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# Diabetes control in a primary care setting: a retrospective study of 651 patients

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**BACKGROUND AND OBJECTIVES:** As part of an ongoing evaluation of the process of care, the management of type 2 diabetes in primary healthcare settings was studied in a series of audits with the objective of improving diabetes care in a primary care center of the Saudi National Guard Health Affairs, Riyadh, Saudi Arabia.

**METHODS:** A sample of 30 files was randomly selected every 2 weeks from a sampling frame of medical records of type 2 diabetes patients seen over the previous two weeks. The criterion of good management was arbitrarily defined as a glycated hemoglobin ($HbA_{1c}$) less than 7%, with a test frequency of once every 3 months. The proportion of patients not conforming to the criterion was reported back to the care providers. Specially trained nurses did all randomization, data extraction, and entry.

**RESULTS:** Data were extracted form 651 medical records, including 355 (54.5%) for females and 296 (45.5%) for males. Both the mean and median age of those studied was 53 years. Mean $HbA_{1c}$ was 9.0±2.0%, mean fasting plasma glucose was 9.9±3.9 mmol/L, and mean 2-hour postprandial plasma glucose was 15.0±5.3 mmol/L. In 20.6% (134/651) (95% CI, 17.5%-23.9%) of patients the $HbA_{1c}$ level was less than 7%. Only 10.4% (68/651) (95% CI, 8.2%-13.0%) had $HbA_{1c}$ measured in the previous 3 months that was less than 7.0% and thus met the criterion for good management. In the previous 3 months, 55.4% (95% CI, 51.5%-59.3%) had been tested for $HbA_{1c}$.

**CONCLUSIONS:** Management of diabetes at the primary care level leaves much to be desired. There is a need for an ongoing process of evaluation to follow up the implementation of care guidelines.

Diabetes and coronary heart disease have emerged as major contributors to the global burden of disease over the latter half of the last century, a trend that is projected to continue.[1,2] The high prevalence of these disorders has been reported across the varied sociocultural environments, with Saudi Arabia being no exception.[3-5] While the Diabetes Prevention Program[6] and the Finnish Diabetes Prevention Study[7] demonstrated the effectiveness of primary prevention of diabetes, the importance of strict control of plasma glucose levels in decreasing complications both in type 1 and type 2 diabetes was highlighted by the Diabetes Control and Complications Trial[8] and the UK Prospective Diabetes Study.[9] These landmark studies highlighted the fact that we need to focus on both the primary and secondary levels of prevention for diabetes. Primary care is in a unique position to offer both levels of prevention. Care providers at this level have a pivotal role to play in this respect.[10,11] Glycemic control in type 2 diabetic patients managed in primary care is poor,[12,13] with treatment approaches not being intensive enough for a large proportion of patients,[14] and being inappropriate for achieving the targets of care.[15] Realization of these facts is reflected in the National Guard Health Affairs' impetus on primary care services, managed by the Department of Family and Community Medicine. All Saudi National Guard employees and their families have access to primary care, a system that is a very well integrated with the secondary and tertiary levels of care. The department not only provides care guidelines, but also ensures an ongoing provision of opportunities for personal and professional development for the care providers. It was against this background that, at the beginning of 2003, colleagues in primary healthcare started reviewing the process of care. The consensus was that a practice without an ongoing evaluation of reality was like driving blindfolded on a busy road. A series of audits in diabetes care clinics was planned with ongoing

reports of the results to care providers. This paper reports the status of diabetes management that we found during that series of audits.

## METHODS

Twenty-three general physicians provide care to more than 30 000 individuals in the Diabetes Care Clinic, King Saud City Family and Community Medicine Center, National Guard Health Affairs, Riyadh, Saudi Arabia, including more than 1200 persons with diabetes. After initial treatment at the King Abdul Aziz Medical City Endocrinology Department, the patients are later followed up at different primary care centers. Diabetes, hypertension, dyslipidemia and asthma are all managed in special clinics for each disorder that are managed by general physicians with a special interest and experience. The objective of these audits was to ascertain the implementation of a given set of guidelines by all those involved in the process of care. This was to be achieved through a regular reporting of audit results to the clinicians.

Data were collected during fortnightly audits over a period of 12 months from March 2003 to February 2004. Two additional audits were done in September 2004. The criterion of good management was arbitrarily based on both diabetes control according to glycated hemoglobin ($HbA_{1c}$) results and the frequency of $HbA_{1c}$ testing. An $HbA_{1c}$ level of less than 7% was considered to be an indicator of ideal/optimal control, which is part of the 2003 recommendations by both American and Canadian Diabetes Associations.[16,17] A patient who was tested for $HbA_{1c}$ within the previous 3 months from the date of audit with an $HbA_{1c}$ result of less than 7.0% was considered to be appropriately managed. Control was further classified according to Canadian Diabetes Association Classification, as suboptimal if $HbA_{1c}$ was from 7% to 8.4%, and inadequate if $HbA_{1c}$ was above 8.4%. High performance liquid chromatography was used for $HbA_{1c}$ analysis, the method used in both the Diabetes Control and Complications Trial and the United Kingdom Prospective Diabetes Study.[18] From a sampling frame of medical record numbers of all type 2 diabetes patients seen in the clinic during the previous two weeks, a simple random sample of 30 medical records was chosen, the list of random numbers having been generated using a computer program. Specially trained nurses then extracted information from the selected records, filled the forms and entered data in an EpiData[19] database. The decisions regarding appropriateness of care was automatically generated as programmed into the database. Analysis was carried out using Epi-Info 6.04[20] and Stata 8.2.[21]

