Quality of Care and Outcomes in Type 2 Diabetic Patients

A comparison between general practice and diabetes clinics

GIORGIA DE BERARDIS, MSC (PHARM CHEM)[1]
FABIO PELLEGRINI, MS[1]
MONICA FRANCIOSI, MSC (BIOL)[1]
MAURIZIO BELFIGLIO, MD[1]
BARBARA DI NARDO, HSDIP[1]
SHELDON GREENFIELD, MD[2]
SHERRIE H. KAPLAN, PHD MPH[2]
MARIE C.E. ROSSI, MSC (PHARM CHEM)[1]
MICHELE SACCO, MD[1]
GIANNI TOGNONI, MD[1]
MIRIAM VALENTINI, MD[1]
ANTONIO NICOLUCCI, MD[1]
ON BEHALF OF THE QUED STUDY GROUP*

OBJECTIVE — The role of general practice and diabetes clinics in the management of diabetes is still a matter of debate. Methodological flaws in previous studies may have led to inaccurate conclusions when comparing the care provided in these different settings. We compared the care provided to type 2 diabetic patients attending diabetes outpatient clinics (DOCs) or being treated by a general practitioner (GP) using appropriate statistical methods to adjust for patient case mix and physician-level clustering.

RESEARCH DESIGN AND METHODS — We prospectively evaluated the process and intermediate outcome measures over 2 years in a sample of 3,437 patients recruited by 212 physicians with different specialties practicing in 125 DOCs and 103 general practice offices. Process measures included frequency of HbA_{1c}, lipids, microalbuminuria, and serum creatinine measurements and frequency of foot and eye examinations. Outcome measures included HbA_{1c}, blood pressure, and total and LDL cholesterol levels.

RESULTS — Differences for most process measures were statistically significantly in favor of DOCs. The differences were more marked for patients who were always treated by the same physician within a DOC and if that physician had a specialty in diabetology. Less consistent differences in process measures were detected when patients followed by GPs were compared with those followed by physicians with a specialty other than diabetology. As for the outcomes considered, patients attending DOCs attained better total cholesterol levels, whereas no major differences emerged in terms of metabolic control and blood pressure levels between DOCs and GPs. Physicians' specialties were not independently related to patient outcomes.

CONCLUSIONS — Being followed always by the same physician in a DOC, particularly if the physician had a specialty in diabetes, ensured better quality of care in terms of process measures. In the short term, care provided by DOCs was also associated with better intermediate outcome measures, such as total cholesterol levels.

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The long-lasting debate on the role of generalists and specialists in the management of diabetes is still unresolved. Nonetheless, the constant increase in the demand for diabetes care and the need for providing adequate and homogeneous levels of care call for a deeper understanding of those structural and organizational characteristics that can play an important role in reaching the desired health outcomes while minimizing unnecessary costs.

Studies have consistently shown that specialist care is associated with better process outcomes in type 1 diabetes (1). However, the few existing studies in type 2 diabetes have generally found that although specialists tend to perform better in process measures than generalists, there are no substantial differences in terms of outcomes (2–6).

It has been recently underlined that to make accurate comparisons of quality of diabetes care between specialty groups, it is of fundamental importance to account for the differences in patient characteristics (case mix) as well as for the physician-level variation (clustering) (5,7). Studies that fail to take these important methodological aspects into account may lead to spurious conclusions when comparing the care provided by generalists and specialists.

Within the context of a nationwide outcomes research program in type 2 diabetes, we evaluated the care provided during a 2-year period to patients attending diabetes outpatient clinics (DOCs) or being followed by general practitioners (GPs). Our study involved a large number of GPs and DOC physicians and offered the opportunity to compare the quality of diabetes care provided by generalists and specialists while accounting for patient case mix and physician-level clustering.

RESEARCH DESIGN AND METHODS

The Italian health care system

All Italian citizens are covered by a government health insurance and are registered with a GP. Primary care for diabetes is provided by GPs and in DOCs. Patients can choose one of these two ways of accessing the health care system according to their preferences or they can be referred to DOCs by their GPs. The DOCs are usually staffed by diabetologists, internists, and/or endocrinologists, who are primarily responsible for diabetes care;

From the [1]Department of Clinical Pharmacology and Epidemiology, Istituto di Ricerche Farmacologiche Mario Negri, Consorzio Mario Negri Sud, S. Maria Imbaro, Chieti, Italy; and the [2]Center for Health Policy Research, University of California, Irvine, Irvine, California.

Address correspondence and reprint requests to Antonio Nicolucci, MD, Department of Clinical Pharmacology and Epidemiology, Consorzio Mario Negri Sud, Via Nazionale, 66030 S. Maria Imbaro, Chieti, Italy. E-mail: nicolucci@negrisud.it.

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*A complete list of the QuED Study Group can be found in the APPENDIX.

Abbreviations: DOC, diabetes outpatient clinic; GP, general practitioner; TIBI, Total Illness Burden Index.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

other specialists (e.g., ophthalmologists, cardiologists) may also practice part time in the clinic. Given the existence in Italy of a specialty in "diabetes and metabolic disorders," the term "diabetologist" refers only to a physician with such specific training. In some DOCs, patients are always cared for by the same specialist, whereas in other clinics patients can be seen by different physicians on different occasions.

Study design

The study involved 212 physicians practicing in 125 DOCs and 103 general practice offices. Details on the study design and sampling of physicians have already been reported elsewhere (8–10).

Briefly, all patients with type 2 diabetes (adult onset of disease, fasting venous plasma glucose concentration ≥7.8 mmol/l on at least two separate occasions, diabetes not requiring insulin treatment at diagnosis) were considered eligible for this project, irrespective of age, duration of diabetes, and treatment. In diabetes clinics, patients were sampled using random lists, stratified by patient age (<65 or ≥65 years). Each center was asked to recruit at least 30 patients, whereas GPs enrolled all consecutive patients for whom they were primarily responsible for diabetes care, up to a maximum of 10 patients. Patients were enrolled between March 1998 and December 1999.

