Database and Programming Needs of Research/Health Care Dietitians

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This morning I want to depart from our discussion of databases and consider the front-end program that manipulates the data. I am particularly interested in the programming needs of health care or clinical dietitians in their role of nutrition counselor. This morning I will narrow my focus to the printout that results from nutrient calculations.

The printout is one outcome of computerized nutrient calculation programs often used by nutrition counselors. While a nutrition counselor knows that attitude, not knowledge, is the primary force that drives eating habits, counselors should be sure their clients have adequate knowledge to support making desired changes. The computer can help provide accurate information about dietary intake and is a potentially useful information resource in the counseling process.

The two reasons clinicians might use nutrient intake data in counseling are to identify problems, and to monitor dietary change. Both objectives involve collecting information, sorting and interpreting the information, and giving it back to the client in a more meaningful form.

Information about diet is most meaningful when it represents a whole day or an average day's dietary intake. A variety of software is available to help develop and interpret this type of dietary information. The interpretation may involve food groups or exchanges or a detailed report of nutritive and non-nutritive components. Some programs manipulate over 50 components, and since a typical intake includes at least 10 food items, the computer will generate 500 or more data points for each daily intake. This is more information than clients can easily remember. The client seldom wonders how much zinc or boron is present in each food but rather will ask "How good is my intake?" or, "What is wrong with my diet?"

To evaluate how well computer programs provide information for nutrition counselors and help to answer client's questions I surveyed software developers to obtain a printout for evaluation. I polled producers of the 52 diet analysis programs housed in the National Library of Agriculture in Beltsville, MD asking for printouts that evaluated the nutritionally good and nutritionally poor menus I provided. Table 1 lists the seventeen developers who responded with printouts or a copy of their program (33% of those surveyed).

After receiving program output I was faced with the problem of how to evaluate the results. Some of the best ideas for evaluating printed media come from the newspaper and magazine publishing field where attention is given to appearance and readability and from education where attention is given to setting objectives and guiding the learning process.

Programs should give attention to layout and design, focus attention on important information and avoid a cluttered appearance. Printouts should present selected information, but not too much information. The amount of information can be controlled by setting an educational objective and selecting information to develop that objective.

My request to program developers surveyed was for printouts to support nutrition counseling in general rather than to identify a specific objective. Today's discussion is limited to one set of printouts, whereas the actual software may provide a variety of other options. I will limit my discussion to printouts describing the "good" menu which consisted of:

Breakfast: 1 cup oatmeal
1/2 cup 2% milk
1 slice wheat bread
1 Tbsp jelly
1/2 cup frozen orange juice

Lunch: 2 slices whole wheat bread
1/4 cup tuna salad
1 medium pear
1/2 cup low fat cottage cheese
12 oz can cola

Dinner: 1 chicken breast, broiled
1 medium baked potato
2/3 cup steamed broccoli
2 tsp tub margarine
1 cup iceberg lettuce
1/2 medium tomato, fresh
1 Tbsp French dressing
1 cup skim milk

Snack: 1 fresh apple
8 vanilla wafers

Table 1 - Developers who provided program output

1. CBORD Diet Analyzer, The CBORD Group., 61 Brown Road, Ithaca, NY 14850$995.
2. DAP, Dietary Analysis Program, USDA-HNIS, Belcrest Road, Hyattsville, MD 20782 (sold by NTIS) $60
3. DAS, Dietary Assessment System, Softech Computing Co., 2401 Hirschman Lane, Hartland, WE 53029 $195
4. Dietician, Alsoft, Inc., POBox 927, Spring, TX 77383-0927 MAC $59
5. DINE, DINE Systems, Inc., 586 N. French Road, Ste.2, Amherst, NY 14228 $170 - $345. IBM, MAC
6. Eat for Health, Genesee Intermediate School District, 2413 West Maple Avenue, Flint, MI 48507-3493 $25
7. NDS, University of Minnesota, Nutrition Coordinating Center (NCC), 2221 University Avenue, SE, Ste. 310, Minneapolis, MN 55414 $7,000
8. Nutri-Calc Plus, Camde Corporation, 4435 S. Rural Road, Ste. 331, Tempe, AZ 85282 $225
9. Nutri-Tally, Nutrition Counseling, 221 Seventh St., N. Columbus, MS 39701 $125
10. NAS-2, Nutrient Analysis System 2, DDA Software, PO Box 26, Hamburg, NJ 07419 IBM, MAC $289.95
11. Nutriplanner, Practorcare, 10951 Sorrento Valley Road, San Diego, CA 92121 $800
12. N3 and Rite Byte, Nutritionist III, and Right Byte, N-Squared Computing, 3040 Commercial St., SE, Ste.240, Salem, OR 97302 N3-$495, Right Byte- $595
13. PRUCAL, Dept of Food Science and Human Nutrition, Colorado State University, Fort Collins, OR 80523 $98
14. Professional Dietitian, Wellsource, PO Box 569, 15431 SE 82nd Drive, Ste.D, Clackamas, OR 97015 $495
15. Sante, Hopkins Technology, 421 Hazel Lane, Ste. 300, Hopkins, MN 55343-7117
16. The Good Health and Diet Program, Diet Research, Inc., 3665 Brighton Way, Reno, NV 89509 $60 Negotiable
17. You Are What You Eat, Marshware, PO Box 8082, Shawnee Mission, KS 66208 $41.95

