*Published in: Diabetic Medicine: A Journal of the British Diabetic Association (2008), vol. 25, iss. 2, pp. 179-185*
*Status: Postprint (Author's version)*

# Organization of a quality-assurance project in all Belgian multidisciplinary diabetes centres treating insulin-treated diabetes patients: 5 years' experience

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## Abstract

**Aims** To describe the IQED, a quality-assurance system started in 2001 in Belgian hospital-based multidisciplinary diabetes centres, and its effects on the quality of care.

**Methods** The study was conducted through four data collections (in 2001, 2002, 2004 and 2006). Approximately 120 diabetes centres provided data on a systematic random sample of 10% of their adult diabetic patients on at least two daily insulin injections. Data on patient characteristics, glycaemic control, cardiovascular risk, diabetes complications, follow-up procedures and treatment were obtained. Local quality promotion was encouraged by returning comprehensive feedback (benchmarks) and during information meetings.

**Results** Nearly all diabetes centres (98-100%) participated. The pooled sample consisted of 9194 (32%) Type 1 and 19 828 (68%) Type 2 diabetes patients, with mean diabetes duration of 17 years and 14 years, prevalence of microvascular complications of 23% and 38% and prevalence of macrovascular complications of 9% and 26%, respectively. At the start, the quality of care was good in terms of risk-factor testing rates and moderate in terms of patients meeting goals for risk-factor management. At least 50% of the centres initiated quality-promoting initiatives. After 5 years, significant improvements were seen in risk-factor testing rates, apart from renal screening. Improvements in intermediate outcomes were less obvious, apart from an increase in patients reaching the targets for blood pressure and LDL cholesterol.

**Conclusions** It is feasible to implement a continuous quality-improvement project on a nationwide scale, with improvements particularly in process indicators.

**Keywords:** quality ; care delivery ; audit ; medical practice ; insulin-treated diabetes

**Abbreviations** ADA, American Diabetes Association ; AMI, acute myocardial infarction ; BIS, basic information sheet ; DARTS, Diabetes Audit and Research in Tayside Scotland ; DCCT, Diabetes Control and Complications Trial ; EDIC, Epidemiology of Diabetes Interventions and Complications ; IPH, Scientific Institute of Public Health ; IQED, Initiative for Quality improvement and Epidemiology for Diabetes ; LDL, low-density lipoprotein ; NCQA, National Committee for Quality Assurance ; NISII, National Institute for Sickness and Invalidity Insurance

## Introduction

Clinical research has shown that diabetes complications can be postponed or prevented through better management by the healthcare team and the patient [1]. However, the inability to effectively translate this scientific evidence into clinical practice represents a major barrier to reducing the burden of diabetes complications [2-4]. With the worldwide epidemic of diabetes, the quality of care for patients with diabetes has come under increasing attention. Strategies for quality improvement have been developed in many countries [5].

In Belgium, hospital-based multidisciplinary diabetes centres, comprising at least an endocrinologist, a certified diabetes nurse educator and a certified diabetes dietician educator, provide most outpatient care to insulin-treated (at least two daily injections) diabetic patients. By entering into an agreement with the NISII (a governmental organization), these centres can obtain payment for individual patient education and for the provision of material for self-monitoring of blood glucose. In 2006, about 86 000 patients were treated in these centres. The centres are represented on a national board that advises the government on diabetes care. In 2001, this board advised the authorities to oblige all centres to participate in a quality-assurance programme. For this purpose, endocrinologists on the board initiated the IQED. The goals are improvement of quality of care using data collection and feedback, and gathering epidemiological data on insulin-treated diabetic patients. IQED is funded by the government, but the scientific steering committee is independent and the government does not see any

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individual data from the participating centres.

The current paper describes the feasibility of setting up such a quality-assurance initiative and its effects on the quality of diabetes care.

## Subjects and methods

### *Study population*

Each Belgian diabetes centre with a NISII agreement ($n$ = 134, 131, 125 and 124 in 2001, 2002, 2004 and 2006, respectively [the decrease is the result of mergers of hospitals]) was asked to collect data on at least 10% of their registered patients, with a minimum of 50 patients. Only adult (> 18 years) diabetic patients treated with at least two daily insulin injections were studied. To ensure that the data were collected in a random unbiased sample, patient recruitment started from a random letter ('E' in 2001, 'N' in 2002, 'W' in 2004 and 'I' in 2006) in the most recent alphabetical patient list until the required number of consecutive patients was reached.