In this paper, we report proportions as percentages. For measures of location and spread we report mean and standard deviation for symmetrically distributed numerical variables while median and median absolute deviation for the time intervals for different tests, the distributions of which are right skewed. Confidence intervals for binary variables are exact binomial confidence intervals. We have used t tests for comparing numerical variables and z tests for binary categorical variables. Pearson's coefficient is reported for correlations between numerical variables. Nonparametric median one-way analysis, the sign test, the Kruskal-Wallis test, equality-of-medians, and sign rank tests were used to compare medians.

## RESULTS

At the end of the audit series, complete information for 651 patients was available, including 355 (54.5%) females and 296 (45.5%) males. Mean and standard deviation for age was 53.2±11.7 years, with females significantly older than males ($P \leq .001$). The mean and standard deviation for $HbA_{1c}$ was 9.0±2.0% (range, 4.8% to 15.9%). The mean and standard deviation for fasting plasma glucose (FPG) was 9.9±3.9 mmol/L (range, 2.9 to 28 mmol/L). Mean and standard deviation for 2-hour postprandial plasma glucose (2-hour PPG) was 15.0±5.3 mmol/L (range, 4.2 to 31.9 mmol/L). In the previous 3 months, 55.4% (95% confidence interval [CI], 51.5%-59.3%) had been tested for $HbA_{1c}$, 64% for FBS ($P \leq .001$) and 61% for 2-hour PPG ($P=.04$) (Table 1). Thirty-one percent (95% CI, 27.8%-35.0%) were tested for $HbA_{1c}$ during the previous month compared to 46.5% for FBS ($P \leq .001$) and 42.1% for the 2-hour PPG test ($P \leq .001$). The difference in $HbA_{1c}$ levels for those tested less frequently and those tested within the previous 3 months ($P=.97$) or previous one month ($P=.08$) was not significant.

Irrespective of the frequency of tests, 20.6% of patients achieved the therapeutic goal for $HbA_{1c}$ (95% CI, 17.5%-23.9%) while 25.0% (95% CI, 21.9%-28.7%) achieved the goal for FPG and 16.0% (95% CI, 13.4%-19.2%) for 2-hour PPG. Only 6.9% of those studied achieved therapeutic goals on all the three tests while 13.7% achieved $HbA_{1c}$ and FPG goals. More than 54% (95% CI, 50.8%-58.6%) had $HbA_{1c}$ levels above 8.4% (Table 2). Differences in $HbA_{1c}$ and FPG levels between the sexes were not significant ($P=.7$ and .1, respectively), while 2-hour PPG was found to be higher among males, with borderline significance ($P=.04$). Time since last $HbA_{1c}$, FPG, and 2-hour PPG tests did not differ between the sexes ($P=.9$, .7 and .8 respectively). Correlations between age and $HbA_{1c}$, age and FPG,

**Table 1.** Time since last test for 651 patients.

| Months since last test | $HbA_{1c}$ | | FPG | | 2-hour PPG | |
|---|---|---|---|---|---|---|
| | n (%) | 95% CI (%) | n (%) | 95% CI (%) | n (%) | 95% CI (%) |
| <1 month | 204 (31.3) | 27.8-35.0 | 303 (46.5) | 42.6-50.5 | 274 (42.1) | 38.3-46.0 |
| 1-2.9 months | 157 (24.1) | 20.9-27.6 | 117 (18.0) | 15.1-21.1 | 123 (18.9) | 16.0-22.1 |
| 3-5.9 months | 134 (20.6) | 17.5-23.9 | 65 (10.0) | 7.8-2.5 | 77 (11.8) | 9.4-14.6 |
| 6-8.9 months | 47 (7.2) | 5.4-9.5 | 31 (4.8) | 3.2-6.7 | 36 (5.5) | 3.9-7.6 |
| 9-11.9 months | 98 (15.0) | 12.1-18.0 | 133 (20.4) | 17.4-23.7 | 129 (19.8) | 16.8-23.1 |
| 12-17.9 months | 11 (1.69) | 0.8-3.0 | 2 (0.3) | 0-1.1 | 8 (1.2) | 0.5-2.4 |

CI: Confidence interval

**Table 2.** Distribution of $HbA_{1c}$, fasting plasma glucose, and 2-hour postprandial plasma glucose levels in 651 type 2 diabetes patients.

| $HbA_{1c}$ | n (%) | 95% CI (%) | Mean fasting plasma glucose (mmol/L) | Mean 2-hour postprandial plasma glucose (mmol/L) |
|---|---|---|---|---|
| <6% | 32 (4.9) | 3.4-6.9 | 6.2 | 9.0 |
| 6%-6.9% | 102 (15.7) | 13.0-18.7 | 6.9 | 10.9 |
| 7%-8.4% | 161 (24.7) | 21.5-28.2 | 8.3 | 13.3 |
| >8.4% | 356 (54.7) | 50.8-58.6 | 11.8 | 17.4 |

$HbA_{1c}$: Glycated hemoglobin

and age and 2-hour PPG were not significant (r=−0.03, −0.05 and 0.004; *P*=.4, .2 and .9 respectively).