The educational objective of the majority of printouts I received was to depict overall nutritional adequacy. The programs gave information to describe the nutritional value of the menu in a variety of formats. If I had any criticism it is they tried to give too much information on one or two pages. There seem to be two main messages in all the programs, guided by both the Recommended Dietary Allowances (R.D.A.) (1) and Dietary Guidelines (2). The first is avoid deficiency (fulfill the R.D.A.) and then second is avoid excess (follow the Dietary Guidelines). The mistake too often made is to try to make this a single message.

Graphs communicate information in a memorable way. Most programs used graphs to convey information about dietary adequacy and dietary excess. I will show you a few examples to illustrate how computer programs express nutritional adequacy and excess. By far the most attractive result was from Nutrient Analysis System 2 (NAS-2) by DDA Software shown in Figure 1. I'd Like to point out a couple of factors that I think make this a good display. First, the evaluation shows nutrients up to 100% of the R.D.A. and not beyond. Nutrition experts do not recommend exceeding the R.D.A. so depicting more than 100% does not enhance the message on adequacy. If the message is avoid deficiency, then this graph explains clearly how well this diet avoids deficiency. Each bar would extend to the right hand margin if the diet provided 100% of the RDA for all nutrients.

CBORD and NCC take the RDA graph to 200% (Figure 2) On casual observation, this graph seems to say there is too little of some nutrients and too much of others, i.e., it is not 'balanced'. That is the wrong message for this diet. While vitamins C and E exceed the RDA there is no danger to this level of intake but graphing it to 200% dwarfs the other nutrients. As a nutritionist I am not concerned about excesses until they reach several times the RDA. If I wanted to wa a client about excess nutrient intake I would probab want to show intakes of 5 to 25 times the RDA as sometime consumed in supplements, but prefe food graph to show the value of meals m 3 to 100% of the R.D.A.

Returning to the NAS-2 graph, (Figu that what I thought was a well selected m than 1/2 the R.D.A. for zinc. Follo nutritional dogma I chose tuna fish fo chicken for dinner -- no red meat. Therefo contained only 1/2 the RDA for zinc. It is for dietaries to be below the R.D.A. for zinc, in fact it is quite common. I lecture to dental students and review their computer assignment of evaluating a colleague's diet using the USDA's Dietary Analysis Program. They are almost always zinc deficient by their computer analysis, and it is not because the data base is sparse.

We know the RDA's tend to err on the high side. The 1990 RDA's reduced the folacin allowance by half, and suddenly we are no longer a nation deficient in folacin. Although some of my colleagues disagree, I believe the RDA is too high for zinc and will eventually be reduced when we have sufficient data to make a reduction. If I used dietary analysis routinely in practice for the purpose of evaluating nutrient adequacy I personally would want to remove the zinc comparison for my clients when I think showing this so-called deficiency would be a disservice. Therefore I would want to create customized bar graphs for my use.

For example, in an intervention study involving children we use diet calculations to track cholesterol intake. Figure 3 shows a graph we routinely create on "Cricket Graph" to illustrate this one point. I would like to have more options in nutrient analysis programs to create customized printouts which use graphs such as this. A realistic educational objective for a client may involve only one piece of information. Comprehensive bar charts are too complex for some counseling sessions.