### *Data collection*

For the first three data collections, the BIS of the DiabCare Quality Network® was used [6]. This software tool, which was developed by the World Health Organization and the International Diabetes Federation in 1989, allows an easy input of relevant patient data: demographic data, type of diabetes, diabetes duration, blood-glucose-lowering therapy, blood-glucose self-monitoring, additional medical treatment, follow-up procedures, glycaemic control ($HbA_{1c}$), cardiovascular risk profile, microvascular and macrovascular complications. In 2006, a new software tool was developed by IQED for the data collection. It was largely based on DiabCare®, but some parameters were added (e.g. waist circumference), while others were removed (e.g. outcome of gestational diabetes). The new tool also allowed a more detailed assessment of glycaemic and cardiovascular treatment. For some parameters, the way of questioning and hence the subsequent analysis changed somewhat (e.g. smoking status and the documentation of retinal examination, foot examination and renal screening).

The methods used for the determination of $HbA_{1c}$ differed between the centres. The most frequently used methods were techniques of charge-dependent separation (ion-exchange high-performance liquid chromatography) and immunoassay methods. Although most methods were aligned to the DCCT, there was a large variation in reference ranges between the centres, particularly during the first data collections in 2001 and 2002. To allow a comparison, the results were standardized to the normal values of the DCCT using the following formula:

$$\text{Corrected } HbA_{1c} = (Mr + mr)/2 + ([Mr - mr]/4) \times (R - [Md + md]/2)/([Md - md]/4),$$

where *Mr* and *mr* represent respectively the upper and the lower limit of the normal values of the reference method (here: 4.0-6.0%), *Md* and *md* represent the upper and lower limits, respectively, of the normal values of a deviant method (used by the centre) and *R* represents the result obtained by the deviant method. This formula, of course, only corrects for the differences in reference ranges, not for the accuracy and precision of the individual assays used in each centre.

Because LDL cholesterol levels were not available, they were calculated with Friedewald's formula on lipid levels measured in fasting samples [7].

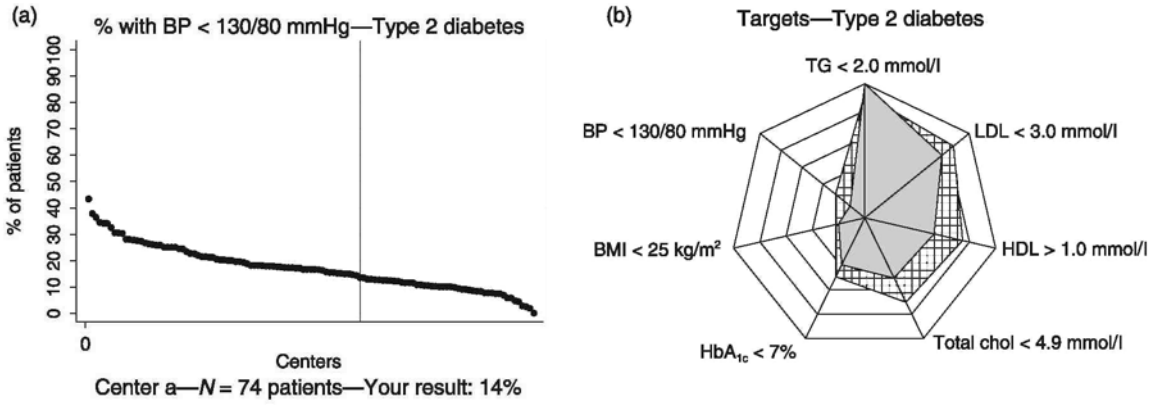
The data referred to the registrations in the patient record of visits that took place within 15 months of the start of each data collection. The time foreseen to collect data was limited to 2 months because a larger sampling period could induce bias, when patients consulting the diabetes centre in the meantime would have been treated in a way that did not reflect true routine diabetes care (Hawthorn effect). Participation in IQED is mandatory for keeping the NISII agreement. Centres that fail to participate once are cautioned; on the second occasion, they lose recognition. No centre has lost recognition yet. Each centre is obliged to keep a list of the patients included in the registration for a possible future audit.

