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Sustaining quality in the community: trends in the performance of a structured diabetes care programme in primary care over 16 years

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What's new?

- Most studies on the impact of multifaceted, structured, primary care programmes on the quality of diabetes care have a short follow-up time; studies demonstrating long-term sustainability are lacking.
- We found significant improvements in quality of care (care processes delivered) among practices enrolled in a primary care programme over a 16-year period.
- Lifestyle processes were less well recorded, and there were declines in foot assessment and attendance at annual review, and participants continued to have poor risk factor control.
- Programmes may be limited when operating within the constraints of primary care and the wider service context.

Abstract

Aim To examine the quality of care delivered by a structured primary care-led programme for people with Type 2 diabetes mellitus in 1999–2016.

Methods The Midland Diabetes Structured Care Programme provides structured primary care-led management. Trends over time in care processes were examined (using a chi-squared trend test and age- and gender-adjusted logistic regression). Screening and annual review attendance were reviewed. A composite of eight National Institute for Health and Care Excellence-recommended processes was used as a quality indicator. Participants who were referred to diabetes nurse specialists were compared with those not referred (Student's *t*-test, Pearson's chi-squared test, Wilcoxon–Mann–Whitney test). Proportions achieving outcome targets [HbA_{1c} ≤58 mmol/mol (7.5%), blood pressure ≤140/80 mmHg, cholesterol <5.0 mmol/l] were calculated.

Results Data were available for people with diabetes aged ≥18 years: 1998/1999 (*n*=336); 2003 (*n*=843); 2008 (*n*=988); and 2016 (*n*=1029). Recording of some processes improved significantly over time (HbA_{1c}, cholesterol, blood pressure, creatinine), and in 2016 exceeded 97%. Foot assessment and annual review attendance declined. In 2016, only 29% of participants had all eight National Institute for Health and Care Excellence processes recorded. A higher proportion of people with diabetes who were referred to a diabetes nurse specialist had poor glycaemic control compared with those not referred. The proportions meeting blood pressure and lipid targets increased over time.

Conclusions Structured primary care led to improvements in the quality of care over time. Poorer recording of some processes, a decline in annual review attendance, and participants remaining at high risk suggest limits to what structured care alone can achieve. Engagement in continuous quality improvement to target other factors, including attendance and self-management, may deliver further improvements.

Introduction

Diabetes mellitus is a complex chronic condition requiring structured management, including a focus on treatment goals for blood pressure, glucose control and lipids, regular review and recall, screening for complications, and input from a multidisciplinary professional team [1]. Primary care, as a first point of contact and source of continuous, comprehensive and coordinated care, is often seen as a starting point for the delivery and organization of diabetes care [2]. Evidence suggests that primary care management can be as effective as hospital-led care if well supported and organized [2]. Efforts to optimize care across different health systems have led disease management programmes to better organize management in primary care and improve coordination between the community, outpatient/ambulatory and inpatient settings [3–5].

Disease management programmes in primary care incorporate different components: multidisciplinary cooperation; registration systems; audit and feedback; clinician reminders; patient and professional education; and/or the establishment of a specific communication system and ongoing collaboration between specialities and primary care (shared care). Structured approaches to diabetes care, combining some or all of these elements, demonstrate improvements in glycaemic control and cardiovascular risk factors [4,6], although the evidence for the effectiveness of shared care is less certain [7,8]. Specific components delivering significant improvements in clinical outcomes [6,8,9] and care processes [6], include access to a multidisciplinary team [8], case management [8], partial replacement of physicians by nurses [9], self-management promotion [8], and interventions to prompt recall and review of patients, including electronic registries, reminders and tracking systems [6]. Interventions operating at all levels of the health system (system, provider and patient), however, have demonstrated a greater effect on glycaemic control than interventions targeting a single level [8].

Despite growing evidence regarding ways to improve the quality of diabetes care, some uncertainties remain, including whether the effects achieved by evaluative quality improvement studies can be replicated in ‘real-life’ practice. Despite international consensus on optimal diabetes management, a gap persists between recommendations and actual practice [10]. With increasing pressure on primary care, growing patient numbers and workforce shortages [2,11], demonstrating the long-term sustainability of structured primary care management is a challenge. Internationally, high-quality service evaluations to address this evidence gap are lacking [11]. Most studies examining diabetes management in primary care have a relatively short follow-up [4,6,7], cannot provide an insight into the sustainability of these programmes over time, and may not be able to demonstrate effectiveness [7]. Few studies evaluate enhanced models of primary care management over a longer period, of 10 years or more [12–14].

