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PROPAT: A study to improve the quality and reduce the cost of diabetes care

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Abstract

Objective: In PROPAT we implemented an integrated approach to diabetes care designed to improve the quality and reduce the cost of care.
Study design and methods: PROPAT was a case-control study matching patients by age and gender (diabetes:control ratio 1:2) within IOMA, a public employment-based health maintenance organization (HMO) of the Province of Buenos Aires, Argentina. Costs were evaluated using prevalence data from an HMO perspective. We currently report clinical and biochemical data and costs from the first 297 patients enrolled who completed 1 year in PROPAT, and compare them with those derived from control patients.
Results: All recommended practices recorded as care provided at baseline increased significantly 1 year after implementing PROPAT, with a parallel significant improvement in several clinical and biochemical parameters, and markedly lower total annual *per capita* costs.
Conclusions: These results demonstrate that the implementation of a comprehensive diabetes care program can simultaneously improve quality while reducing costs.

Keywords: Secondary prevention; Diabetes; Direct costs; Prevention program

1. Introduction

Diabetes mellitus is a common, costly and ever-increasing health problem with chronic complications, that results in a heavy socioeconomic burden [1,2].

Diabetes prevalence in Argentina is around 7% within the age range 20–74 years [3]. Approximately 50% of people with diabetes are undiagnosed receiving neither check-ups nor treatment, 68% of diabetes is diagnosed incidentally, often during the presentation of a chronic complication, and 20–30% of diagnosed patients are untreated [4]. Consequently, about two-thirds of the diabetes population is at risk of developing – or already have – chronic complications.

Chronic complications can be significantly reduced by appropriate control of blood glucose and associated cardiovascular risk factors (CVRF) [5,6]. The effectiveness of prevention strategies partly depends on the quality of medical care provided, which is frequently far from optimal. In the US, less than 2% of adults with diabetes receive optimal care as defined by the

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American Diabetes Association (ADA) [7,8]. Similar data have been reported for Latin America [9].

Herein we describe results from a comprehensive and integrated program to improve clinical, biochemical, and economic outcomes of people with diabetes – Program for the Prevention, Care and Treatment of People with Diabetes (PROPAT) – implemented by the social security system of the Province of Buenos Aires through the Instituto de Obra Médico Asistencial (IOMA). The program addresses diabetes care at the primary care setting, bringing together the healthcare team and patients as central and empowered participants. It is based on a more rational use of resources and the implementation of prevention strategies, using education of both providers and patients as a key tool. To test the evolution of PROPAT implementation, we have currently analyzed clinical and biochemical outcomes, as well as their costs, in the first group of patients who completed 1 year in the Program.

2. Research design and methods

2.1. The Program and the Institution

IOMA is a public employment-based health insurance organization of the Province of Buenos Aires, Argentina, with about 1.5 million affiliates. Patient care is provided in a decentralized system with free selection of physicians. IOMA covers doctors' visits, laboratory and clinical tests, drugs, equipment and supplies for insulin treatment and self-monitoring of blood- and urine-glucose and hospitalizations.

IOMA implemented PROPAT in four urban cities with different population size (large, medium and small) and medical care complexity (low, medium and high) of the Province of Buenos Aires (Mar del Plata, Balcarce, Tandil and Trenque Lauquen). A city with similar demographic, medical care complexity and socioeconomic characteristics was used as control of each intervention city to compare diabetes ''direct'' costs in the program.

PROPAT is based on the guidelines established by WHO/IDF Experts Committee for National Diabetes Programs [10], being the first program of this type implemented in Argentina. PROPAT is jointly sponsored by PAHO/WHO, IDF and the Argentine Diabetes Society [11].

An enhanced data management system facilitated communication and practice-initiated follow-up.

The long-term goals of PROPAT are to improve CVRF and, thereby, decrease diabetes-related cardiovascular events. The short-term goals include decreasing the rate of acute complications requiring hospitalization and the frequency and length of hospitalizations due to chronic complications by rationalizing the frequency of doctors' visits, laboratory testing and prescriptions, improving clinical and metabolic self-control, and increasing the knowledge and skills of patients.