### *Feedback to the centres*

Data were transferred to the IPH, an independent semi-governmental organization. Once all the data had been gathered, feedback for various indicators of care was generated ranking the different diabetes centres according to their results and indicating the position of every single centre in relation to the other anonymous centres (benchmarks) (example in Fig. 1a). These benchmarks were accompanied by three so-called 'radar graphs' generated using Excel: one regrouping the targets, one the follow-up examinations and one the complications. For each indicator an axis is created in the radar graph and along each axis two results are indicated: (1) the centre's result and (2) the so-called 'target'. The latter is obtained by calculating the best result achieved by 10%

of the centres (90th percentile). A connection of all the centre's results for the different indicators and all the targets (P90) gives rise to two surfaces: one representing the centre's results and one representing the target results (example in Fig. 1b). In this way, a more global viewpoint is obtained: the more surface occupied by the centre's results, the better the care.

***FIGURE 1*** *Examples of the provided feedback, (a) Benchmark, (b) Radar graph; the hatched area represents the target result and the grey area represents the centre's result.*




In addition to this graphical feedback, percentile lists have been generated for almost all parameters collected ($n$ = 60) and the distribution of these results across the participating centres (10th, 50th and 90th percentile).

Furthermore, each data collection is followed by a national meeting attended by physicians (60%) and other team members, where the pooled study results are presented and quality-promoting initiatives are stimulated.

The results of every data collection are described extensively in a report that is sent to the authorities and to all participating centres. This report is available in both French and Dutch on the IPH website (http://www.iph.fgov.be/epidemio). To guarantee confidentiality, this report does not contain results from individual centres.

In 2003, an enquiry was held by using questionnaires to assess the centres' opinions on how they perceived the use of IQED. In addition, all centres were invited to send reports of local meetings where they used the feedback to determine their quality of care and to undertake quality-promoting initiatives.

*Statistical analysis*

For the description of the population (patient characteristics), the pooled data from 2001 to 2006 are used ($n$ = 32 865). The analysis was limited to a sample of 29 022 patients (derived from 125 centres) because patients whose diabetes was not of Type 1 or 2 or with unknown disease duration were excluded.

To examine changes in the quality of care during 4 years of IQED, only those centres that participated in every data collection and did not undergo reformations because of fusion were considered for this article. In this way, 113 centres were retained with 6271, 6643, 6962 and 7882 patients in the samples of 2001, 2002, 2004 and 2006, respectively.

All analyses were performed using Stata 9.2 (Stata Corp, College Station, TX, USA).

Linear and logistic regression, taking into account age, diabetes duration and gender, were used to compare risk-factor control (both process and intermediate outcome) between the 4 years of IQED. A probability of $\leq 0.05$ was considered as significant.

**Results**

The participation rate was 100% in 2001 and 2002, 98% in 2004 and 99% in 2006.

The samples obtained in 2001, 2002, 2004 and 2006 contained 7599, 8088, 8098 and 9080 patients, respectively; this represents about 11-13% of the total number of diabetic patients included in the NISII agreement.

The patient characteristics are presented in Table 1. Thirty two per cent had Type 1 diabetes ($n$ = 9194) and 68% Type 2 ($n$ = 19 828). Seventy-five per cent of the Type 1 patients were < 58 years old. They had a long mean diabetes duration of 17.4 years. More than 80% of patients were treated with three or more daily insulin

injections. The Type 2 diabetes population was characterized by high age (75% were older than 59 years) and long known diabetes duration (mean: 14.2 years). Almost three quarters were treated with two daily insulin injections.

In the Type 2 diabetic population, 19% had a history of AMI, 10% of stroke, 17% suffered from diabetic nephropathy (defined as requiring renal replacement therapy or macro-albuminuria or serum creatinine ≥ 132 μmol/l), 14% received laser treatment for retinopathy, 8 % had a history of foot ulcer and 1% had had a leg amputation. About one quarter (26%) had at least one macrovascular complication and 38% had at least one of the microvascular complications mentioned earlier. Lower prevalence rates were found in the Type 1 diabetic population (6%, 3%, 8%, 11%, 5% and 0.6%, respectively, with 9% having macrovascular and 23% having microvascular complications), but the mean age of this group of Type 1 diabetic patients was 20 years lower than that of the Type 2 diabetic population.