Clinical information was abstracted from clinical records by the participating physicians and reported in ad hoc forms. Data were collected at baseline and 6-month intervals. Patients are being followed for 5 years; the present analysis refers to data collected during the first 2 years.

All recruited patients were requested to fill in a questionnaire regarding the presence and severity of diabetes complications and comorbidities and the SF-36 Health Survey. The presence and severity of diabetes complications and comorbidities were summarized using the Total Illness Burden Index (TIBI), a widely used comorbidity measure specifically developed for diabetic outpatient populations (11).

Based on the recommendations of the American Diabetes Association (12), we identified process measures that could be considered as representative of quality of diabetes care. Process measures included frequency of HbA_{1c}, lipid profile (total and HDL cholesterol, triglycerides), microalbuminuria, and serum creatinine measurements and frequency of foot and dilated eye examination. Although blood pressure measurement is an important process indicator, we did not consider it as all patients had at least two measurements per year.

We defined the assessment of HbA_{1c} as adequate if at least two measurements per year were performed, whereas all other process measures were considered appropriate if at least one measurement/examination per year was performed.

We also identified intermediate outcome measures, including mean HbA_{1c}, blood pressure, and total and LDL cholesterol levels over 2 years. For each outcome, we considered the proportion of patients with satisfactory values as well as those with unacceptably high values. Outcomes were considered satisfactory if HbA_{1c} levels were ≤7.0%, blood pressure values were ≤130/85 mmHg, total cholesterol levels were ≤5.18 mmol/l, and LDL cholesterol levels were <2.86 mmol/l. Unsatisfactory outcomes included HbA_{1c} levels >8%, blood pressure values ≥140/90 mmHg, total cholesterol levels >5.70 mmol/l, and LDL cholesterol levels >3.37 mmol/l. LDL cholesterol was estimated by the Friedwald equation.

Statistical analysis

Patient characteristics and the percent of patients conforming with process and outcomes measures were compared using χ^2 statistics for categorical variables and Mann-Whitney *U* test for continuous variables.

To compare the two settings of care, for each process and outcome measure we used three regression models to calculate estimated odds ratios (ORs) and 95% CIs. In the first model, we estimated unadjusted ORs. In the second model, ORs were adjusted for patient case−mix variables, including age, sex, school education, BMI, duration of diabetes, treatment of diabetes, TIBI, and physical functioning, as measured by the specific 10-item SF-36 subscale. In the third model, to account for the multilevel nature of the data (patients clustered within physician or practice) and to control simultaneously for the possible confounding effects of the different variables, we used multivariate multilevel logistic regression models (13,14).

Because the clustering effect within practices could be more relevant for those patients always followed by the same physician within a clinic, we ran additional analyses on this subgroup. In particular, we tested whether being followed by a GP or always by the same physician practicing in a DOC had an impact in terms of process and outcome measures. Moreover, we also tested whether the specialty of the physician played a role (GP versus endocrinologists, diabetologists, internists, or other specialists).

For process measures, an OR >1.0 indicated a higher probability to perform the exam or the measurement for patients cared for in DOCs as opposed to those followed by GPs. For intermediate outcome measures, an OR >1 indicated a higher likelihood to present adequate/inadequate values for patients cared for by DOCs as opposed to those followed by GPs.

All the analyses were performed using SAS Statistical Package version 8.2 (SAS Institute, Cary, NC). Multilevel logistic regression was performed using the SAS language macro routine GLIMMIX.

RESULTS — Overall, 3,437 patients were enrolled, of whom 2,658 were recruited by DOCs and 779 by GPs. Of the 3,437 subjects, 2,130 were always followed by the same physician. In DOCs, 31% of the physicians were diabetologists, 15% were internists, 38% were endocrinologists, and 16% were either from other specialties (10%) or had no further training (6%).

Patients' characteristics according to the setting of care are shown in Table 1. Patients seen by GPs tended to be older, be female, have a shorter diabetes duration, and have hypertension or dyslipidemia, whereas those followed in DOCs were more likely to be treated with insulin and to suffer from retinopathy and neuropathy. Overall, patients seen in the two settings did not significantly differ in terms of physical functioning and severity of clinical conditions, as expressed by the TIBI score.

The percent of patients conforming with process measures are reported in Table 2. Statistically significant differences in favor of patients treated by DOCs were found for HbA_{1c}, HDL cholesterol, and microalbuminuria testing, as well as for foot and eye examinations. The differences in the percent of patients conforming with process measures were even more marked when the comparison was

Table 1—*Patient characteristics according to setting of care*

	GPs	DOCs	*P*
n	779	2,658	
Male (%)	49.7	55.2	0.007
Age (years)	64 ± 10	62 ± 10	<0.0001
School education ≤5 years (%)	56.0	51.3	0.09
BMI (kg/m^2)	28 ± 4	28 ± 5	0.10
Duration of diabetes (years)	10 ± 9	11 ± 9	0.006
HbA_{1c} (%)	7.2 ± 1.6	7.2 ± 1.5	0.30
Treatment (%)			<0.0001
Diet alone	19.5	15.5	
Oral agents	65.2	61.5	
Insulin	9.6	13.5	
Insulin + oral agents	5.7	9.5	
Hypertension (%)	59.1	49.8	<0.0001
Dyslipidemia (%)	26.5	22.6	0.02
Complications (%)			
Retinopathy	14.2	21.5	<0.0001
End-stage renal disease	0.5	0.8	0.40
Neuropathy	6.8	10.1	0.0003
Foot complications	3.6	3.0	0.40
Myocardial infarction	7.8	8.3	0.20
Stroke	4.7	3.1	0.04
TIBI	14 ± 13	13 ± 13	0.40
Physical functioning	71 ± 26	74 ± 25	0.09

Data are means ± SD unless otherwise indicated. *P* values refer to χ^2 for categorical variables and Mann-Whitney *U* test for continuous variables.

restricted to patients always seen by the same physician (Table 2).