The Program's procedures include a care plan with scheduled annual visits to a nutritionist, cardiologist, ophthalmologist and diabetologist; coverage of laboratory tests for metabolic control and early diagnosis of complications; free provision of drugs and supplies for treatment and self-monitoring; provision of a check-book for annual medical check-ups, laboratory tests and drug prescription. It incorporates education as integral to diabetes care, an accreditation system for diabetes educators, the regular provision of education material to healthcare providers and patients, and continuous multiple information sources for monitoring of quality of care (clinical, biochemical, and economic indicators).

2.2. The protocol

The stages of the Program were as follows: (0) Situational analysis (already reported) [12]; (1) Data reports in scientific journals [11] and mass media; (2) Patient and provider enrollment; (3) Information and training of doctors [13], nutritionists, and the administrative personnel from IOMA; (4) Implementation of the program; (5) Education of people with diabetes; (6) Follow-up and evaluation.

An interdisciplinary team was responsible for continuous contact with the different organizations/institutions (ambulatory care, biochemical tests, pharmacies, and hospitalizations) involved and for data management. The IOMA administrative personnel were trained to optimize feedback among the different partners of the program.

2.3. Program information and marketing activities

Pamphlets, posters and messages for the mass-media were distributed in the cities involved together with material describing the program's characteristics and implementation. This approach was based on social marketing to influence physician behavior [14].

2.4. Enrollment of providers and patients

Physicians and nutritionists from the four intervention cities were enrolled through their respective organizations. Patients with diabetes diagnosed according to the International Classification of Diseases, Ninth

Revision, Clinical Modification (ICD-9-CM 250.xx) were invited to participate in the program by their physician.

Patients were eligible if they had been registered in IOMA for at least 2 years and had had at least two visits coded specifically for diabetes. Subjects with cancer, blindness, drug or alcohol addiction, or who were unable to provide self-care were excluded.

PROPAT progressively enrolled 668 patients (approximately 53% of the estimated diabetic population of these cities), 110 doctors and nine nutritionists in the four cities during a 6-month period. For each patient, two people with diabetes from the control cities (identified by their IOMA records) were simultaneously enrolled and matched by gender and age to compare costs of diabetes care in the intervention and control cities with the same criteria, system and period as those used to enroll patients in the intervention cities (see above).

Patients enrolled received information about the program by IOMA, including their rights to care and benefits, educational material (foot care, clinical and biochemical self-monitoring, prevention of ketoacidosis and hypoglycemic episodes, and regular practice of physical activity), and a check-book authorizing them to receive free annual visits to the physician, laboratory tests, visits to the nutritionist, cardiologist, ophthalmologist and diabetologist (when their primary care doctor was a general practitioner), and the free provision of drugs necessary to control glucose metabolism and other CVRF. Intercurrent events during the study not included in the check-book were covered by IOMA and recorded separately. Patients were interviewed annually by trained personnel who collected demographic information, self-reported comorbidities, current healthcare practices and medical therapies, self-assessment of current status of diabetes control, and overall satisfaction with the healthcare plan and healthcare staff in the previous year.

2.5. Diabetes education

Physicians enrolled in PROPAT received the book *"Type 2 diabetes: diagnostic, control and treatment"* edited by the Argentine Diabetes Society as part of their training program for general practitioners [13]. The book includes the algorithms for the diagnosis, control and treatment of diabetes. Participating physicians who attended these courses received a 20% incentive over their customary per-patient fee. During the courses, great emphasis was put on the importance of prescribing a meal plan and of the regular practice of physical activity to attain appropriate clinical and metabolic control.

Enrolled patients had free access to annual group education courses – with proven efficacy to improve patient compliance and optimization of diabetes outcomes [15] – implemented by physicians and nutritionists previously accredited by an intersectorial committee (IOMA, CENEXA, Medical College of the Province of Buenos Aires, La Plata School of Medicine, Argentine Diabetes Society, Association of Nutritionists of the Province of Buenos Aires, and Federation of Association of People with Diabetes). As in the case of physician training, the educators largely explained the advantages of following an appropriate meal plan with self-selection of foods, and of the regular practice of physical activity.

2.6. Implementation of the Program

2.6.1. Initial encounter

At the initial encounter, blood pressure, height and weight were recorded and a complete, protocol-based clinical evaluation was performed. Quality of laboratory tests was monitored by the Federation of Biochemists of the Province of Buenos Aires.