***Table 1*** *Patient characteristics by type of diabetes-pooled data*

| | Type 1 (*n* = 9194) | Type 2 (*n* = 19 828) |
|---|---|---|
| Sex ratio (male : female) | 1.23 | 0.86 |
| Age (years), mean (P25-P75) | 45.8 (33-58) | 66.2 (59-75) |
| *n* of years since diagnosis, mean (P25-P75) | 17.4 (7-25) | 14.2 (7-20) |
| *n* of daily insulin injections | | |
| 2 injections | 15.9% | 72.2% |
| ≥ 3 injections | 84.1% | 27.6% |
| Previous AMI | 6.2% | 19.1% |
| Previous stroke | 3.4% | 9.7% |
| Diabetic nephropathy* | 8.0% | 17.3% |
| Previous laser treatment for diabetic retinopathy | 11.4% | 13.7% |
| Previous foot ulcer | 5.1% | 8.2% |
| Previous leg amputation | 0.6% | 1.1% |

* Renal replacement therapy or macroalbuminuria or serum creatinine ≥ 132 μmol/l.

***Table 2*** *Risk-factor control in Type 1 diabetes, by year of data collection*

| | | 2001 | 2002 | 2004 | 2006 |
|---|---|---|---|---|---|
| $HbA_{1c}$ (%) | % tested | 96.4 | 98.3** | 98.4** | *99.6*** |
| | result (mean ± SD) | 8.0 ± 1.9 | 8.0 ± 1.9 | 8.2 ± 1.7* | 8.1 ± 1.6* |
| | % < 7.0%† | 28.5 | 29.4 | 23.3** | 21.3** |
| LDL cholesterol (mmol/l) | % tested | 42.2 | 43.5 | 43.9 | 48.2** |
| | result (mean ± SD) | 3.0 ± 0.9 | 2.9 ± 0.9 | 2.8 ± 0.9 | 2.5 ± 0.8 |
| | % < 3.4 mmol/l† | 68.1 | 73.4* | 77.1** | 84.7** |
| Blood pressure (mmHg) | % tested | 95.5 | 97.3* | *96.6* | 98.7** |
| | result (mean ± SD) | 131/77 ± 19/10 | 130/76 ± 18/9 | 129/75 ± 18/10* | 129/76 ± 17/9* |
| | % < 140/90 mmHg† | 63.0 | 64.5 | 67.4** | 69.8** |
| BMI ($kg/m^2$) | % tested | 82.4 | 85.4* | 91.0** | 94.7** |
| | result (mean ± SD) | 25.4 ± 4.4 | 25.3 ± 4.4 | 25.5 ± 4.5 | 25.7 ± 5.8* |
| Smoking status | % tested | 92.6 | 96.1** | 96.7* * | (92.7) |
| | result (% smoking) | 22.6 | 23.2 | 21.2 | 22.1 |
| Retinal examination‡§ | % tested | 81.1 | 81.9 | 83.8* | (88.0**) |
| Foot sensory examination‡¶ | % tested | 82.7 | 89.0** | 90.3** | (90.4**) |
| Renal screening‡†† | % tested | 81.7 | 82.3 | 84.2 | (85.7*) |

**P*<0.05; ***P*<0.001 (data from 2001 is used as reference).
†Targets were based on the Diabetes Physician Recognition Program of the ADA and the NCQA [8].
‡Type 1 diabetic patients with diabetes duration < 5 years were excluded.
§Exclusion of patients with blindness.
¶Test for loss of protective sensation (10 g monofilament and/or 128 Hz tuning fork and/or biothesiometer; exclusion of patients with amputation).
††Urinary screening for micro- and macroalbuminuria, exclusion of patients for whom renal replacement therapy was indicated.

***Table 3*** *Risk-factor control in Type 2 diabetes, by year of data collection*

| | | 2001 | 2002 | 2004 | 2006 |
|---|---|---|---|---|---|
| $HbA_{1c}$(%) | % tested | 95.4 | 98.0** | 98.2** | 99.3** |
| | result (mean ± SD) | 7.9 ± 1.9 | 7.8 ± 1.8** | 8.0 ± 1.7 | 7.8 ± 1.5 |
| | % < 7.0%† | 32.5 | 35.0* | 29.1* | 29.7* |
| LDL cholesterol | % tested | 48.6 | 47.1 | 49.7 | 53.2** |
| (mmol/1) | result (mean ± SD) | 3.1 ± 0.9 | 3.1 ± 0.9 | 3.0 ± 0.8 | 2.6 ± 0.9 |
| | % < 3.4 mmol/l† | 64.0 | 64.5 | 71.0** | 82.7** |
| Blood pressure | % tested | 97.3 | 98.5** | 97.6 | 99.3** |
| (mmHg) | result (mean ± SD) | 143/80 ± 21/10 | 142/79 ± 20/10 | 140/78 ± 19/10** | 139/78 ± 19/10** |
| | % < 140/90 mmHg† | 37.0 | 38.1 | 44.4** | 47.2** |
| BMI ($kg/m^2$) | % tested | 79.4 | 85.0** | 88.4** | 91.9** |
| | result (mean ± SD) | 30.4 ± 5.9 | 30.5 ± 6.0 | 30.8 ± 6.0* | 30.9 ± 5.9** |
| Smoking status | % tested | 91.0 | 95.0** | 95.5** | (91.5) |
| | result (% smoking) | 15.0 | 12.4* | 12.9* | 12.9* |
| Retinal examination‡ | % tested | 74.8 | 76.4 | 75.6 | (83.7**) |
| Foot sensory examination§ | % tested | 86.0 | 88.9** | 87.5 | (89.7**) |
| Renal screening¶ | % tested | 80.2 | 81.6 | 82.5* | (81.3) |