As for outcome measures, more DOC patients showed satisfactory blood pressure and total cholesterol values compared with those seen by GPs, whereas high total and LDL cholesterol levels were found more often among patients cared for by GPs. Similar figures emerged when analyzing patients always seen by the same physician (Table 2).

Results for unadjusted, case-mix adjusted, and both case-mix and physician level−clustering adjusted ORs are shown in Table 3. In the whole sample, adjustment for patient case mix did not substantially modify the results, confirming that patients followed by DOCs and GPs had similar health conditions. Accounting for physician-level clustering increased all the ORs relative to process measures, except for microalbuminuria testing and foot examination. The statistical significance was achieved for HbA_{1c}, HDL cholesterol, triglycerides, serum creatinine, and microalbuminuria measurements and for eye examination.

As for the outcome measures considered, after accounting for case mix and physician-level clustering, patients treated in DOCs still showed a higher

Table 2—*Proportion of patients conforming with process and outcome measures by setting of care, unadjusted for patient characteristics*

	GPs	DOCs 1*	DOCs 2†	*P*: GPs vs. DOCs 1	*P*: GPs vs. DOCs 2
Process measures					
HbA_{1c} at least twice a year	42.9	73.2	75.5	<0.0001	<0.0001
Total cholesterol at least once a year	66.4	65.8	70.7	0.8	0.05
HDL cholesterol at least once a year	49.7	54.7	58.0	0.015	0.0003
Triglycerides at least once a year	62.9	63.9	67.5	0.6	0.04
Serum creatinine at least once a year	65.0	64.8	75.0	0.9	<0.0001
Microalbuminuria at least once a year	31.3	52.6	49.0	<0.0001	<0.0001
Dilated eye examination at least once a year	38.5	54.8	57.9	<0.0001	<0.0001
Foot examination at least once a year	39.5	51.5	48.0	<0.0001	0.0008
Outcome measures					
HbA_{1c} >8%	25.6	26.7	24.2	0.60	0.50
HbA_{1c} ≤7%	52.0	48.3	50.7	0.10	0.60
Blood pressure					
≥140/90 mmHg	64.6	64.5	63.7	0.95	0.72
<130/85 mmHg	11.5	14.4	14.8	0.04	0.04
Total cholesterol					
>5.70 mmol/l	46.7	41.0	40.5	0.008	0.01
≤5.18 mmol/l	29.7	36.8	38.4	0.0005	0.0002
LDL cholesterol					
>3.37 mmol/l	57.8	53.2	52.3	0.08	0.05
<2.86 mmol/l	13.6	16.4	14.6	0.15	0.65

P values refer to χ^2 test. *All patients followed by DOCs; †only patients always followed by the same physician within DOCs.

Table 3—*Process and outcome measures, by method of adjustment*

	Unadjusted	Case-mix adjusted	Clustering and case mix adjusted
Whole sample			
Process measures			
HbA_{1c} at least twice a year	3.63 (3.08–4.29)	3.62 (3.06–4.28)	3.83 (2.52–5.81)
Total cholesterol at least once a year	0.97 (0.82–1.16)	0.98 (0.82–1.17)	1.52 (0.95–2.42)
HDL cholesterol at least once a year	1.23 (1.04–1.44)	1.23 (1.04–1.45)	1.74 (1.04–2.91)
Triglycerides at least once a year	1.04 (0.88–1.24)	1.05 (0.88–1.25)	1.64 (1.03–2.60)
Serum creatinine at least once a year	0.99 (0.83–1.18)	0.99 (0.83–1.19)	1.88 (1.12–3.16)
Microalbuminuria at least once a year	2.44 (2.05–2.90)	2.52 (2.11–3.01)	2.27 (1.28–4.05)
Dilated eye examination at least once a year	1.94 (1.64–2.28)	1.87 (1.58–2.22)	2.33 (1.59–3.41)
Foot examination at least once a year	1.63 (1.35–1.96)	1.58 (1.30–1.91)	1.37 (0.97–1.92)
Outcome measures			
HbA_{1c}			
>8%	1.06 (0.87–1.29)	0.98 (0.80–1.21)	0.92 (0.64–1.32)
≤7%	0.86 (0.73–1.03)	0.92 (0.77–1.11)	1.04 (0.74–1.45)
Blood pressure			
≥140/90 mmHg	0.99 (0.84–1.18)	1.12 (0.94–1.34)	1.03 (0.80–1.32)
<130/85 mmHg	1.30 (1.02–1.67)	1.19 (0.92–1.54)	1.24 (0.90–1.69)
Total cholesterol			
>5.70 mmol/l	0.79 (0.67–0.94)	0.83 (0.70–0.99)	0.84 (0.68–1.04)
≤5.18 mmol/l	1.38 (1.15–1.65)	1.31 (1.08–1.57)	1.26 (1.00–1.60)
LDL cholesterol			
>3.37 mmol/l	0.83 (0.67–1.02)	0.86 (0.70–1.07)	0.88 (0.67–1.15)
<2.86 mmol/l	1.24 (0.93–1.67)	1.18 (0.88–1.59)	1.08 (0.77–1.52)
Patients always followed by the same physician			
Process measures			
HbA_{1c} at least twice a year	4.13 (3.41–5.01)	4.14 (3.40–5.04)	5.24 (3.30–8.33)
Total cholesterol at least once a year	1.22 (1.00–1.50)	1.23 (1.00–1.51)	2.00 (1.18–3.37)
HDL cholesterol at least once a year	1.40 (1.17–1.69)	1.41 (1.16–1.70)	2.23 (1.25–4.00)
Triglycerides at least once a year	1.23 (1.01–1.50)	1.23 (1.01–1.50)	2.05 (1.22–3.43)
Serum creatinine at least once a year	1.63 (1.33–1.99)	1.63 (1.33–2.01)	2.74 (1.59–4.73)
Microalbuminuria at least once a year	2.12 (1.75–2.56)	2.08 (1.71–2.54)	2.53 (1.32–4.84)
Dilated eye examination at least once a year	2.21 (1.84–2.66)	2.09 (1.73–2.53)	2.57 (1.65–3.99)
Foot examination at least once a year	1.43 (1.16–1.76)	1.37 (1.10–1.70)	1.38 (0.97–1.96)
Outcome measures			
HbA_{1c}			
>8%	0.92 (0.74–1.15)	0.83 (0.66–1.05)	0.83 (0.56–1.22)
≤7%	0.96 (0.79–1.16)	1.06 (0.86–1.30)	1.11 (0.76–1.61)
Blood pressure			
≥140/90 mmHg	0.97 (0.80–1.17)	1.08 (0.89–1.32)	0.97 (0.73–1.29)
<130/85 mmHg	1.34 (1.02–1.75)	1.27 (0.95–1.68)	1.33 (0.93–1.91)
Total cholesterol			
>5.70 mmol/l	0.78 (0.65–0.95)	0.84 (0.69–1.02)	0.85 (0.66–1.10)
≤5.18 mmol/l	1.47 (1.20–1.80)	1.36 (1.10–1.67)	1.32 (1.00–1.75)
LDL cholesterol			
>3.37 mmol/l	0.80 (0.63–1.00)	0.84 (0.67–1.07)	0.86 (0.63–1.17)
<2.86 mmol/l	1.08 (0.78–1.49)	1.00 (0.71–1.40)	0.98 (0.67–1.43)

