a prolonged period with little variation in $HbA_1$ levels, so that the correlation between $HbA_1$ and FPG is relatively poor (Fig. 2 *top*).

The excellent agreement between FPG and $HbA_1$ in NIDDM patients suggests that FPG offers a reliable, simple, and adequate measure of glycemic control and leads us to question the need for routine testing of $HbA_1$ in such patients. Even in the unstructured setting of diabetic outpatients, the fasting blood sample has the advantage of some standardization, and fasting from the night before the test is no problem in outpatients. Theoretically, FPG measurements could indicate spuriously good control if patients dieted before a clinic visit. However, the excellent correlations we obtained over a wide range of glycemia suggest that such attempted deception is relatively rare.

At a time of increasing concern about the cost of health-care provision, it behooves physicians to exercise the greatest efficiency possible in clinical investigation and management. We do not suggest that measurement of $HbA_1$ should be abandoned in NIDDM patients, but we believe its use could be rationed, perhaps to no more than one measurement per year in most patients, without compromising clinical care.

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# Computer-Generated Formats for SMBG Data

Advances in microcomputer software are beginning to provide physicians with a sophisticated capacity for manipulating patients' self-monitored blood glucose (SMBG) data to interpret metabolic control (1). In anticipation of greater use of this technology, it is important to determine whether the manipulation of SMBG data by computer affects physicians' therapeutic decision making. One basic question is whether specific visual formats and/or degrees of data reduction enhance or inhibit recognition of different patterns of metabolic control.

We evaluated the ability of physicians to identify and respond to glucose patterns for simulated diabetes cases in which display format and degree of SMBG data reduction were manipulated independently. Two cases were created to portray distinct patterns of control for adolescents with insulin-dependent diabetes mellitus (IDDM), i.e., a stable pattern of late-morning hypoglycemia secondary to overinsulinization and a pattern consistent with the Somogyi phenomenon. In this fashion, we compared decisions based on traditional SMBG logs (i.e., unreduced-tabular format) with those based on computer-generated portrayals of the same data.

The 44 subjects were pediatric residents ($n$ = 15 1st-yr, 14 2nd-yr, and 11 3rd-yr postgraduates) and subspecialty fellows ($n$ = 4) from the Indiana University Medical Center. Their training includes experience in managing patients with IDDM. SMBG data for 4 wk from actual patients were transformed into four anonymous case summaries representing the independent manipulation of two variables, i.e., whether the format was tabular or graphic and whether the data were unreduced or reduced (Fig. 1). Each physician was assigned randomly to one of the four SMBG formats. Subjects then read both case summaries and answered a series of open-ended questions concerning the diagnosis of the metabolic control pattern and therapeutic changes they would make using the available SMBG data. Responses were judged for correctness by one of the investigators (M.P.G.) who was blind to subjects' experimental conditions. Fisher's exact test was used to analyze the frequency of correct response as a function of format and degree of data reduction.

Half of the 44 subjects in all conditions identified and responded appropriately to the pattern of morning hypoglycemia. Sixty-four percent of residents using the two tabular formats responded correctly, compared to 36% of those using the line or bar graphs (14 of 22 vs. 8 of 22 correct; $P$ = .13). The relative advantage of the tabular format was most pronounced when data were reduced. Eight of 11 residents using statistical tables responded to the problem appropriately, compared to 3 of 10 using bar graphs ($P$ = .09).

The Somogyi phenomenon proved a much more difficult problem to identify, with only 10 (23%) of 44 subjects responding appropriately. Thirty-eight percent of residents using data-reduced SMBG formats responded correctly, compared to 10% of subjects assigned unreduced data (8 of 23 vs. 2 of 21, $P$ = .07). This trend toward a main effect favoring data reduction is strongest when contrasting the two tabular formats. Five of 12 subjects who interpreted the statistical tables made correct responses. None of the 10 subjects given

