but had not lost additional weight, while the TE group now weighed more than they had at the beginning of the study (3.8 ± 9.1 lb, NS).

Knowledge and skills. The CE group gave an average of 5.7 more correct answers about the Exchange Lists at the reassessment than they had at the assessment ($P < 0.001$, Table 2), while the TE group performance at reassessment was only slightly improved over assessment, with an average of 0.8 more correct answers (Table 3). The CE group assessment

TABLE 3
Evaluation data for traditional education group

Evaluation parameters	N	Assessment	Reassessment	Difference	P-value
Body wt (lb)	12*	215.3 ± 40.0†	213.2 ± 42.9	−2.0 ± 6.3	NS
Exchange list score	16	36.0 ± 5.3	36.8 ± 5.5	0.8 ± 3.1	NS
Food portioning score	16	3.1 ± 1.5	3.5 ± 1.2	0.4 ± 0.9	NS
24-h recall fat content (% of calories)	16	42.7 ± 10.1	39.6 ± 8.7	−3.1 ± 12.3	NS
24-h recall minus diet prescription (%)	12*	−6.1 ± 40.8	−12.5 ± 28.3	−6.4 ± 44.0	NS
Buffet lunch minus diet prescription (%)	12*	6.9 ± 50.8	−4.4 ± 40.4	−11.3 ± 44.6	NS
Recall lunch minus diet prescription (%)	12*	−34.9 ± 54.2	−11.4 ± 51.2	23.5 ± 48.4	NS

*Obese subjects only.
†Mean ± standard deviation.

food portioning average score was quite high, at 4.0 out of 5.0 (Table 2), and they demonstrated only a slight improvement at the reassessment (NS). The TE group did not score as well initially, with an average score of 3.1, and had a moderate improvement, to 3.5, at the reassessment (NS).

Compliance. Compliance with the diet prescription was evaluated in several ways. The first was a comparison of the subjects' 24-h recall calorie levels with their diet prescription calorie levels. The assessment values were different for the two groups, with the CE group overeating by an average of 30.3% (Table 2), while the TE group reported undereating by an average of 6.1% (Table 3). Reported eating habits changed significantly in the CE group after the educational intervention. They decreased their reported 24-h calorie consumptions compared with their calorie prescriptions by an average of 39.4% ($P < 0.005$), going from overeating to undereating (Table 2). The TE group decreased their reported calorie intakes by a further small amount at the reassessment, a net decrease of 6.4% (NS, Table 3).

The protein, fat, and carbohydrate contents of the 24-h recalls before and after the nutritional intervention were determined. The CE group decreased their fat intake by almost 8% ($P < 0.05$, Table 2), while the TE group decrease was only 3% (NS, Table 3). The CE group replaced 80% of these fat calories with carbohydrate calories, while the TE group replaced 80% of their fat calories with protein calories.

The subjects' diet prescription lunch calorie levels were compared with their actual calorie consumptions at the buffet lunch and their 24-h recall lunch calorie levels (Tables 2 and 3). Both the CE and TE groups slightly exceeded their prescription calorie amounts at the assessment buffet and these excesses were not significantly altered at the reassessment buffet. The comparison of the 24-h recall lunch calories to the diet prescription lunch calories showed that the CE group decreased their reported overeating, while the TE group changed from reporting large undereating to a moderate level of undereating; neither change was significant.

Another subject compliance evaluation parameter was whether or not the individual selected and ate a food containing concentrated carbohydrate (CC) at the buffet lunch. The CE group had six patients selecting a CC during the assessment buffet and only three doing so at the reassessment buffet (all three of these subjects had also chosen a CC at the assessment). The TE group performance was essentially the opposite, with three subjects choosing a CC at the assessment in addition to four subjects who did so at the reassessment. Both differences in performance were statistically significant (Fisher's Exact Test, $P < 0.05$).