Data are OR (95% CI). DOCs are the reference category.

probability of having adequate total cholesterol levels (≤5.18 mmol/l). On the other hand, the difference in the proportion of patients with inadequate total and LDL cholesterol levels and with adequate blood pressure levels were no longer significant.

To better evaluate the role of physician-level clustering, the analyses were repeated after excluding patients followed by different physicians within the same structure. Even in this analysis, the adjustment for physician-level clustering substantially increased ORs for most of the process measures considered, confirming their statistical significance, with the only exception being foot examination (Table 3).

As far as outcomes measures are concerned, the only statistically significant difference found referred to patients with adequate total cholesterol levels.

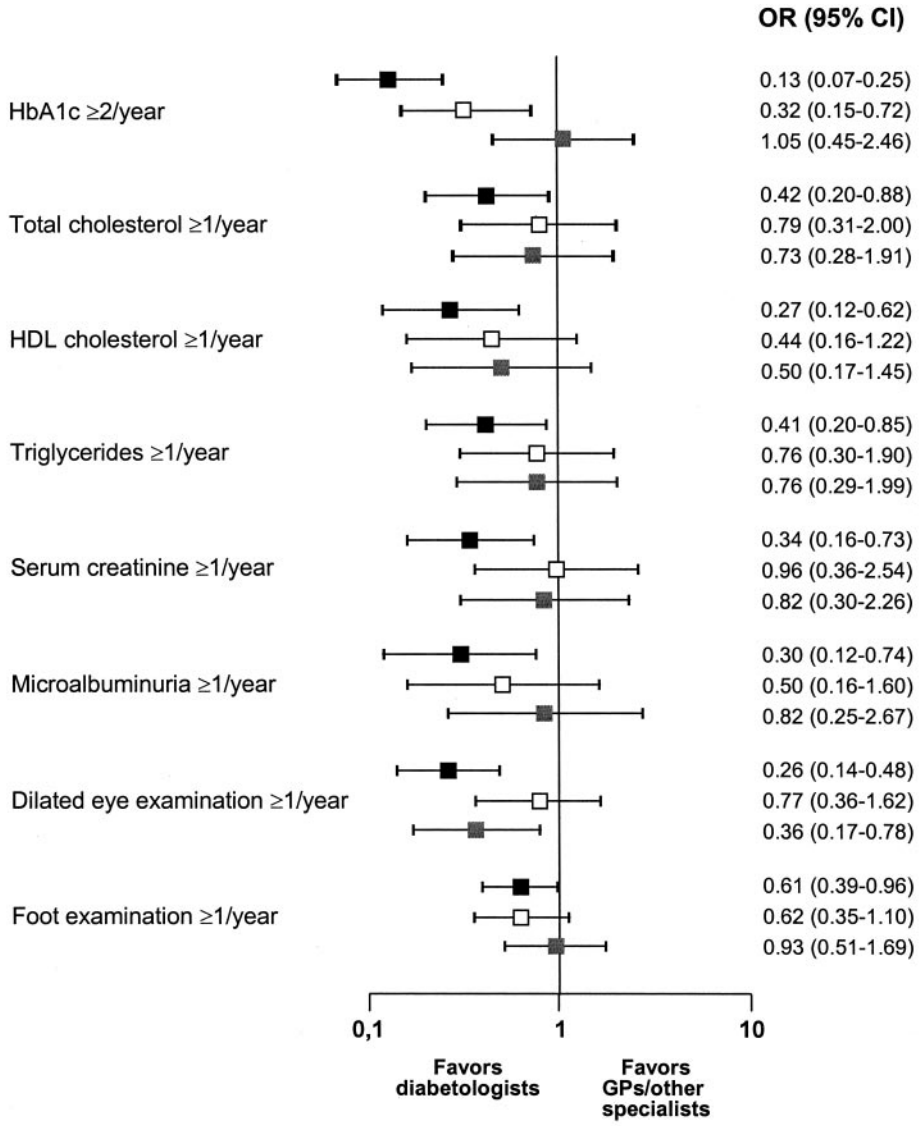

Figure 1—*Process measures: case mix– and clustering-adjusted ORs for patients followed by GPs (■), endocrinologists (□), and internists/other specialists (▩), as opposed to those treated by diabetologists.*