In Ireland [15], as elsewhere in Europe [5], national policy in recent years has focused on moving from hospital-led management to delivering care in the community. Diabetes care is historically unstructured, but formal primary care initiatives have been developed across the country to improve the quality of care and service delivery at a local level. The longest running is the HSE Midland Diabetes Structured Care Programme (Midland Programme), established in 1997/1998. We aimed to examine the quality of care delivered by the Midland Programme over a long follow-up period (1999–2016) through a series of cross-sections. We reviewed the delivery of the programme by examining trends in the processes of care performed for people with Type 2 diabetes mellitus and benchmarked the programme against international standards [16,17].

Methods

Setting

In Ireland, the national prevalence of doctor-diagnosed diabetes among adults aged ≥18 years is 5.2%, an increase from 2.2% in 1998 [18]. Over one-third of adults (37%) are overweight and 23% are obese. The prevalence of smoking is 23% [19].

Midland Diabetes Structured Care Programme

The Midland Programme, based in four counties in Ireland (Longford, Westmeath, Laois and Offaly), includes several evidence-based intervention components: adoption of clinical guidelines; patient register and recall and protected time for review (three 30-min visits per year); organization and coordination of care by practice nurses; structured multidisciplinary support; and professional and patient education [8,9]. Practices are remunerated for patients' visits through an existing chronic disease programme, Heartwatch, or reimbursed for practice nurse time. Practices receive clinical (diabetes nurse specialists, podiatry/chiropody, dietetic), educational, and administrative support, which has changed since the programme was first established; for example, there has been a loss of dietetic support (Fig. 1).

Data collection

Diabetes nurse specialists extracted data from practice records on people with Type 1 and Type 2 diabetes (aged ≥18 years) enrolled at four time points: 1998/1999; 2003; 2008; and 2016. A census sample was selected in 1998/1999 and 2003, and a random sample in 2008 and 2016. In 2008, participants were sampled by sorting alphabetically first by name, and selecting every third person. In 2016, all participants who were still alive and were part of the census sample in 1998/1999 were selected. After ordering randomly, every third person was sampled from these participants. The remainder of the participants in 2016 were sampled by sorting alphabetically first by name, then sampling every third person. This approach was taken to approximate a random sample overall in 2016. Sample size was calculated based on precision of HbA_{1c} estimates. In 2003, the mean HbA_{1c} for the total sample was 60 mmol/mol (7.6%) and the 95% CI was ± 1 mmol/mol (0.11%), which equates to ~1.5%; therefore, a confidence level of 95% and CI of 2% was chosen to calculate the sample size for 2008 and 2016. Based on the total population of 2275 participants in 2008, the sample size was 1168. Based on the total population of participants in 2016 of 3797, the sample size was 1471. Only data on participants with Type 2 diabetes are reported here.

Data sources included clinical notes (electronic and paper), outpatient appointments letters and referrals to chiropody/podiatry, retinopathy and dietetics. Data were collected on demographics: age, gender and general medical services status (a means-tested method of public health insurance; general medical services cardholders have free access to general practitioner services and medications) [20]. Data were also collected on diabetes type, duration, annual review attendance, use of diabetes-related services (retinopathy screening, specialist eye services (any service in community or hospital, private or public), diabetes nurse specialist or podiatrist/chiropodist), prescription of diabetes medications (oral hypoglycaemic agents, insulin, injectables) and other medications (statins, angiotensin-converting enzyme inhibiters, aspirin). Data were collected on care processes carried out in the previous 12 months: foot assessment carried out by any healthcare professional (i.e. general practitioner, practice nurse, diabetes nurse specialist, consultant, podiatrist), measurement of glycated haemoglobin (HbA_{1c}), cholesterol, blood pressure, creatinine, albumin creatinine ratio, BMI, smoking status) and intermediate clinical outcomes (HbA_{1c}, cholesterol, triglycerides, blood pressure, creatinine). Smoking status (yes/no) in the past 12 months was determined on the basis of participants' response to a question about whether they smoke now. Data on complications were also collected: retinopathy, macrovascular [heart attack (myocardial infarction), heart failure (congestive cardiac failure), stroke (cerebrovascular accident), and mini stroke (transient ischemic attack)], peripheral neuropathy, autonomic neuropathy, foot risk category, and ulcer. Both eyes are checked during assessments and people were classified as having retinopathy if it was recorded in at least one eye. Both feet are also checked and classification of foot risk (low/moderate/high) was recorded on the basis of the highest risk in either foot. Ulcer was recorded as 'yes' if the person had an ulcer in at least one foot.