*$P < 0.05$; **$P < 0.001$ (data from 2001 is used as reference).
†Targets were based on the Diabetes Physician Recognition Program of the ADA and the NCQA [8].
‡Exclusion of patients with blindness.
§Test for loss of protective sensation (10 g monofilament and/or 128 Hz tuning fork and/or biothesiometer; exclusion of patients with amputation).
¶ Urinary screening for micro- and macroalbuminuria, exclusion of patients for whom renal replacement therapy was indicated.

In 2001, most risk-factor tests were carried out in at least 80% of patients (Tables 2 and 3). Exceptions were the determination of LDL cholesterol on a fasting blood sample (only 42% and 48% of Type 1 and Type 2 diabetic patients, respectively), retinal examination (75% of Type 2 diabetic patients) and body mass index (BMI) determination (79% of Type 2 diabetic patients).

When comparing the risk-factor testing rates over the years, the results of 2006 regarding smoking status, retinal examination, foot sensory examination and renal screening cannot entirely be compared to the previous results because of the changed questionnaire in 2006. Hence for these indicators we will only take into account the data up to 2004. In Type 1 diabetes, risk-factor testing increased for $HbA_{1c}$, LDL cholesterol, blood pressure, BMI and for retinal and foot sensory examination. In Type 2 diabetes, risk-factor testing increased for $HbA_{1c}$, LDL cholesterol, blood pressure, BMI and slightly for renal screening.

For both Type 1 and Type 2 diabetes, we observed increased reporting of smoking status, which fell back in 2006, most likely because of the addition of the response possibility 'ex-smoker'.

Targets were based on the Diabetes Physician Recognition Program of the ADA and the NCQA [8,9]. In 2001, only 29% of Type 1 and 33 % of Type 2 diabetic patients showed excellent glycaemic control ($HbA_{1c} < 7.0$ %). The LDL target (< 3.4 mmol/l) was reached by 68 % of Type 1 and 64 % of Type 2 diabetic patients; the blood-pressure target (< 140/90 mmHg) was reached by 63% and 37%, respectively. Both Type 1 and Type 2 diabetic patients had high mean BMI values (respective means: 25.0 $kg/m^2$ and 30.0 $kg/m^2$). About 23% and 15% of Type 1 and Type 2 diabetic patients were current smokers. In subsequent years, improved blood pressure and LDL cholesterol levels were observed in both the Type 1 and Type 2 diabetic population. However, glycaemic control deteriorated slightly and BMI increased. Furthermore, in the Type 2 diabetic population, the prevalence of current smokers decreased slightly.

Seventy-eight per cent of the centres returned the completed questionnaire concerning their perception of the study (Table 4). About 80% of the centres felt that the system of data collection and feedback was useful for internal quality evaluation and promotion. Almost all the centres (96%) particularly valued the extensive report. However, 63% of the centres stated that the administrative workload caused by IQED was too high. Nevertheless, in the latter group, 75% still valued the utility of data collection and feedback and 93 % valued the utility of the report.

Fifty-six per cent of the centres returned at least one structured report on local quality assessment and promotion (Table 5).

***Table 4*** *Perception of the use of IQED by the diabetes centres*

| | % of centres |
|---|---|
| Response rate | 78% |
| Centres that value the utility of | |
| The data collection | 83% |
| The feedback | 80% |
| The report | 93% |
| Centres that value the quality of | |
| The feedback | 86% |
| The report | 74% |
| The information meeting | 89% |

***Table 5*** *Reports of meetings where centres used the feedback to evaluate their quality of care and to take quality-promoting initiatives*

| Number of reports sent | *n* of centres (%) |
|---|---|
| 1 | 43 (34) |
| 2 | 15 (12) |
| 3 | 7 (6) |
| ≥ 4 | 5 (4) |
| Any | 70 (56) |

## Discussion

We succeeded in setting up a continuous system of quality improvement in all the Belgian multidisciplinary diabetes centres (participation rate 98-100%). This system provides representative data of a large sample of insulin-treated diabetic patients ($n$ = 29 022). Within 5 years (from 2001 to 2006), four cross-sectional data collections were organized.