Food records for the CE group. CE subjects were asked to use computer menus as food diaries, checking the foods and amounts eaten, or writing in "exchanged" foods and amounts (Figure 1). The results of the evaluation of the CE group marking of the CPM are presented in Table 4. Over the 4-wk educational intervention period all CE subjects used CPM to record the food items they ate (number of checked foods plus number of exchanges, whether correct or not) 80% of the time. Exchanged foods were selected from the correct exchange list 16% of the time; however, only 7% of the CPM food items were exchanged using the correct exchange list and amount.

TABLE 4
Computer-planned menu record keeping by subjects*

	Current study (N = 16)	Previous study (N = 80)	P-value
Percent of foods on menus that was checked	62 ± 21†	50 ± 27	<0.025
Percent of foods on menus that was exchanged	18 ± 14	11 ± 10	<0.01
Percent correct exchange list	16 ± 13	10 ± 9	<0.025
Percent correct exchange list and amount	7 ± 8	3 ± 5	<0.01

*Comparison of results of Wheeler and Wheeler[12] with current study results.
†Mean ± standard deviation.

The results of a previous study with a similar subject population[12] in which computer-planned menus were used is also presented in Table 4. The educational content of this study was very similar to the current study, with the important exception that a slide/audiotape system was used in place of the CAI/VIDEO approach of the current study. The slide/audiotape was machine-paced and lasted a total of 2 h ($1\frac{1}{2}$ h plus written questions after each module), whereas the CAI/VIDEO lasted an average of 3 h. The subjects in the CAI/VIDEO study performed better than those in the slide/audiotape study in every category of food records and the differences were all statistically significant.

DISCUSSION

There are approximately $5\frac{1}{2}$ million Americans diagnosed as having diabetes mellitus and an additional 5 million are estimated to have diabetes but have not yet developed overt symptoms.[24] It is likely that most of these individuals who receive diet instruction are initially educated in a busy hospital or clinic situation. From the point of view of the instructor, much of this initial instruction is repetitive (education about good nutrition, Exchange Lists concepts, food purchasing, portion control) or computational (meal planning) in nature. In this study, two computer programs were used to automate these processes. One created a meal pattern based on the diet prescription and provided menus as a "behavioral modification" tool for subjects to use at home. The other program incorporated text, video, audio, and graphics (CAI/VIDEO).

Our experience has indicated that computer programs, developed to automate these repetitive tasks, can be incorporated into a patient education program with positive effects, especially in a clinic with educationally disadvantaged patients. Persons exposed to computer meal planning and education not only improved their level of knowledge of the Exchange Lists, but were able to put this knowledge to use in avoiding foods containing concentrated carbohydrates at a buffet and to decrease reported fat intake. Obese individuals were able to lose weight at a satisfactory rate during the 1-mo study period. The fact that those CE subjects for whom clinic records were available maintained their weight loss for 1 yr suggests that if frequent refresher education is given, perhaps clinically significant weight loss will result.

The comparison of patient marking of the CPM in this study with that observed in a similar study, which used a slide/audiotape in place of the CAI/VIDEO,[12] provides some insight into the contribution of the CAI/VIDEO approach. The subjects in the current study performed better than the previous subjects in every evaluation parameter ($P < 0.01$ to $P < 0.05$). This appears to support the conclusion that CAI/VIDEO is an effective patient education tool.

In addition, our results are consistent with other studies that have compared use of computers to provide medical education (to students) with other instructional approaches of providing education. These studies found that computers were at least as good in improving student knowledge as more traditional methods such as tutorial or lecture formats.[25-31]

Our subjects were for the most part inner-city, middle-aged or elderly persons who had not completed high school. They had previously had little or no knowledge about computers but were able to operate the CAI/VIDEO system with little instruction. We believe that this was due to the limited number of answer keys to be pressed, and the color coding of the keys.