Analysis

Practice addresses were mapped to Electoral Divisions and assigned a deprivation score and decile using the 2011 National Deprivation Index for Health and Health Services Research developed by the Small Area Health Research Unit [21]. Data were represented as means ± SD or median (interquartile range; continuous data) or numbers and proportions (categorical data). Quality of care was defined using a composite of eight care processes recommended by the National Institute for Health and Care Excellence (NICE): HbA_{1c}, blood pressure, cholesterol, smoking status, BMI, creatinine, albumin creatinine ratio and foot examination[22], while recording of triglycerides was reported, this process was excluded from the composite. Trends over time in the proportion with processes recorded were examined using the chi-squared test for trend, and logistic regression models adjusted for age and gender. Trends in recording were examined for selected processes collected across all 4 years (HbA_{1c}, blood pressure, cholesterol, smoking status, BMI, creatinine) across practices. Differences in the proportion with processes recorded between participants aged <75 years and ≥75 years were examined using Pearson's chi-squared test. The proportions attending annual review and diabetes-related services were reported at different time points. Differences in the demographic and clinical profile of participants referred and those not referred to a diabetes nurse specialist were tested using Student's *t*-test or Wilcoxon–Mann–Whitney test (continuous data), and Pearson's chi-squared test (categorical data). Guidelines recommend people with complicated Type 2 diabetes mellitus attend a diabetes nurse specialist [23]. People with complicated Type 2 diabetes are defined as those requiring insulin, those with HbA_{1c} >58 mmol/mol (7.5%) on two or more glucose-lowering agents (not insulin), and those with complications or graded as having a high-risk foot [23]. Continuous outcome data were categorized according to international standards: blood pressure ≤140/80 mmHg, triglycerides <2.0 mmol/l, cholesterol 5.0 mmol/l and HbA_{1c} ≤58 mmol/mol (7.5%) [16,17, 24], and proportions of participants meeting clinical outcome targets were calculated. All analysis was carried out in STATA v.12 for windows (StataCorp, College Station, TX, USA).

Results

Profile of the sample population

Data on 336 people with Type 2 diabetes in 1998/1999 (10 practices), 843 in 2003 (20 practices), 988 in 2008 (30 practices), and 1029 (30 practices) in 2016 were available for analysis. Overall <10% of data were missing, with some exceptions depending on time points: creatinine (1–31%), BMI (27–44%), smoking status (21–32%), podiatrist/chiropodist attendance (0–17%) and dietitian attendance (0–40%). Where missing data occur, the figures represent the recorded data. Over 85% of general practitioners were based in practices within the lowest deprivation deciles: 9 (n=14, 41%) or 10 (n=15, 44%). In 2016, the median (interquartile range) age of the cohort was 68 (60–76) years, most were men (n = 603, 59%) and most had a general medical services card (n = 823, 80%). The median duration of diabetes was 9 years. The profile of people with Type 2 diabetes was similar across time points (Table 1).

Process measures

In 2016, recording for most care processes was >97%. Recording improved significantly since 1998/1999, with change more evident between earlier time points (Fig. 2). Recording of BMI and smoking status remained consistently lower than other processes. Although there was a significant improvement between 1998/1999 and 2008 (BMI: 60% vs 73%; smoking status: 68% vs 77%) recording remained below 80% from 2008 to 2016. The proportion of participants with a foot assessment in the past 12 months declined from 2008 to 2016 (77% vs 53%). In 2016, only 29% (n = 296) of participants had all eight NICE-recommended processes recorded.