The third dietary guideline reads "Choose a diet low in fat, saturated fat, and cholesterol" which is defined as 30% or less of calories from fat and less that 10% from saturated fat. It is difficult to translate this into a useable guideline for clients. It is like trying to hit a moving target. If you have a meal with 45% of calories from fat and you add 3 slices of bread, the percent (since it is part of the whole) could drop to 20% for a small meal or to 40% for a large meal.

Programers typically illustrate this guideline with a pie chart. Two years ago Chor San Khoo, speaking about food labels, said "No one understands pie charts", and I tend to agree (3). At least I am not skillful at making sense out of pie charts as they relate to dietary macronutrients. The best use I have seen for pie charts illustrating nutritional concepts was on the back of a Healthy Choice Frozen meal. Figure 4 illustrates three values from a frozen meal label, 2% of calories from saturated fat, 17% of the maximum 300 mg cholesterol, and 11% of the maximum 2400 mg sodium. Notice that these pie charts are limited to one value. Pie charts depicting percent of carbohydrate, protein, and fat and sometimes alcohol try to give too much information. I find it hard to attend to differences in four factors in these 2 pie charts from the NAS-2 program shown in Figure 5. Usually the important piece of information that can be clearly depicted is the percent of calories from fat and since that is the only percent expressed in the seven dietary guidelines, a customized bar chart showing percent of calories from fat would be meaningful and memorable.

Figure 6 is a graph from the Rite Byte program which illustrates another problem with nutrient calculation programs. Note that zinc is deficient, and so is saturated fat. Mixing RDA and dietary goals introduces a mixed message. I doubt that any dietitian would suggest a client should increase saturated fat to reach the recommended 10% of calories or to increase fat intake that is greater than 20% up to the recommended 30% of calories, but putting them on the same chart suggests to me that 100% is the goal and ideally all components should be increased to meet the 100% goal. In fairness to Rite Byte notice that "+" before some components indicate they are dietary goals and not RDA's, but combining goals and R.D.A. in this way requires attention to each separate detail rather than providing the opportunity to make a global assessment based on how complete the graph appears.

Some programs go beyond the RDA and dietary guidelines. DINE has taken on the difficult task of interpreting data that is not always best when it is 100% by using heavy lines to indicate the recommended range for a whole host of factors. The DINE graph in Figure 7 shows the macronutrients, and the division between animal and vegetable protein. The first bar is for protein showing 19% of calories is from protein.

Table 2. Polyunsaturated fatty acid (PUFA) content of 7 food items from two nutrient calculation programs.

	PUFA, g	
	NDS	DAS
Oatmeal	0.87	-
WW Bread	0.32	-
Jelly	0.01	-
WW bread	0.65	-
Tuna salad	3.65	-
Cola	0.07	-
Vanilla wafers	0.77	-
Total	6.33	0

The recommended percentage is 10-15% shown by the dark line. Total fat is 22% shown with up to 30% recommended as illustrated by the dark bar extending to the 30% mark. Saturated, monounsaturated and polyunsaturated fatty acids are each less than the recommended 10% as illustrated by heavy lines. The diet also falls short of the recommended 50% of carbohydrate as complex carbohydrate, and plant protein falls far short of the recommended 50%. This is a complex message presented graphically. There are many ways to depict data and the graphs displayed here each tell the nutrition story in a unique way.

Nutri-tally has a different way to graph data uing a circle with 3 sections where the inner circle represents 100% of RDA. Figure 8 from Nutri-tally pictures all the information in one graph. While it depicts a lot of information in one place it has the problem of accentuating excesses and the format is not as familiar as either the bar or pie charts, so for me it requires more study to fully understand the message.

Before leaving the topic of printouts I feel obligated to at least mention the data. I said I would not talk about databases, but you really cannot separate the report from the data. Missing values is a common problem among several programs. For example the PUFA in the DAS printout was 10 g rather than as much as 16 g in calculations from other programs. DAS provides no PUFA values for the 7 food items listed in Table 2 whereas NDS's more complete data base listed values for each. Total PUFA would have been at least 1 1/2 times greater in the DAS calculation if all foods actually containing PUFA had complete fatty acid information.