The additional analyses on health care delivery modalities within DOCs and according to physician specialty offered important additional information. In particular, being followed by different physicians within DOCs was associated with performance rates of the different process measures similar to those of GPs, with the only exception being higher rates of patients conforming with HbA_{1c} measurement (clustering- and case mix–adjusted OR 2.55, CI 1.51–4.30) and eye examination (OR 2.09, CI 1.32–2.30). No difference was found for any of the outcome measures considered.

Quality of diabetes care for patients treated by GPs or always followed by the same physician in DOCs was further differentiated when the specialty of physicians practicing in DOCs was taken into account. Case mix– and clustering-adjusted ORs for process measures are reported in Fig. 1, with patients followed by diabetology specialists as the reference category. Diabetologists performed significantly better than GPs on all process measures considered. Differences between GPs and the other specialists practicing in DOCs were less consistent; in fact, no statistically significant difference emerged for lipid monitoring and foot examination between those groups, whereas internists tended to perform better than GPs in terms of HbA_{1c} measurement (OR 8.11, CI 4.01–16.4) and serum creatinine and microalbuminuria testing (OR 2.43, CI 1.06–5.58 and OR 2.79, CI 1.07–7.31, respectively). Endocrinologists performed better than GPs in terms of HbA_{1c} measurement (OR 2.49, CI 1.31–4.70), serum creatinine testing (OR 2.83, CI 1.29–6.22), and eye examination (OR 2.91, CI 1.58–5.37). Within DOCs, the proportion of patients conforming with HbA_{1c} measurement was significantly lower among those treated by endocrinologists compared with diabetologists. Similarly, the proportion of patients who received at least one eye examination per year was significantly lower for patients cared for by specialists in internal medicine or with other specialties as compared with those treated by diabetologists.

As for the outcomes considered, no statistically significant difference related to physician specialty emerged (Fig. 2).

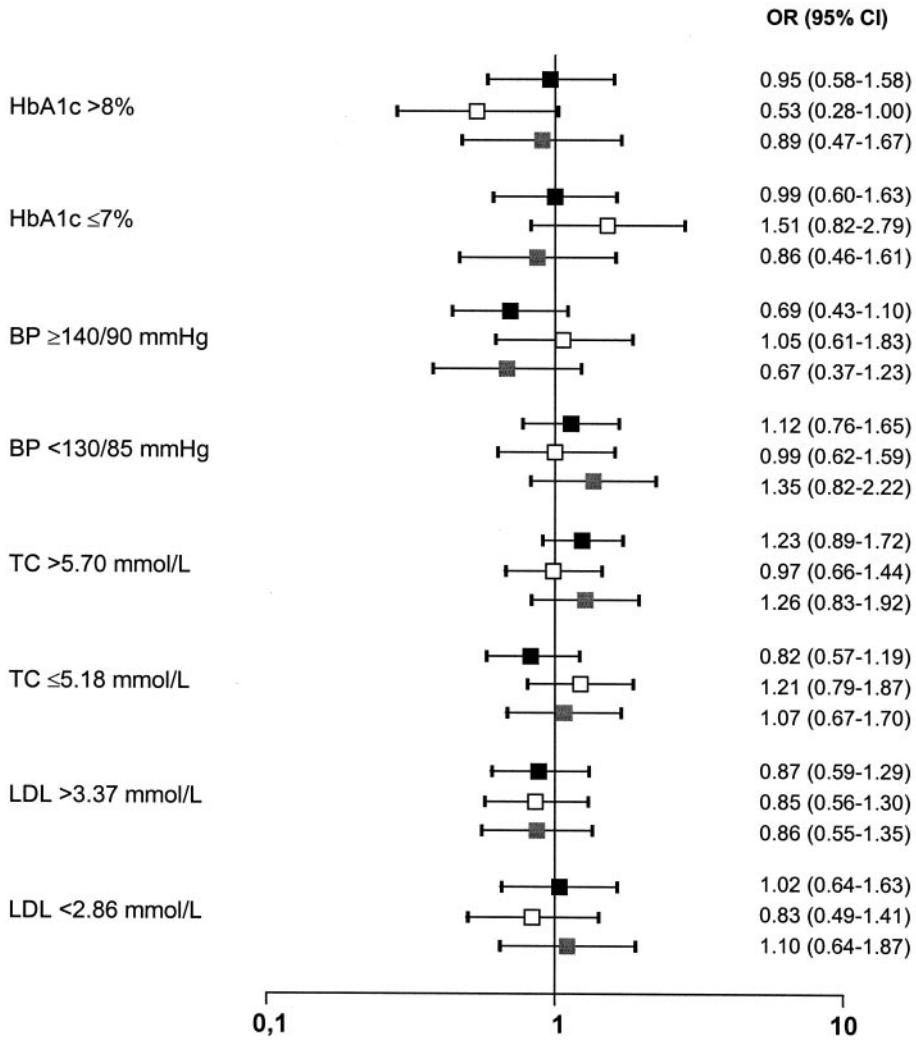

Figure 2—*Outcome measures: case mix– and clustering-adjusted ORs for patients followed by GPs (■), endocrinologists (□), and internists/other specialists (■), as opposed to those treated by diabetologists. An OR >1 indicates a higher likelihood to present adequate/inadequate values for patients cared for by diabetologists as opposed to those followed by other specialists or GPs. BP, blood pressure; TC, total cholesterol.*

CONCLUSIONS — Our study involved a large number of GPs and physicians practicing in DOCs and offered an important opportunity to compare the quality of diabetes care provided by generalists and specialists using appropriate statistical techniques (5,15).