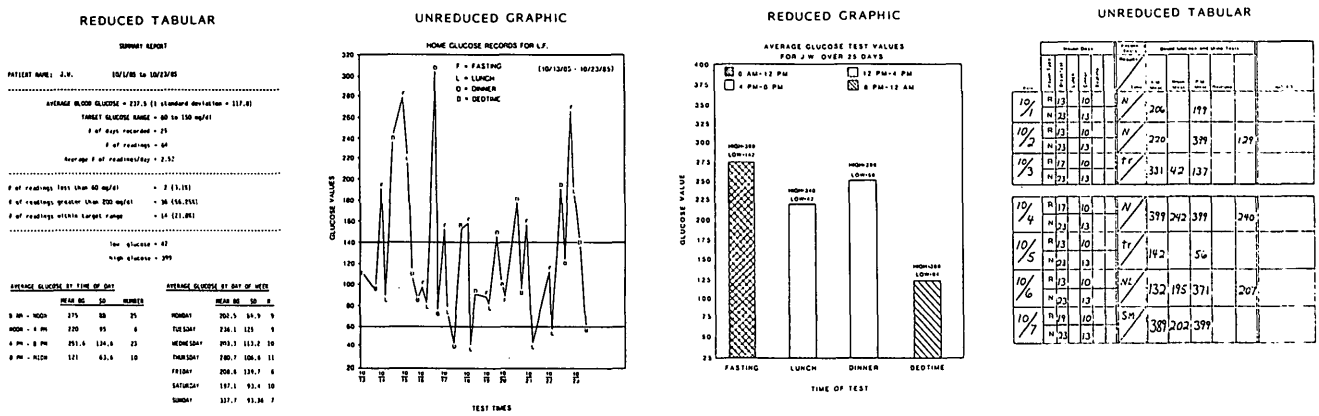


**FIG. 1. Examples of SMBG data formats.**

traditional logs identified the Somogyi phenomenon ($P = .04$).

The size of our pediatric resident cohort severely limited our power to detect statistically significant main effects. These data indicate that tabular format and data reduction are two characteristics of computerized SMBG displays that facilitate the identification of patterns of metabolic control. Tabular formats (compared with graphs) were associated with a 75% increase in correct interpretation of a stable pattern of hypoglycemia due to overinsulinization. Correct identification of the Somogyi phenomenon was 3–4 times more likely among physicians using data-reduced formats compared with unreduced data. Moreover, in both cases, combining data reduction and tabular format (i.e., statistical tables) increased respondents' likelihood of making correct decisions.

Because subjects in this study were residents, caution should be taken in generalizing these results. Perhaps the advantages of tabular format and data reduction would be diminished with more experienced users. These results clearly show that computer-manipulated SMBG data do not eliminate deficits in clinical knowledge. Thus, we have two suggestions for the future development of computerized SMBG systems. First, as knowledge of the pattern-specific utility of display format increases, microcomputers can be employed as teaching tools. Computer-assisted instruction is well suited for teaching situations that require a sensitive, swift, and tireless taskmaster. Programmed tutorial lessons in numeric or visual pattern recognition could help potential users develop their diagnostic expertise as it relates to this new technology. Second, the sheer analytic power of microcomputers is underutilized by current SMBG systems. The statistical tabling of data seems to improve the decision making of users. But why stop with percentages, means, and standard deviations? Further statistical analysis could evaluate the goodness of fit of a patient's data with respect to standard patterns for euglycemia, Somogyi, and other common deviations from normal. Output could be in the form of a probability estimate, indicating the likelihood of being correct if a given diagnosis were attached to the SMBG data in question. We do not envision these data replacing human judgment; rather, they would offer welcome empirical corroboration for decisions that physicians must constantly make.

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# Is Difference of Arterial and Venous Oxygen Content a Possible Marker for Diabetic Foot?

In Japan, the incidence of diabetic gangrene seems to be increasing (1,2). Since 1978, 606 diabetic patients have been admitted to our clinic—29 with gangrene—but little is known about the pathogenesis of gangrene and there are few useful methods for screening. To investigate the disturbance of tissue-oxygen utilization in diabetic gangrene, difference of arterial and venous ox-