Even with a complete database, providing accurate nutrient information is a challenge for the clinical dietitian. I provided to software developers what I thought was a reasonably detailed day's menu composed of common foods about which data is available, but the resulting nutritional data still showed inconsistencies.

Some inconsistencies occur when conflicting decisions are made by coders. For example, coders differed on what they assumed a serving of chicken breast was. I provided only as much information as I thought would be available from a client, and since my clients who eat chicken usually describe white meat as a chicken breast, even though 1/2 breast is the most common cut in the market and cafeteria. Most coders did assume a chicken breast serving is 1/2 breast, but two coders assumed a chicken breast serving was the whole breast. This type of discrepancy could be attributed to untrained coders or poor documentation. Figure 10 depicts the discrepancies in caloric value for the sample menu made by several programs with the two higher values resulting from choosing a whole rather than a half chicken breast.

This points out the importance of training coders and standardizing procedures and terminology. Inadequate training is a problem as is the proliferation of sparse data bases. Last year I issued a plea for programs to suppress summations of nutrient columns containing vacant data cells - where no data is available for a nutrient thought to be present in a food, to try to prevent use of incomplete data (4). As a result of this year's project I received a new program from Hopkins Technology called Sante which thrilled me by offering a choice of suppressing totals from columns with missing values. It was refreshing to see a program actually announce that the database was sparse, and to offer a way to deal with the sparseness. Here, I thought, was a reasonable solution, I could still have incomplete totals, but since I have to ask for them I should at least be aware of their weakness. I was mildly disappointed that this held true only for totals displays, and summations of incomplete values were still displayed when a line-by-line data table was generated. At least with the line-by-line printout I can see that some values are missing, but too many users do not consider this deficiency and even when programs alert users to incomplete data many users are not discouraged from reporting the results.

Summary: There is a rich resource of commercial computational programs that manipulate nutrient data available for purchase. The primary educational objective inherent in those I reviewed is overall nutritional adequacy. Assessment of macronutrient percentages is commonly used to evaluate fat intake and comparison of nutrient totals to the RDA are the most prominent educational goals.

We need better ways to individualize programs for unique counseling needs. This is possible to some degree with most of the programs reviewed. N-3, Practorcare, NDS and many others allow selecting of nutrients to be printed so that the nutrition counselor can present only calories and fat grams if that is the educational goal. Displaying selected values in graphic form would help clinical dietitians individualize instruction.

References

1. Recommended Dietary Allowances, 10th Edition, Washington, DC: National Academy Press, 1989.

2. Nutrition and Your Health: Dietary Guidelines for Americans, Third Edition, 1990, US Department of

Agriculture, US Department of Health and Human Services, Washington, DC: Government Printing Office.

3. Khoo, Chor San, Industry perspectives on food labeling, Proceedings of the Fourteenth National Nutrient Databank Conference, Ithaca, NY: CBORD, 1989.

4. Stumbo, Phyllis J. Nutrient Calculation Systems for Educators and Clinicians II. Evaluating Data Bases for Microcomputer Programs, Proceedings of the Fifteenth National Nutrient Databank Conference, Ithaca, NY: CBORD, 1991

Figure 1. Graphic display from NAS2 (#10) showing percent of RDA provided by sample menu.

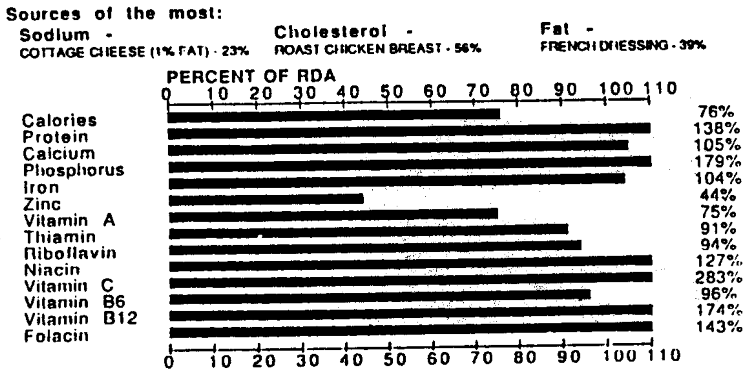

Figure 2. Graphic display from CBORD (#1) showing percent of RDA provided by sample menu.