Overall, the performance of Italian physicians participating in the project was very similar in terms of process measures to that reported in other studies conducted in the U.S. comparing generalists with specialists (4–6,16). As for the outcomes considered, good metabolic control was attained in the vast majority of patients, with only 26% showing HbA_{1c} values >8%. Control of cardiovascular risk factors was less satisfactory, with 65% of the patients showing total cholesterol levels >5.18 mmol/l and blood pressure levels ≥140/90 mmHg.

We found several differences between generalists and specialists for both process and outcome measures, despite the fact that patients followed in the two settings did not differ in terms of overall disease severity and functional status. This substantial similarity in the overall clinical conditions is the result of a mix of favorable and unfavorable characteristics for the patients cared for by GPs as compared with those followed in DOCs.

The lack of major clinical differences was confirmed by the analyses adjusted for patient case mix, which did not modify specialty differences found for process and outcomes measures.

Physician level–clustering adjustment showed that all the process measures were performed significantly more often by physicians practicing in DOCs than in general practice offices, particularly when the analysis was restricted to those patients always cared for by the same physician. The latter finding suggests that modalities of health care delivery within DOCs can influence quality of care. In fact, only minor differences in process measures emerged when comparing patients followed by GPs with those followed by different physicians within a same DOC.

Our results were consistent with those reported in the existing literature indicating that specialists are more resource intensive than generalists and adhere to process of care guidelines more closely (4–6). Nevertheless, it is not possible to exclude the possibility that reasons other than physician attitude can be at least partially responsible for our findings. One possibility is that patients followed by GPs could have less access to the testing facilities that are easily available in DOCs, which are usually located within hospitals. This could be particularly true

for older individuals living in rural areas, for whom the access to testing facilities and DOCs might represent a major problem. It is also possible that patients cared for by specialists prefer a more aggressive style of care and thus could be motivated in having their tests completed. Therefore, the differences in process measures documented in our study could be at least partially attributed to differences in the study populations not captured by case-mix and clustering adjustment.

The evaluation of physician specialty added another important element in comparing diabetes care provided by generalists with that by specialists. In fact, diabetologists performed consistently better than GPs for all the process measures considered, whereas the differences between GPs and the other specialists practicing in DOCs tended to be less marked and not systematic. As for the outcomes measures considered, satisfactory total cholesterol levels were obtained more often in DOCs than in general practice offices, irrespective of the specialty of physicians practicing in DOCs.

Process measures have been criticized as often lacking strong links to outcomes (17). From this point of view, it is of particular interest to note that more frequent monitoring of blood lipids in patients attending DOCs was also associated with a higher proportion of patients with satisfactory total cholesterol levels. This finding is further supported by the higher proportion of dyslipidemic patients treated with cholesterol-lowering drugs in DOCs as compared with treatment received in general practice offices (51 vs. 42%; $P = 0.03$). On the other hand, a significantly higher frequency of HbA_{1c} monitoring in DOCs was not associated with better outcomes in terms of metabolic control. We have previously shown that personal attitudes and beliefs of the individual physician, rather than physician specialty or setting of care, influence metabolic control (8). Furthermore, it is also possible that patients who are more difficult to manage in terms of metabolic control are referred to specialists by GPs.

Our study also offered interesting methodological hints. In a previous study, it has been shown that the failure to account for physician-level clustering could lead to overestimation of the statistical significance of the groups being compared (5). We have documented that the use of inappropriate statistical techniques can also lead to underestimation of the differences when comparing generalists with specialists. In fact, some nonstatistically significant unadjusted differences between the two settings (i.e., triglycerides and serum creatinine measurements) (Table 3) became statistically significant once the physician-level variation was taken into account.

Some of the potential limitations of our study need to be discussed. First, physicians were selected according to their willingness to participate in the project. They could thus represent those clinicians, particularly GPs, who are more interested in diabetes care and therefore not be reflective of diabetes care delivered by Italian physicians in general. From this point of view, the differences documented in our study could be underestimated and the true variability in process and outcomes measures could be even greater.

Second, some of the differences in process measures could be related to disparities in the accuracy of reporting. Nevertheless, the consistency of our findings across the whole spectrum of measures considered strongly suggests a true difference in physicians' performance.

Finally, because of the relatively short period of observation, we could select only intermediate outcome measures. It is therefore not clear to what extent the noted differences could determine different outcomes in terms of major clinical events in the long term. The analysis after the completion of the 5-year follow-up will allow a deeper understanding of the relation between process and major outcomes.

In conclusion, our findings suggest that being followed always by the same physician practicing in a DOC, particularly if the physician has a specialty in diabetes, ensures better quality of care in terms of process measures. In the short term, care provided by specialists was also associated with better intermediate outcome measures, such as total cholesterol levels. Because of the short period of observation, we could not document whether long-term outcomes were also affected.

The increasing number of patients with diabetes, together with the progressive rise in demand for diabetes care stemming from increased life expectancy, call for an efficient and coordinated health care delivery. In this respect, the involvement of general practice represents a crucial aspect. Therefore, more attention should be paid to minimizing quality of care differences, decreasing unnecessary and inappropriate care, improving the referral process for patients with complicated conditions, and promoting a comanagement and teamwork approach to diabetes care. To this end, an important first step is to ensure that the same level of care is provided by physicians with a diabetes specialty. Unfortunately, no single approach has been shown to be effective for all physicians in changing their practice. Multiple interventions, including educational programs, practice guidelines, financial incentives, regulatory measures, and total quality management techniques are likely to enhance physician performance (18). The ongoing transformation of general practice in Italy, moving from solo practice to group practice and the reorganization of team function and practice systems (e.g., appointments and follow-up) to meet the needs of chronically ill patients will also represent an important step forward in improving the standard of diabetes care. Finally, the recent implementation of shared information systems that allow a bidirectional information flux between generalists and specialists will greatly facilitate the interaction between the different health care providers while ensuring the continuity of diabetes care.