Trends in recording were similar when stratified by age (<75 years and ≥75 years) with the exception of smoking status and blood pressure recording among participants <75 years (Table S1). At individual time points certain processes were consistently less well recorded (P< 0.05) among participants aged ≥75 years: 1999 (BMI: 64% vs 48%; triglycerides: 72% vs 51%), 2003 (BMI: 58% vs 48%; triglycerides: 93% vs 87%), 2008 (BMI: 75% vs 67%; triglycerides: 99% vs 96%; albumin creatinine ratio: 74% vs 67%), and 2016 (albumin creatinine ratio: 85% vs 75%)

Consistent improvements in recording were seen across all practices for HbA_{1c}, systolic blood pressure, cholesterol, triglycerides and creatinine. There was some variation in proportions recorded in 1999 among the 10 originally enrolled practices (HbA_{1c} 0–100%; blood pressure 69–100%; cholesterol 0–100%; triglycerides 0–100%; creatinine 0–97%). BMI and smoking status recording did not improve consistently, with some practices showing a decline in recording over time. Data for the 10 original practices are shown in Table S2.

Attendance at annual review and diabetes-related services

Annual diabetes review attendance increased between 1998/1999 (18%, *n* = 46/261) and 2008 (91%, *n* = 895/980), but dropped in 2016 (77%, *n* = 788/1025). In 2016, clinical characteristics were recorded for most participants who attended and did not attend annual review (HbA_{1c}: 100% vs 97%; blood pressure: 99% vs 93%; cholesterol: 100% vs 96%; creatinine: 100% vs 95%); however, there were differences in recording of foot assessment (57% vs 38%), BMI (79% vs 47%) and smoking status (86% vs 56%). A similar pattern was observed in 2008. In 2008, 58% of participants (*n* = 548/949) had seen a chiropodist or podiatrist in the past 12 months, which declined further by 2016 (51%, *n* = 439/863). In 2008, only 51% (*n* = 507/988) had attended specialist eye services, but in 2016, 80% (*n* = 800/1006) of participants had attended either the national screening programme (RetinaScreen) or specialist eye services. The proportion who had seen a hospital or community dietitian dropped from 50% (*n* = 167/336) in 1998/1999 to 7.1% (*n* = 42/610) in 2016, but recording quality also declined; 41% (*n* = 419/1029) were missing data in 2016 compared with 0.3% (*n* = 1/336) in 1998/1999.

Attendance at a diabetes nurse specialist increased between 2008 and 2016 (11% vs 15%). Participants who were referred had diabetes for longer and were younger than those who were not referred (Table 2). A greater proportion of people referred had poor glycaemic control [HbA_{1c} >58 mmol/mol (7.5%); 50% vs 20%; P<0.001], were on oral hypoglycaemic agents or injectables (98% vs 81%; P<0.001), and had retinopathy (41% vs 30%; P<0.01); however, a lower proportion were classified as having a high risk of foot disease (1.9% vs 4.4%; P<0.05).

Outcome targets

Over time, the proportion meeting blood pressure and lipid targets increased, whereas the proportion with HbA_{1c} ≤58 mmol/mol (7.5%) was similar (Table 1). Across time points, the proportion meeting all three outcome targets (HbA_{1c}, blood pressure and cholesterol) ranged from 12% (1999) to 39% (2016). Those at high risk [HbA_{1c} >58 mmol/mol (7.5%)] had diabetes for longer. The proportion on oral hypoglycaemic agents only was similar among high- and low-risk groups. A greater proportion at low risk were on oral hypoglycaemic agents or injectables (Table S3).

Discussion

We examined the quality of care delivered by a structured primary care management programme for people with Type 2 diabetes. We found significant improvements in process of care recording. These are consistent with changes in recording [3,6,13,14] reported by multifaceted international programmes with similar components: registration [6,13,14], practice guidelines [3,14], incentives [3], ongoing professional education [6,14], nurse case management [13], and structured multidisciplinary support [3]. Our findings suggest these changes can be sustained over time in a real-life setting; however, despite evidence of ongoing improvement, there may be limits to what structured programmes can achieve in the long term. BMI and smoking status were consistently less well recorded, and performance of foot assessment and attendance at dietetic and annual review declined in the later years of the programme, and some participants remained at high risk.