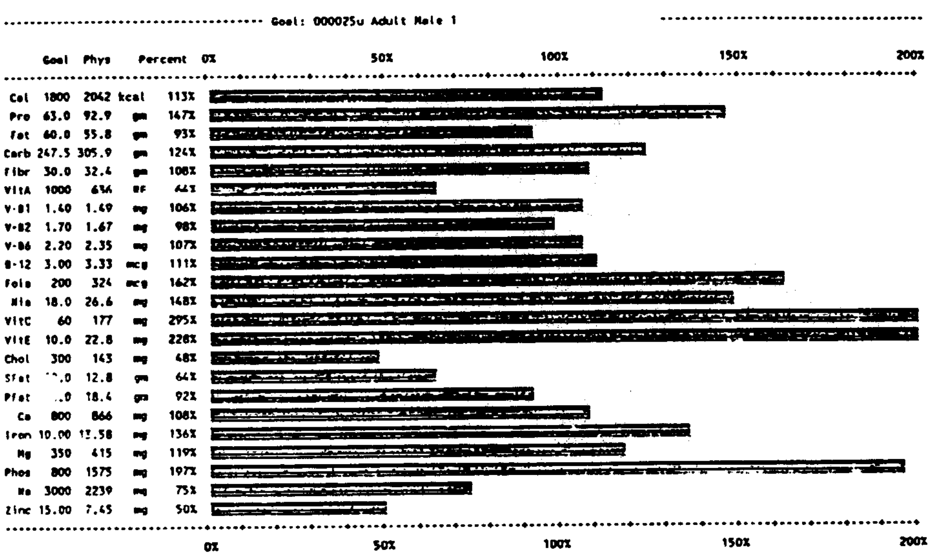

Figure 3. Cholesterol intake recorded at 3 month intervals compared to the study goal for cholesterol intake.

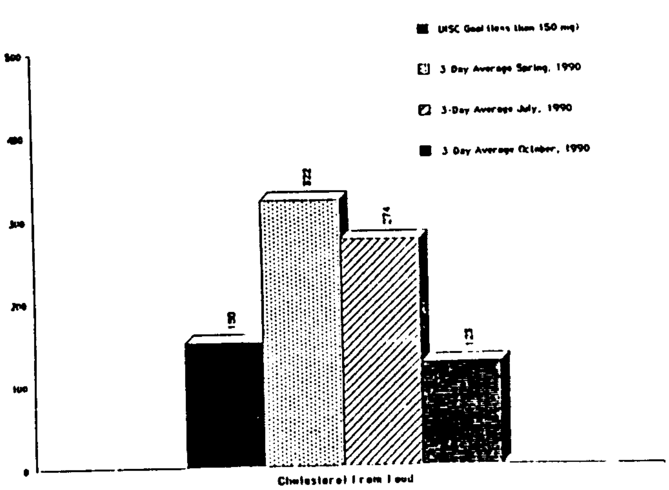

Figure 4. - Pie Charts from Frozen Dinner Label

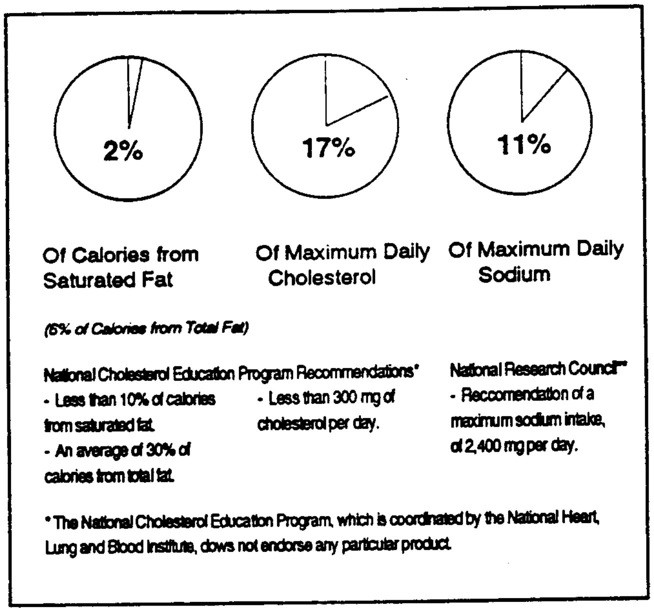

Figure 5. Pie charts showing calorie distribution of sample menu from NAS2 (#10)