Hospital and clinic dietitians have only a limited amount of time to spend in educating and counseling. This time should be used to produce the best possible patient outcomes. Our study has shown that use of computer programs can release the dietitian's time from repetitive education. This time saving can be used to reduce health care costs by providing a given amount of nutritional education with less dietitian time or, preferably, to focus on personal counseling and deal with individual patient problem areas such as compliance and support mechanisms. The CAI/VIDEO material can be reviewed by patients (either in total or by subject area) at subsequent hospital or clinic visits without additional use of dietitian time.

Although our results apply only to the area of diabetes and diet counseling, it seems logical that the CAI/VIDEO concepts could be extended to other phases of diabetes education (foot care, insulin injection techniques) and could be used for other chronic diseases.

Although computers are becoming commonplace in hospitals and homes, there are still problems of software compatibility. In our study we used a large mainframe computer to run the computer menu planning program and a microcomputer that is not widely available to present the CAI/VIDEO material. For this concept to be used in the routine care of individuals who have diabetes, programs must be written for easily available microcomputers such as the IBM PC. The CPM and the CAI/VIDEO programs are currently being converted to satisfy this requirement. A videodisc player is necessary for the CAI/VIDEO material.

The results of our use of computer nutritional programs in the clinic setting are short-term and preliminary but encouraging and we are in the process of applying our programs to other patient populations to see if the results will be the same.

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APPENDIX

CAI/VIDEO system characteristics. The CAI/VIDEO system includes a Terak model 8510a microcomputer (with its floppy disc drive, keyboard, and monitor) and a computer-controlled video subsystem (Pioneer model 7820-3 videodisc player and a Sony color television monitor). The Terak has a DEC LSI 11/2 central processing unit, 64K bytes of memory, and a 512K byte floppy disc, and can provide moderately high resolution graphics and tones. A videodisc player was chosen instead of a videotape player because of its ability to access any part of the video material within a few seconds. A mobile enclosure was designed for the equipment so that it could be easily moved to a patient's bedside or to other locations.

The CAI authoring system used was the Videocomputer Courseware Implementation System (VCIS), developed at the University of Utah.[32] This advanced CAI authoring system was used because it can be executed on microprocessors and supports interactive video. VCIS is a user-oriented system in which CAI functions are selected by depressing a single key at each of a series of displays of options arranged in an inverted tree. For example, to display text on the computer, monitor one presses "D" for display, "T" for text, and the page number of the text. A nonprogrammer can easily use VCIS. The vast majority of the CAI material in the present study was entered by a study team member who had no previous computer experience.

VCIS can now be run on the IBM PC class of microcomputers. Only slight modifications would be required to allow the CAI/VIDEO material developed in this study to be presented using IBM PC class equipment.

Development of the CAI/VIDEO materials. The CAI/VIDEO design is based on traditional CAI approaches. A very specific concept is presented (e.g., the fact that the primary difference among the milk subgroups is the amount of fat they contain) and a question regarding the concept is displayed on the computer monitor. If the question is answered correctly, a positive reinforcement page is overlaid on the question page. If the question is answered incorrectly, remediation is supplied in one of various ways. The simplest approach is to display the remediation material as an overlay in similar fashion to the positive reinforcement. Other remediation techniques include narrated (using the videodisc audio tracks) graphics sequences and video motion segments.

At the end of each block of material presentation (e.g., bread exchange list) the patient is asked a practical food selection problem that requires the application of the basic concepts presented in the block. Incorrect answers result in the presentation of video remediation or a "branching back" to repeat the appropriate parts of the instructional block.

To provide for simplest use, all questions are true/false and multiple choice (three possible answers) types. The response keys are covered by red, yellow, and blue caps. The choices are identified in the questions by color.

Eleven instructional modules were developed: introduction to using the CAI/VIDEO system, general nutritional principles, introduction to the Exchange Lists, milk, vegetables, fruits, breads, meats, fats, additional diabetes nutritional ideas, and advanced Exchange Lists concepts. All modules include information about food purchasing, food preparation, and portion control.

All patients (some of whom are elderly and most of whom had never seen a computer) have been able to use the system with essentially no assistance from the study staff.

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