2.6.2. Patient follow-up and data evaluation

The study monitored quality of care using multiple information sources including medical records (clinical, biochemical and therapeutic parameters), information provided by the patients in structured interviews and prescription check-books. The data collected included demographics, CVRF, acute/chronic complications, and treatments. Quality-of-diabetes-care indicators were frequency of visits to the primary care physician, diabetologist, ophthalmologist and cardiologist; laboratory tests; type and frequency of clinical procedures (foot examinations, blood pressure measurements, examination of insulin injection sites and nervous system assessments); and frequency and causes of hospitalizations. Frequency and performance of care provided in the previous year was specifically recorded.

A Cost of Illness study evaluated the cost of diabetes care in order to estimate the savings if diabetes complications were prevented. In a prevalence-based design recording direct costs, we focused on costs of hospitalization, physician services, consumption of diabetes-related supplies (e.g. testing meters, insulin syringes and stripes for blood glucose self-monitoring) and drugs. To obtain direct costs of each item we used the consumption and financial data records of IOMA. Data obtained in the four PROPAT cities were compared with those obtained in four control cities.

Table 1
PROPAT innovative procedures: types and outcomes

Procedure	Outcome
Interdisciplinary team approach	Provides broader and complementary scope for the program
Continuous intersectorial contact	Facilitates the implementation and follow-up of the program
Training of administrative personnel	Optimizes relationship among different partners
Marketing activities	Speed up the knowledge of the program benefits and the consequent adherence
High priority to careful and periodic clinical control	Promotes reasoning and patients' counseling activities
Check book	Prompts the provider for diagnostic and therapeutic strategies
Free provision of drugs and supplies	Removes accessibility barriers to care and treatment
Continuous education for physicians and people with diabetes	Improves adherence, compliance and quality of care
Accreditation system for diabetes educators	Ensures the performance of practices by qualified and experienced educators
Multiple information sources for quality of care monitoring	Reduces the *bias* of the provider's view point

3. Statistical analysis

Data from the first 297 patients who had completed 1 year in PROPAT and the consumption of a double number of patients from the control cities (594) were entered into a computerized data base developed at CENEXA. The statistical analysis of the data was performed using the Data Base and Statistical Program for Public Health EpiInfo 6 (version 6.02, CDC and WHO, 1994). Differences between proportions and means in an unadjusted univariate analysis were tested for statistical significance using the χ^2-test and ANOVA.

4. Results

Table 1 summarizes the main characteristics of the procedures used in PROPAT and their corresponding outcomes.

Table 2 shows the characteristics of the first 297 patients (out of the total of 668) enrolled and who had been 1 year in PROPAT. During such period we did not record any patient lost either from the Program or from the control group. The majority of patients were women (mean age, 56 ± 16 years; mean diabetes duration, 12 ± 11 years). The most common complication was retinopathy (32%), and the most common CVRF was hypertension (45%).

Table 3 shows the positive changes observed in the medical procedures 1 year after the implementation of PROPAT. All performed diagnostic procedures recorded at baseline had increased significantly, including clinical parameters (foot examination, blood pressure control) and referral to specialists (ophthalmologist, cardiologist and nutritionist).

Blood- and urine-glucose self-monitoring increased significantly in the intervention population 1 year after the start of the program (blood glucose 36% versus 48%, $P < 0.01$; urine glucose 11% versus 23%, $P < 0.01$).

Table 4 shows that almost all the clinical and metabolic parameters measured improved significantly their values 1 year after PROPAT implementation: there was a significant decrease in body weight (−8%), fasting blood glucose (−17%) and total cholesterol (−7%), whereas triglyceride serum levels (−17%), systolic (−4%) and diastolic (−8%) blood pressure did not change significantly. HbA1c values fell (13%) close to statistical significance ($P = 0.07$), with an overall mean decrease of 0.66%. Although still not significant, the average of such decrease was 1.88% when we considered only those patients who had decreased their HbA1c values.

Table 2
Characteristics of the population sample in PROPAT

Gender (% of women)	58
Age (years)	56 ± 16
Diabetes duration (years)	12 ± 11
Chronic complications, CVRF and CV events (%)	
Retinopathy	32
Hypertension	45
AMI	11
Stroke	9
Foot surgery	5
Lower-limb bypass	1.3
ESRD	0.7

CVRF: cardiovascular risk factors; CV: cardiovascular; AMI: acute myocardial infarction; ESRD: end-stage renal disease. Unless specified, values are means ± S.D.; $n = 297$. People treated with insulin represented 44% of the population (type 1 and type 2 diabetes with insulin); the remaining 56% were treated without insulin (type 2 diabetes).