The quality of the data was high because of specific controls activated during registration (e.g. when impossible values were introduced). Moreover, extensive data cleaning was carried out at the IPH, with consultation with the individual centres when needed.

Precise data on diabetes prevalence in Belgium is lacking. However, considering the prevalence estimate of 3.5% (HIS, 2004) [10], of which less than 10% have Type 1 diabetes [11], it is estimated that almost all Belgian adult Type 1 diabetic patients are treated through this agreement. Moreover, given that reimbursement for self-monitoring material and education occurs only through this specific agreement, we estimate that the majority of patients treated with two or more daily insulin injections are included in this report. This implies that the studied population is representative for the entire Belgian adult Type 1 diabetic population and for the intensively treated Type 2 diabetic patients.

As expected in this selected population, there was a high prevalence of chronic diabetes complications, particularly in the patients with Type 2 diabetes.

Diabetes risk-factor management was of rather good quality in terms of risk-factor testing rates. However, overall, there is still room for improvement. Only LDL cholesterol determination was far from optimal. Lipid levels were frequently tested, but the samples were usually not fasting, precluding the use of the Friedewald formula for the calculation of LDL. A similar problem was seen with BMI. Weight was almost always registered, but measuring height was often omitted, precluding the calculation of BMI.

Quality of care was lower in terms of proportions of patients meeting goals for risk-factor levels. This confirms the findings of other studies showing the difficulties in attaining the treatment goals [12-15], especially in patients with Type 2 diabetes and even in highly specialized centres [16].

It is not the aim of our study to compare our data with results in other countries. The organization of care differs substantially between different countries. Moreover, it is difficult to compare with other published surveys: most reports do not separate Type 1 and Type 2 patients and combine insulin-treated and tablet-treated Type 2 diabetic patients. We have the impression, however, that the baseline level of care at the start of IQED was comparable to international data in comparable settings. The risk-factor testing rates (process indicators) at the start of IQED were comparable or better than in other studies [9,12,16-19]. The same is true for the achievement of treatment goals (intermediate outcome indicators). To illustrate this, the mean $HbA_{1c}$ value of the IQED Type 1 diabetic

patients (8.0%) is comparable to that of the EDIC study (7.9% for the same diabetes duration) [20]. In a mixed population of Type 1 and Type 2 diabetic patients, including patients on oral glucose-lowering drugs alone, US academic centres obtain a mean $HbA_{1c}$ of 7.9 + 1.8% [12].

IQED was developed to improve the quality of care by providing individual feedback and stimulating the centres to take measures to improve those parameters for which they clearly scored worse than their peers. This resulted in significant improvements in several parameters. The improvement with regard to the testing rates is in agreement with other studies, which have shown that the implementation of quality-improvement initiatives leads effectively to a more complete annual review of patients [17,21-23]. It is much more difficult to obtain improvements in intermediate outcome parameters. Nevertheless, we observed significant improvements in cardiovascular risk management, with slightly better blood-pressure control, and clearly better lipid control. Among Type 2 diabetic patients, the frequency of smokers decreased slightly. Without a control group, it is impossible to prove that the observed changes are the result of the introduction of IQED. Indeed, other changed circumstances in the field of diabetes could have caused these changes. For example, the reimbursement of lipid-lowering agents, which was extended in Belgium in 2003, could well explain the subsequent observed improvement in LDL cholesterol levels.

We took a lot of care to stimulate the organization of quality cycles in the individual centres, because 'it's not the data, it's what you do with it' that determines quality. Our way of data reporting, with easily interpretable graphical feedback, allowing a centre to conclude at a glance which parameters need improvement, was chosen to promote quality cycles. In addition, we developed a manual for quality cycles, and organized a meeting after each data collection where practical examples of quality cycles were presented. An enquiry revealed that at least 56% of the centres assessed their quality of care and initiated quality-promoting initiatives. However, we believe that more focused quality-promoting initiatives are needed in the future.