Unlike the Quality and Outcomes Framework in the UK, payment as part of the Midland Programme is not based on process recording. Smoking status and BMI recording remained lower than other processes, comparing poorly with the recent National Diabetes Audit [22], based on Quality and Outcomes Framework data, and with other European countries [25]. BMI and smoking status recording in the National Diabetes Audit, however, was also lower than recording of other processes. While incentivizing individual indicators can improve recording to a degree, poor documentation of certain processes may persist. Some may be given lower priority than other clinical measurements during review visits. BMI recording, for example, may only occur if a general practitioner or practice nurse recognizes the person with diabetes as overweight/obese, intends to offer management, or feels willing or able to engage in discussions about weight [26]. We found variation across practices in recording of BMI and smoking status, with some practices showing a decline in recording over time. With the exception of 2016, BMI was consistently less well recorded among older participants (aged ≥75 years). Foot assessments, also poorly recorded, have been more frequently performed among people with low income, poorer metabolic control, or complications, and less frequently by general practitioners compared with specialists [27]. Assessments may be time-consuming and unfeasible as part of regular review, or only prioritized when the general practitioner is aware of an increased risk of amputation.

We found a significant, improving trend over time in recording of care processes; however, this was driven by more substantial improvements between earlier time points. There was minimal change between 2008 and 2016 once recording >97% had been achieved; however, a similar pattern was observed for BMI and smoking status, although these were less well recorded. This suggests that recording may plateau irrespective of whether near maximal recording has been achieved or not. A plateau was also observed in the UK 1 year after the introduction of the Quality and Outcomes Framework [28], suggesting limits to what can be achieved through incentives, regardless of the reimbursement method. This raises the question of whether the Quality and Outcomes Framework should be replaced with a model to deliver more sustained improvements [29]. This has implications for the new Diabetes Cycle of Care initiative introduced in Ireland in 2015, which remunerates general practitioners for care of people with stable Type 2 diabetes who hold a general medical services card. Practices are paid on the basis of registering eligible people with diabetes, delivering two review visits per year, recording and reporting on care processes (clinical characteristics, routine foot screening/referral, lifestyle review), not on the basis of meeting clinical targets. The initiative may improve the delivery of care processes, but only up to a point. Scotland has recently replaced the Quality and Outcomes Framework, establishing general practitioner quality clusters, small groups of practices which engage in local, peer-led quality improvement activities [29]. While they may see an initial decline in care processes, there is scope for improvement beyond what is achievable through payments.

Although we did not track clinical outcomes in a fixed population, by reviewing outcomes in separate cross-sections, we gained some insight into the profile of people with diabetes receiving structured care. In Ireland, 40% of older adults (≥55 years) are reported to have high blood pressure (systolic blood pressure ≥140 mmHg), and 41% have cholesterol >5 mmol/l [30]. Although recording of most processes in the Midland Programme was >97%, many participants were in high risk categories in terms of glycaemic control and their cardiovascular profile. Between 2003 and 2016, 26–40% had HbA_{1c} >58 mmol/mol (7.5%), 41–52% had blood pressure >140/80 mmHg, and 15–42% had cholesterol >5 mmol/l, consistent with research showing recording does not necessarily translate to better outcomes [31].

Recording clinical values is a quality measure in itself which may indicate the need to intensify treatment; however, achieving outcome targets requires appropriate action by professionals and people with diabetes. Emphasizing processes alone, as with the Cycle of Care, may not deliver improved outcomes. Motivation of the person with diabetes, adherence to treatment and the efficacy of self-management, influence risk factor management [10], but were not captured in the present study. We found the proportion of people with HbA_{1c} ≤58 mmol/mol (7.5%) was similar across time points, which could reflect the long disease duration among participants or the declining effect of oral hypoglycaemic agents [32]. While treatment goals provide a benchmark for quality, Lipska *et al.* [33] have recently questioned the use of 'surrogate' outcome targets, such as HbA_{1c}, as quality indicators. They may not be appropriate for certain subgroups (e.g. the elderly or those with comorbidities) and should be individualized according to complication risk, preferences and control strategy. Greater emphasis has been placed on involving people with diabetes in the decision about their individual HbA_{1c} target [16,17]. Future monitoring of the Midland Programme should consider incorporating this information; that is, recording whether a target has been agreed, documenting the agreed target, and using this as a basis for evaluating the quality of care.