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APPENDIX

Investigators

Diabetologists. Rinaldi R., Papini E., Pagano A., Petrucci L. (Albano Laziale, RM); Maresca P., Malvicino F. (Alessandria); Corsi A., Torre E., Ponzani P., Menozzi F. (Arenzano, GE); Baracchi S., Iorini M. (Asola, MN); Gentile L. (Asti); Di Berardino P. (Atri, TE); Dell'Aversana P. (Aversa, CE); Savino T. (Bari); Amore G. (Bassano Del Grappa, VI); Zerella F. (Benevento); Travaglino F., Morone G. (Biella); Pinna N. (Borgosesia, VC); Poli M.A. (Bovolone, VR); Sanna A.M., Carboni L., Farci F., Contini P., Brundu M. (Cagliari); Nativo B., Medico C. (Caltagi-

rone, CT); Vancheri F., Burgio A. (Caltanissetta); De Fini M. (Carbonara, BA); Vincis L., Renier G. (Carbonia, CA); Bargero G., Caramellino A., Ghezzo G., Venturi E. (Casale Monferrato, AL); Grosso J. (Castel di Sangro, AQ); De Simone G., Gentile S., Gaeta I. (Castellammare di Stabia, NA); Cafaro A. (Castellaneta, TA); Panzolato L. (Castiglione delle Stiviere, MN); Trinelli V. (Ciriè, TO); Campanelli C., Norgiolini R. (Città di Castello, PG); Pastorelli R., Fiore S. (Colleferro, RM); Testero S. (Cologno Monzese, MI); Staianò A. (Corigliano Calabro, CS); Cazzalini C., Menozzi F., Inzoli S., Valsecchi C. (Crema, CR); Borretta G., Magro G., Cesario F., Piovetan A., Procopio M. (Cuneo); De Giuli G. (Darfo Boario Terme, BS); Marelli G., Bellato L. (Desio, MI); Richini D. (Esine, BS); Muscogiuri A., Tanzarella F. (Francavilla Fontana, BR); Santilli E., Versace G.S. (Frascati, RM); Morandi G., Mazzi C. (Gallarate, VA); Melga P., Cheli V., De Pascale A. (Genova); Majellaro V. (Giovinazzo, BA); D'Ugo E. (Gissi, CH); Pisano G., Vacca F., Fois A. (Isili, NU); Morea A. (Isola della Scala, VR); De Giorgio L., Lecis R. (La Spezia); Pupillo M. (Lanciano, CH); Tagliaferri M., Vitale C. (Larino, CB); Nuzzo M., Formoso G., Cosi D. (Lecce); Caldonazzo A. (Leno, BS); Lorenti I. (Lentini, SR); Barbaro D., Orsini P. (Livorno); Guarneri R., Guarneri I. (Locri, RC); Maolo G., Giovagnetti M. (Macerata); Saggiani F., Pascal G., Dina E. (Mantova); Sciangula L., De Patre P., Azzalini F., Mauri C., Roncoroni C., Banfi E. (Mariano Comense, CO); Venezia A., Morea R. (Matera); Pata P., Mancuso T., Cozzolino A., De Francesco C. (Messina); Negri S., Adda G., Zocca A., Perdomini A.G., Pizzi G.L. (Milano); Gentile S., Guarino G., Oliviero B., Scurini C., Turco S., Fischetti A., Marino M.R., Di Giovanni G., Borrelli G. (Napoli); Trovati M., Ponziani M.C. (Orbassano, TO); Torchio G., Palumbo P. (Paderno Dugnano, MI); Belotti M.L. (Palazzolo sull'Oglio, BS); Provenzano V., Imparato S., Aiello V. (Partinico, PA); Bazzano S., Nosetti G. (Pavia); Antonacci E. (Penne, PE); Capani F., Vitacolonna E., Ciccarone E., Ciancaglini R., Di Martino G., La Penna G. (Pescara); Galeone F. (Pescia, PT); Giorgi D. Pierfranceschi, De Joannon U., Matteo M., Bianco M., Zavaroni D. (Piacenza); Ruffino C. (Pietra Ligure, SV); Bassi E., Ghirardi R. (Pieve di Coriano, MN); Lieto C. (Pomigliano d'Arco, NA); De Simone G., Riccio M. (Portici, NA); Gelisio R., Moretti M. (Portogruaro, VE); Bianchi A., Dagani R. (Rho, MI); Tatti P., Di Mauro P., Cristofanelli D., Cappelloni D., Urbani A., Leotta S., Ceccarelli G., Mauceri M., La Saracina M.F., Baldelli A., Napoli A., Morano S., Cipriani R., Gabriele A., Pantellini F., Liguori M., Laurenti O., De Mattia G. (Roma); Monesi G., Mollo F., Manunta R., Lisato G., Beretta F., Bellinetti L., Bordon P. (Rovigo); Bagolin E. (San Donà di Piave, VE); Clementi L., Vespasiani G. (San Benedetto del Tronto, AP); Del Vecchio E., Orio F., Caggiano D., Tenuta M. (Salerno); Arca G.M., Scardaccio V. (Sassari); Diana A., Montegrosso G., Grottoli S., Tati M., Della Valle M.P. (Savigliano, CN); Galenda P. (Sondalo, SO); Libera E. (Sondrio); Diodati M.B., Tritapepe A. (Sulmona, AQ); Coppola C., Bosi M. (Suzzara, MN); Magno M., Scarpa E. (Taranto); Lattanzi E., Damiani G., Di Michele D., Fava A., Di Pietro E., Brancali M. (Teramo); Veglio M., D'Andrea M., Grassi A., Mormile A., Bruno A., Pisu E., Bruno G., Tagliaferro V., Passera P., Trento M. (Torino); Margiotta A. (Tradate, VA); Bossi A (Treviglio, BG); Taboga C., Mreule S., Noacco C., Colucci F., Tonutti L. (Udine); Sposito S. (Velletri, RM); Bogazzi A.R. (Venaria, TO); Moro E., Zanbon C., Pais M., Bittolo Bon G., Sfriso A . (Venezia); Francesconi M.F., Erle G. (Vicenza).