Table 3
Percent diagnostic and care procedures provided 1 year before and after PROPAT implementation

Parameter	Baseline	1 year	*P*
Foot examination	69	90	0.00
Sensorimotor evaluation	67	79	0.00
Blood pressure control	95	99	0.00
Control of insulin injection site	83	91	0.00
Cardiologist (annual check-up)	63	81	0.00
Ophthalmologist (annual check-up)	78	91	0.00
Nutritionist	12	74	0.00
Educational courses	9	28	0.00
HbA_{1c}	67	89	0.00
Protein/microalbuminuria (annual check-up)	54	74	0.00

Values are expressed as percentages (in all cases, $n = 297$).

When the people with diabetes enrolled in PROPAT were grouped into good, fair and poor control [16] according to their data, most of the parameters studied switched significantly ($P < 0.05$) from poor to fair or good (Fig. 1). However, in the case of systolic and diastolic blood pressure, we recorded a non-significant increase in the percentage of people with poor and fair control.

PROPAT significantly lowered the percentage of hospitalizations during the previous year (28 versus 21%, $P < 0.05$; Table 5), as compared to the four control cities. The same applied to the frequency (2.18 versus 1.45%, $P < 0.01$) and length (7.1 versus 5.1 days, $P < 0.01$) of hospitalizations *per person*, with the consequent decrease in the annual *per capita* cost of hospitalization ($P < 0.01$) due to a marked decrease in acute diabetes complications (from 49% to 28%).

Table 4
Changes in clinical and biochemical parameters in people with abnormal baseline values

Parameter	Baseline	1 year	*P*
Body weight (kg)	82.9 ± 19.3	76.4 ± 14.5	0.02
Systolic blood pressure (>140 mmHg)	158 ± 10	152 ± 14	0.01
Diastolic blood pressure (>90 mmHg)	101 ± 5	93 ± 9	0.09
Fasting blood glucose (>110 mg/dl)	186 ± 58	154 ± 49	0.01
HbA_{1c} (>6%)	9 ± 2	7.8 ± 2.7	0.07
Total cholesterol (>200 mg/dl)	244 ± 36	228 ± 41	0.01
Triglycerides (>150 mg/dl)	302 ± 215	250 ± 155	0.20

Values are means ± S.D.; $n = 211$. Between parentheses, reference values used to define the abnormal levels of different indicators of care.

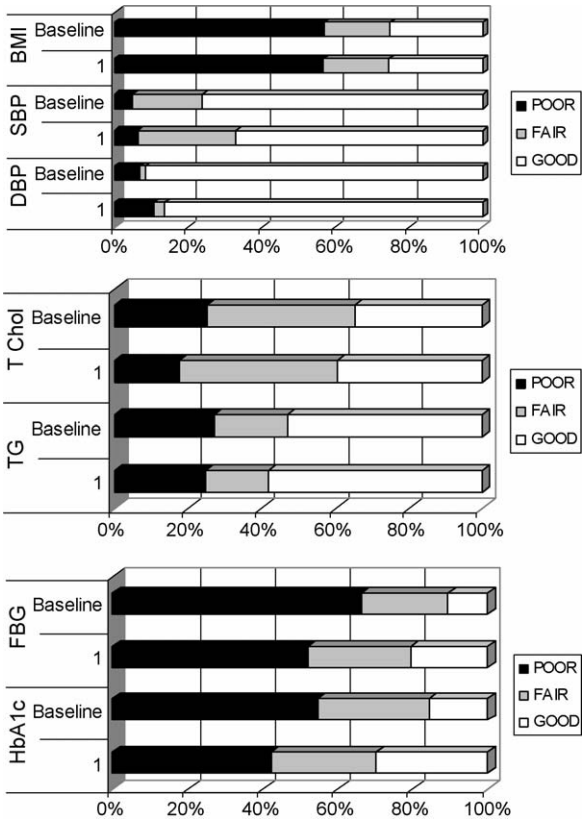

Fig. 1. People with diabetes enrolled in PROPAT were grouped into good, fair and poor control [16] according to their data. Parameters represented include BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; FBG: fasting blood glucose; T. Chol: total cholesterol; TG: triglycerides. Most of the parameters studied switched significantly from poor to fair or good. FBG (decrease in the condition of poor control, $P < 0.01$, and increase in the condition of good control, $P < 0.01$; HbA1c (increase in the percentage of good control, $P = 0.05$); T. Chol and TG, NS. In the case of SBP and DBP, we recorded a non-significant increase in the percentage of people with poor and fair control.