Although retinopathy screening attendance improved, in 2016, 20% had not attended specialist eye services or RetinaScreen, the new national screening and treatment programme introduced in 2013. National guidelines recommend that people with complicated Type 2 diabetes should attend a diabetes nurse specialist, including people requiring insulin, people with HbA_{1c} >58 mmol/mol (7.5%) on two or more glucose-lowering agents (not insulin), or people with complications or graded as having a high-risk foot [23]. In line with this recommendation, we found participants with more complicated diabetes were referred to a diabetes nurse specialist. While the rate of non-attendance was low overall, those who did not attend had a higher median HbA_{1c} than attenders. Further work is necessary to understand barriers to attendance among these participants, ways to improve attendance, and facilitate risk management. Although most participants attended for annual review, this declined between 2009 and 2016 (91% vs 77%). Transport, work and family commitments, and lack of motivation have been cited as reasons for non-attendance at annual review [34]; however, practice-level resource constraints could also account for this decline. An official annual review may not be performed at a single visit but instead components spread over several visits to lessen practice nurse workload. The increasing complexity of management may require longer reviews that cannot be incorporated into one visit [35]. Unlike clinical measurements, BMI, smoking status and foot assessment were less well recorded among those who did not attend annual review. These processes may not be a priority during regular visits, particularly for people with poor attendance.

Ireland is moving towards the delivery of structured, integrated diabetes management in primary care, with the establishment of the National Clinical Programme for Diabetes, the resourcing of community-based 'integrated' diabetes nurse specialists to facilitate delivery of the new model of integrated care that manages people with diabetes according to their complexity, and the Cycle of Care (Fig. 1) [23]; however, as a multi-component programme with good specialist support, the Midland Programme provides an insight into the impact of providing structured care in the community that predates these national changes (Fig. 1). As enhanced access to community-based specialist resources does not form part of the Cycle of Care initiative, care may be moved to the community in areas with less access to a well-resourced multidisciplinary team. Programmes such as the Midland Programme may also be influenced by health service changes. We observed a drop in dietetic screening alongside a loss of resources, further indicating the importance of sustained resources to deliver care in the community.

A strength of the present study is that it examines, over a long follow-up period, the impact of structured primary care-led service model, delivered in routine practice rather than as part of a quality improvement trial; however, participants were not the same at each time point (although some were represented at each). We also took different approaches to sampling at each time point. In 2008 and 2016, as the number enrolled in the programme exceeded 2000, it was not feasible to collect data manually on every participant, therefore, an appropriate random sample was taken. In 2016, as part of the larger sample taken at this time point, data were collected on all participants who had been enrolled in 1998/1999 and were still alive in 2016. This was done in order to facilitate a separate analysis which examines survival in the original cohort enrolled in the programme since its initiation. We can judge the overall delivery of the programme, but cannot infer the impact on individual participants since enrolment. Although different individuals were represented across different time points, it is encouraging that participants enrolled in this structured care programme were meeting outcome targets; however, we lacked control practices to determine whether changes in clinical outcomes reflected overall improvements in medication (e.g. new oral hypoglycaemic agents) and management in the time period, or in the organization and delivery of the programme. Most participants enrolled were on lipid-lowering or blood pressure medication. The programme is multifaceted so we cannot prove that one component was more effective than others. Data were extracted from general practice records, and we depended on the reliability of data from this source.

Our findings illustrate sustained improvements in the care delivered by practices in a multifaceted, primary-care led programme over time, suggesting this approach is feasible in real-life primary care; however, our findings also identify limits to what can be achieved by structured care programmes, particularly when operating within the resource constraints of primary care and the wider health service context. We need to better understand general practitioner management decisions, patient attendance, adherence and self-management, and whether these factors moderate the impact of these programmes. Programmes such as the Midland Programme should move beyond monitoring and engage in a continuous cycle of quality improvement to respond to the challenges of delivering optimal primary care-led diabetes care in everyday practice.

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Competing interests

None declared.

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Supporting information

Additional Supporting Information may be found in the online version of this article:

Table S1. Processes recorded among participants aged <75 years and ≥75 years with Type 2 diabetes 1999–2016.