Participation in IQED is mandatory for diabetes centres in order to keep their NISII agreement, and thus the reimbursement for self-monitoring material and education. This compulsory participation could give rise to doubtful validity and quality of data. We took the following measures to prevent this. The authorities have no access to the database, and the published IQED annual report shows only epidemiological data, not benchmarking data. The centres have to keep a list of all patients included in the collection for a possible future audit. The system is organized by endocrinologists, representing the centres, and not by an institution linked to the government. An enquiry held among the diabetes centres revealed that they largely agree on the utility of the IQED system of data collection, feedback and annual reporting. The baseline level of care at the start of IQED was comparable to international data. Hence we assume that IQED data reflect, to a large extent, true diabetes care in these multidisciplinary diabetes centres.

We feel that our quality-assurance system can be improved in several ways. In the enquiry, the majority of the centres felt that the workload for IQED was too high. A system of automatic data extraction from electronic medical files, as used in DARTS [24], is a logical next step. However, many different software packages are used for electronic patient records in Belgium, and current studies show that automatic data extraction is not ready for use yet [25]. Care for Type 2 diabetes, even with advanced disease, should be shared between primary care and diabetes centres. Moreover, the quality of care during the early stages of the disease, when patients are treated exclusively in primary care, determines to a large extent the later risk of chronic complications. Quality assurance should therefore also address primary care, and start from diagnosis onwards. We are taking measures to organize this in Belgium. More measures, in addition to a quality-assurance initiative, are probably necessary to obtain large improvements in care. Quality-based payment of healthcare providers is an inevitable further step [26-29].

In conclusion, we have shown that it is feasible and useful to implement a compulsory and continuous quality-improvement project on a nationwide scale. It allows assessment of the quality of care and stimulates the organization of quality cycles. The results are encouraging, with clear improvements in process indicators and, to a lesser extent, in intermediate outcome indicators.

## Competing interests

None to declare.

## Acknowledgements

We gratefully acknowledge the participating diabetes centres for the time spent on data collection.

## References

1 American Diabetes Association. Standards of medical care in diabetes—2006. *Diabetes Care* 2006; 29 (Suppl. 1): 4-42.

2 McFarlane SI, Jacober SJ, Winer N, Kaur J, Castro JP, Wui MA *et al.* Control of cardiovascular risk factors in patients with diabetes and hypertension at urban academic medical centers. *Diabetes Care* 2002; 25: 718-723.

3 Narayan KM, Benjamin E, Gregg EW, Norris SL, Engelgau MM. Diabetes translation research: where are we and where do we want to be? *Ann Intern Med* 2004; 140: 958-963.

4 Saaddine JB, Engelgau MM, Beckles GL, Gregg EW, Thompson TJ, Narayan KM. A diabetes report card for the United States: quality of care in the 1990s. *Ann Intern Med* 2002; 136: 565-574.

5 Shojania KG, Ranji SR, McDonald KM, Grimshaw JM, Sundaram V, Rushakoff RJ *et al.* Effects of quality improvement strategies for Type 2 diabetes on glycemic control: a meta-regression analysis. *JAMA* 2006; 296: 427-440.

6 Tabak AG, Tamas G, Zgibor J, Wilson R, Becker D, Kerenyi Z *et al.* Targets and reality: a comparison of health care indicators in the US (Pittsburgh Epidemiology of Diabetes Complications Study) and Hungary (DiabCare Hungary). *Diabetes Care* 2000; 23: 1284-1289.

7 Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clin Cbem* 1972; 18: 499-502.

8 Diabetes Physician Recognition Program. Internet Communication. http://www.ncqa.org/dprp/DPRPbrochfinal.pdf. Last accessed 12 March 2007.

9 Suwattee P, Lynch JC, Pendergrass ML. Quality of care for diabetic patients in a large urban public hospital. *Diabetes Care* 2003; 26: 563-568.

10 Bayingana K, Demarest S, Gisle L, Hesse E, Miermans PJ, Tafforeau J *et al.* Gezondheidstoestand: chronische aandoeningen. In: Scientific Institute of Public Health ed. *Gezondheidsenquête door middel van Interview (HIS), België, 2004.* Brussels: Scientific Institute of Public Health, 2006; 47-186.

11 Puddu M, Van Casteren V. Diabetesregistratie huisartsen peilprakti-jken. Diabetes (Type 1 en 2) in 2000: regionale verschillen in incidentie,

prevalentie en behandeling. Resultaten van de huisartsenpeilpraktijken. In: Ministerie van de Vlaamse Gemeenschap ed. *Gezondheidindicatoren.* Brussels: Claes-Printing, 2002: 143-151.