The total annual *per capita* expenditure (ambulatory diabetes care, drugs, laboratory tests and hospitalization) was statistical and markedly lower in the PROPAT versus the control cities (US$ 1733.34 versus 2428.64, $P < 0.01$; Table 6).

Table 5
Annual hospitalization data

Item	PROPAT ($n = 297$)	Control ($n = 594$)	*P*
Patients	21%	28%	0.02
Hospitalizations per person	1.45	2.18	0.00
Mean in-hospital days	5.1	7.1	0.00
Cost *per capita* (US$)	1,230.25	1523.34	0.00

Source of information: Fecliba.

Table 6
Annual expenditure

Item	Costs *per capita* (US$)		*P*
	Control ($n = 594$)	PROPAT ($n = 297$)	
Medical procedures	440.34	178.72	0.00
Drugs	390.98	281.22	0.00
Laboratory tests	73.98	43.15	0.00
Hospitalizations	1523.34	1230.25	0.00
Total	2428.64	1733.34	0.00

Figures represent values recorded in the four PROPAT and control cities in a 1-year period.

5. Discussion

We have previously shown that the frequency of clinical procedures and laboratory tests in IOMA diabetes patients was higher than recommended by guidelines [8,16,17]. While some of these procedures related to patient age or complications, many involved young patients without complications, increasing the costs without increasing quality [12]. The data currently presented are the consequence of a rational and controlled prescription of clinical procedures and laboratory tests and, as reported in other publications [12,18–20], demonstrate that quality of care can be improved while lowering costs using a more rational system of diabetes care involving education of healthcare providers and their patients. Such system prevents the unnecessary high prescription of such studies as well as of drug use [12,15]. The latter could be partly ascribed to the strong emphasis put in the meal plan and the regular practice of physical activity during the education of patients and health providers. The former was also reinforced by the incorporation of the nutritionist consultation as part of diabetes care.

Most of the clinical procedures and laboratory tests performed (Table 3), that include valid quality indicators (patient referral to specialists, hospitalizations, examination of insulin injection sites and neurological assessment), predict improved diabetes control [21].

Despite the significant increase in procedures performed after the implementation of the program (Table 3), none of the values reached 100%, even though their costs were covered by the program. Thus, we are left to speculate why such coverage did not result in a complete compliance.

A significant decrease in body weight (8%) with the consequent decrease in insulin resistance may have accounted for the observed metabolic improvement associated to a decrease in drug therapy requirements.

Complications increase the cost of care. Gilmer et al. showed that the expected cost for a 60-year-old man with heart disease and HbA1c level of 8% was 3.15 times higher than that for one without heart disease [22]. They also showed that in the presence of diabetes, heart disease and hypertension, a 1% improvement in HbA1c from 10% to 9% resulted in a marked reduction in cost over 3 years. Vijan et al. [23] also demonstrated that moving from poor to moderate glycemic control resulted in greater cost savings than from moderate to near normal glycemic control.

We have previously shown that the rate and length of hospitalization were significantly larger in people with diabetes compared with non-diabetic people paired by age and gender [24]. Any attempt to decrease diabetes costs should tackle this problem because hospitalization represents about 50% of the total cost of care. Patients with poor glycemic control had more than double the number of admissions over a 3-year period as compared to those having good glycemic control [25]. Such an effect could account for the simultaneous improvement in metabolic control and decrease in hospitalizations rate and length observed in PROPAT patients.

Menzin et al. reported on the potential short-term economic value of interventions to improve glycemic control, such as disease management programs [25]. Although we have not specifically studied the relationship between glycemic or HbA1c levels and costs, the simultaneous decrease in fasting glucose, HbA1c levels and costs strongly supports the concept that improved glycemic control decreases the direct costs of diabetes care [23–26].

Over the past decade a number of organizations have begun to measure the quality of diabetes care [7,9,19,21,25–31]. This is the first report of quality improvement at a lower cost in Latin America. Whereas PROPAT was conducted in a health care maintenance organization, the results provide a sound basis for the design of future programs within other health care systems directed at improving diabetes care. Such programs have the promise of decreasing the socio-economic costs of the disease and improving the quality of life of people with diabetes.

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