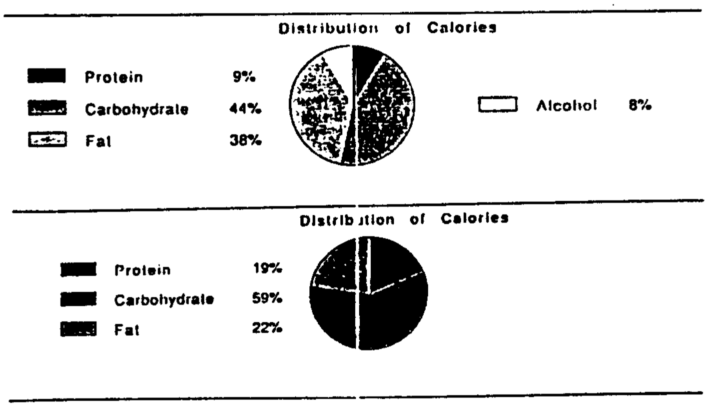

Figure 6. Graphic display from Rite Byte (#12) showing percent of RDA and other nutrient goals provided by sample menu.

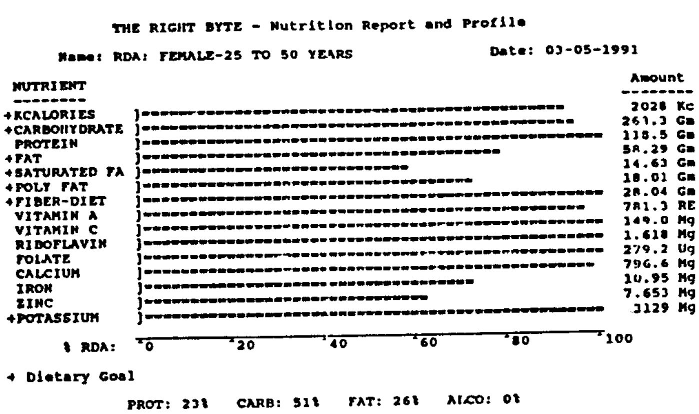

Figure 7. Graphic display from DINE (#5) describing macronutrient composition of sample menu.

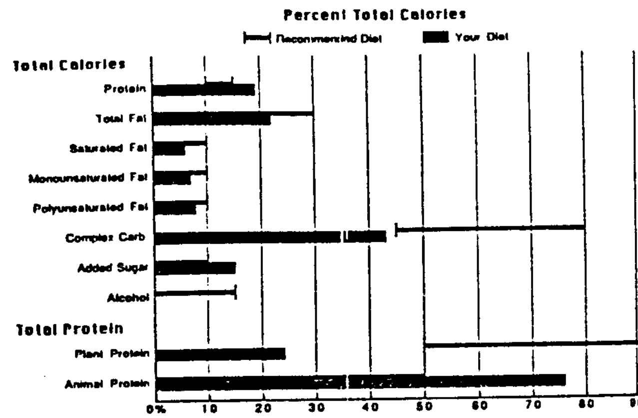

Figure 8. Graphic display from Nutri-tally (#9) showing percent of RDA and other nutrient goals provided by sample diet.

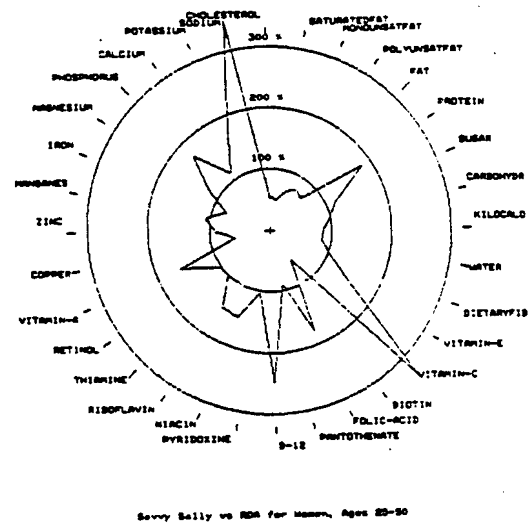

Figure 9. Protein and calories from chicken breast serving.