General practitioners. Sabbi D. (Arquata Scrivia, AL); Mazzarino A. (Aversa, CE); Lippa L. (Avezzano, AQ); Casassa Vigna M. (Balangero, TO); D'Alessandro A . (Bari); Caniglia N. (Barrea, AQ); Brancati F. (Brugherio, MI); Omati G. (Bussero, MI); Danti G. (Buttapietra, VR); Pascali L. (Camerano, AN); Ragazzi G. (Camisano Vicentino, VI); Di Paolo L. (Campo Di Giove, AQ); Di Febo E. (Carsoli, AQ); Ferrari P., Ballarini L. (Castel D'azzano, VR); Tonello P. (Castelgomberto, VI); Capilupi V. (Catanzaro); De Giorgi D. (Cavallino, LE); Spiezio C. (Ciriè, TO); Della Cagnoletta F. (Colorina, SO); Beretta E. (Concorezzo, MI); Nepote Fus M.T., Rapacciuolo T. (Corio, TO); Cannelli B. (Corridonia, MC); Metrucci A. (Cutrofiano, LE); Veldorale A. (Druento, TO); Ioverno E., Visentin G. (Dueville, VI); Bellino L. (Firenze); Brizio E. (Fossano, CN); Zanellato E. (Front, TO); Frapporti G. (Fumane, VR); Della Vedova R. (Gradisca d'Isonzo, GO); Gesualdi F. (Latronico, PZ); Mola E., Bosco T., Fiume D. (Lecce); Falcoz M. (Loira, TV); Martinelli G. (Lovere, BG); Tombesi M., Caraceni L. (Macerata); Di Giovanbattista E. (Magnano in Riviera, UD); Ermacora T. (Maiano, UD); Gualtiero A. (Malo, VI); Morelli F., Capozza G .(Matera); Musso M. (Mathi, TO); Pagliani S., Longoni P. (Milano); Caimi V., Parma E., Riva M.G., Bosisio M. (Monza, MI); Bertini L. (Monzuno, BO); Barra R., D'Alessandro F.M., Alano R. (Napoli); Mezzasalma G. (Nole Canavese, TO); Barberio L. (Paganica, AQ); Petrona Baviera F. (Palermo); De Matteis C. (Paola, CS); Anglano B. (Verona); Scarpolini P. (Pescantina, VR); Milano M., Bernabè S. (Pianezza, TO); Ferrara F. (Pisticci, MT); Filippi S. (Pontremoli, MS); Tosetti C. (Porretta Terme, BO); Dorato P. (Pozzuoli, NA); Moro A. (Preganziol, TV); La Terra Bella B. (Ragusa); Marziani M. (Reggio Emilia); Burzacca S. (Rivalta Di Torino, TO); Zamboni A. (Ro, FE); Saliceti F., Bartoletti P.L., Spalletta L. (Roma); Bonicatto L. (San Francesco al Campo, TO); Catalano A. (San Leucio del Sannio, BN); Crapesi L. (San Lorenzo Isontino, GO); Greco M. (San Pietro in Lama, LE); Mattana G. (San Sperate, CA); Agnolio M.L. (Sandrigo, VI); Piazza G. (Santorso, VI); Lattuada G. (Saronno, VA); Gambarelli L. (Scandiano, RE); Bussotti A. (Sesto Fiorentino, FI); Pinsuti A. (Sinalunga, SI); Signorati L. (Sommacampagna, VR); Baggi V. (Sordio, LO); Riundi R. (Sumirago, VA); Uberti M., Mondazzi A.R., Massaro R., Botto Micca M. (Torino); Massignani D. (Valdagno, VI); Gazzetta F., Bianchetti F., Molla D. (Varese); Marino R., Gribaldo E. (Venaria, TO); Aramini E. (Vercelli); Galopin T., Pettenella G., Bonollo E. (Verona); Luvisi P.F. (Viareggio, LU); Frigo A., Cabri G., Simionato C. (Vicenza); Bevilacqua S., Longhi L. (Viterbo); Dezio G. (Vittoria, RG).

Writing committee and coordinating center

Giorgia De Berardis, MSc (Pharm Chem); Fabio Pellegrini, MS; Monica Franciosi, MSc (Biol); Maurizio Belfiglio, MD; Barbara Di Nardo, HSDip; Sheldon Greenfield, MD; Sherrie H. Kaplan, PhD, MPH; Maria C.E. Rossi, MSc (Pharm Chem); Michele Sacco, MD; Gianni Tognoni, MD; Miriam Valentini, MD; Antonio Nicolucci, MD.

Scientific committee

Vittorio Caimi, MD; Fabio Capani, MD; Andrea Corsi, MD; Roberto Della Vedova,

MD; Massimo Massi Benedetti, MD; Antonio Nicolucci, MD; Claudio Toboga, MD; Massimo Tombesi, MD; Giacomo Vespasiani, MD.

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