$HbA_{1c}$ was the least frequent test among the three common tests, with a difference between the median interval since the last test for $HbA_{1c}$ (median, 2.5 months; median absolute deviation, 2.9 months) significantly longer than that for both FPG (median, 1.2 months; median absolute deviation, 1.4 months) (median one-way analysis, *P*=.001), and 2-hour PPG (median, 1.6 months; median absolute deviation, 1.9 months), (median one-way analysis, P≤.005). Differences between median time since the last test at the time of audit for the 2-hour PPG and FPG tests were also significant (*P*≤.001), with FPG being the most frequently done test. Overall, based on the criterion of good management, only 10.4% (95% CI, 8.2%-13.0%) of those studied were well managed while 89.6% (95% CI, 86.9%-91.8%) were not.

## DISCUSSION

The conclusions of this report are based on the $HbA_{1c}$ level, an arbitrary but empirically pragmatic criterion for appropriate management of diabetes that is only one part of the control standards adapted by American and Canadian Diabetes Associations. In the absence of a full complement of control status parameters like the presence of complications, hypoglycemic episodes, lipid profile and others, the results do have limitations for making inferences about diabetes control. Despite these limitations, we feel it important to report our findings because they reflect the reality of diabetes management in primary care. For generating a dialogue aimed at finding appropriate leverage for change, it is worth emphasizing that this state of management was found against a backdrop of an ongoing drive for significant resource allocation to primary care by the parent organization and at a time when continuing education activities are consistently maintained at a very good level. In view of the fact that training for the care providers is effective in improving diabetes care[22-25], one would have expected outcomes like those reported in 2002 to 2003, with about 37% of patients achieving the therapeutic goals.[26] Our finding of only 20.6% of patients achieving this level is a cause for concern, especially at a time when we are in need of a care process able to handle the pandemic we are facing. As most persons with diabetes, other than the acutely ill, are managed at primary care facilities,[10] the process of management at this level becomes much more relevant and significant in reducing the overall burden on healthcare systems.

If visit or test frequency is taken to indicate patient compliance, then $HbA_{1c}$ levels having no association with the frequency of testing ($P$=.97) may be interpreted as an indicator of lack of benefit from the current state of care for even the well motivated patients. This raises serious concerns regarding the way primary care is managing diabetes. Does the finding that more than 79% of patients failed to achieve therapeutic targets point to some degree of clinical inertia? This question needs to be answered by properly designed studies in order to address important clinical care issues in this regard. Studies are also needed to evaluate care process for other chronic diseases.

We strongly feel that our findings are suggestive of the ineffectiveness of resource allocation or traditional continuing education methods alone as means to improve clinical care for diabetes at the primary care level. Perhaps the very fiber of primary care functionality needs to be looked into and altered to reflect and adjust our response to changing realities. Consistent, scientific, ongoing processes of evaluation of clinical care need to be incorporated into process design, involving all care providers.

Physicians in the primary care setting have to cater for all sorts of acute and chronic disorders other than diabetes and in view of the required expertise and with the time constraints due to high work volume,[27] opportunities for personal and professional growth may not prove as effective as expected. Consistent feedback regarding practice processes and outcomes in different areas will provide the necessary stimulus to initiate collaborative learning, practice behavior modification, and improvement process. Such feedback has been shown to improve diabetes control,[28,29] leading to improved provider behavior and better clinical outcomes.[30]

In an ideal world each uncontrolled patient would be studied individually to gain insights into his/her particular lifestyle and situations, aimed at finding individualized solutions that work. In view of the often non-ideal nature of reality, a simple behavior modification approach might be to develop initiatives aimed at providing realistic insights into the nature of care being provided. The necessity of such an approach should be felt with some urgency at different levels of decision making. Such a process would be most effective if managed locally by the care providers, with a centralized provision of practice guidelines.[31] Unfortunately, training in the required skills, although simple, is not available for most care providers either during their academic carriers or their work experience.[32]

Training and hands-on experience in audit techniques regarding processes and outcomes will certainly have an impact in the long run. We have shown that all the necessary skills for any such initiative, like data management, randomization, data analyses, and other aspects of audits, can easily be provided to the different strata of the workforce on an ongoing basis within the locally available resources. Such locally managed, ongoing evaluation of processes and outcomes has been likened by colleagues in our practice to keeping your eye on the road while driving, a basic pre-requisite for survival.

Diabetes control at primary care level is poor in spite of significant resource allocation. Studies to look into the causes of this phenomenon and to find effective and efficient solutions should rank high on the priority list for all decision makers in healthcare services generally and to those involved in diabetes care especially.

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