12 Grant RW, Buse JB, Meigs JB. Quality of diabetes care in US academic medical centers: low rates of medical regimen change. *Diabetes Care* 2005; 28: 337-442.

13 Edwards R, Burns JA, McElduff P, Young RJ, New JP. Variations in process and outcomes of diabetes care by socio-economic status in Salford, UK. *Diabetologia* 2003; 46: 750-759.

14 Mangione CM, Gerzoff RB, Williamson DF, Steers WN, Kerr EA, Brown AF *et al.* The association between quality of care and the intensity of diabetes disease management programs. *Ann Intern Med* 2006; 145: 107-116.

15 Valk GD, Renders CM, Kriegsman DM, Newton KM, Twisk JW, van Eijk JT *et al.* Quality of care for patients with Type 2 diabetes mellitus in the Netherlands and the United States: a comparison of two quality improvement programs. *Health Serv Res* 2004; 39: 709-725.

16 Gaede P, Vedel P, Larsen N, Jensen GV, Parving HH, Pedersen O. Multifactorial intervention and cardiovascular disease in patients with Type 2 diabetes. *N Engl J Med* 2003; 348: 383-393.

17 New JP, Hollis S, Campbell F, McDowell D, Burns E, Dornan TL *et al.* Measuring clinical performance and outcomes from diabetes information systems: an observational study. *Diabetologia* 2000; 43: 836-843.

18 Whitford DL, Roberts SH, Griffin S. Sustainability and effectiveness of comprehensive diabetes care to a district population. *Diabet Med* 2004; 21: 1221-1228.

19 Beaton SJ, Nag SS, Gunter MJ, Gleeson JM, Sajjan SS, Alexander CM. Adequacy of glycemic, lipid, and blood pressure management for patients with diabetes in a managed care setting. *Diabetes Care* 2004; 27: 694-698.

20 The Writing Team for the Diabetes Control and Complications Trial/ Epidemiology of Diabetes Interventions and Complications Research Group. Effect of intensive therapy on the microvascular complications of Type 1 diabetes mellitus. *JAMA* 2002; 287: 2563-2569.

21 Deichmann RE, Castello E, Horswell R, Friday KE. Improvements in diabetic care as measured by $HbA_{1c}$ after a physician education project. *Diabetes Care* 1999; 22: 1612-1616.

22 Jha AK, Perlin JB, Kizer KW, Dudley RA. Effect of the transformation of the Veterans Affairs Health Care System on the quality of care. *N Engl J Med* 2003; 348: 2218-2227.

23 McClain MR, Wennberg DE, Sherwin RW, Steinmann WC, Rice JC. Trends in the diabetes quality improvement project measures in Maine from 1994 to 1999. *Diabetes Care* 2003; 26: 597-601.

24 Morris AD, Boyle DI, MacAlpine R, Emslie-Smith A, Jung RT, Newton RW *et al.* The diabetes audit and research in Tayside Scotland (DARTS) study: electronic record linkage to create a diabetes register. DARTS/MEMO Collaboration. *BMJ* 1997; 315: 524-528.

25 Van Casteren V, De Clercq E, Lafontaine MF, Degroote K, Jonckheer P, Burggraeve P. Quality of care assessment using data from the Belgian general practitioners' Electronic Patient Record. A pilot study for hypertensive patients with high cardiovascular risk, February-April 2005. *Eur J Public Health* 2006; 16 (Suppl. 1): 1.

26 Guthrie B, Emslie-Smith A, Morris A, Fahey T, Sullivan F. Quality measurement of care for people with Type 2 diabetes in Tayside, Scotland: implications for the new UK general practice contract. *Br J Gen Pract* 2003; 53: 709-713.

27 Ettner SL, Thompson TJ, Stevens MR, Mangione CM, Kim C, Neil SW *et al.* Are physician reimbursement strategies associated with processes of care and patient satisfaction for patients with diabetes in managed care? *Health Serv Res* 2006; 41: 1221-1241.

28 Fisher ES. Paying for performance—risks and recommendations. *N Engl J Med* 2006; 355: 1845-1847.

29 Lindenauer PK, Remus D, Roman S, Rothberg MB, Benjamin EM, Ma A *et al.* Public reporting and pay for performance in hospital quality improvement. *N Engl J Med* 2007; 356: 486-496.