Table 2. BMI and smoking status recording among participants with Type 2 diabetes 1999–2016 attending 10 general practices enrolled in programme since 1999.

Table S3 Demographics, duration and diabetes control among participants with Type 2 diabetes in 2016 (*n* = 1029**).**

FIGURE 1 National reforms, resources available to the programme, and participating general practitioners and people with diabetes enrolled 1999–2016. Information on numbers of resources (diabetes nurse specialists and podiatrists/chiropodists) were unavailable at time points between data collection. DNS, diabetes nurse specialist.

FIGURE 2 Participants with nine care processes recorded 1999–2016. *$P < 0.05$. Albumin: creatinine ratio was not recorded in 1999 and 2003; foot assessment was not recorded in 1999. Proportions were analysed using a chi-squared test for trend and logistic regression adjusted for age and gender. ACR, albumin:creatinine ratio.

Table 1 Characteristics and clinical profile of participants with Type 2 diabetes 1998/1999–2016*

	1998/1999 ***n*** **= 336**	**2003** ***n*** **= 843**	**2008** ***n*** **= 988**	**2016** ***n*** **= 1029**
Median (IQR) age, years	65 (56–74)	65 (56–73)	66 (59–74)	68 (60–76)
Male, *n* (%)	168 (50)	438 (52)	562 (57)	603 (59)
Median (IQR) diabetes duration, years	NA	NA	6 (3–9)	9 (5–12)
General medical services	NA	NA	NA	823 (80)
Mean (SD) BMI, kg/m^2	29.3 (4.7)	30.6 (4.8)	30.6 (4.8)	31.2 (5.9)
BMI <25 kg/m^2, *n* (%)	33 (16)	42 (9)	94 (13)	81 (11)
Smokers, *n* (%)	58 (25)	123 (20)	146 (19)	121 (15)
Diabetes treatment, *n* (%)				
Diet only	60 (18)	187 (22)	131 (13)	173 (17)
OHA only	262 (80)	532 (70)	685 (70)	643 (63)
Insulin + OHA	0 (0)	39 (4.6)	131 (13)	140 (14)
Insulin only	10 (3.0)	25 (3.0)	38 (3.9)	21 (2.0)
Statins, *n* (%)	NA	NA	799 (81)	854 (83)
ACE inhibitors, *n* (%)	NA	NA	734 (74)	680 (67)
Aspirin, *n* (%)	NA	NA	740 (75)	611 (59)
Mean (SD) HbA_{1c}				
mmol/mol	55 (18)	58 (18)	53 (13)	54 (14)
%	7.2 (1.7)	7.5 (1.6)	7.0 (1.2)	7.1 (1.3)
HbA_{1c} concentration, *n* (%)				
<48 mmol/mol (6.5%)	104 (37)	229 (29)	351 (36)	364 (36)
≤53 mmol/mol (7.0%)	156 (55)	382 (48)	589 (61)	607 (59)
≤58 mmol/mol (7.5%)	191 (67)	481 (60)	720 (74)	770 (75)
Mean (SD) systolic blood pressure, mmHg	144.4 (19.9)	140.5 (18.7)	135.9 (16.3)	135.1 (16.0)
Systolic blood pressure, *n* (%)				
<130/80 mmHg	25 (8.0)	96 (12)	212 (22)	212 (21)
≤140/80 mmHg	112 (36)	405 (48)	560 (57)	597 (59)
Mean (SD) cholesterol, mmol/l	5.3 (1.2)	4.9 (1.0)	4.1 (1.1)	4.1 (1.0)
Cholesterol concentration, *n* (%)				
<4.5 mmol/l	60 (23)	268 (33)	647 (67)	711 (70)
<5.0 mmol/l	102 (38)	450 (55)	785 (81)	846 (83)
Mean (SD) triglycerides, mmol/l	2.4 (1.5)	2.1 (1.9)	1.8 (1.2)	1.7 (1.5)
Triglycerides <2.0 mmol/l, *n* (%)	103 (46)	460 (60)	684 (71)	760 (75)
Mean (SD) creatinine, µmol/l	86.5 (30.1)	84.8 (20.7)	87.8 (46.0)	86.5 (34.0)

NA, not available (data on this variable were not collected at this time point); ACE, angiotensin-converting-enzyme; IQR, interquartile range; OHA, oral hypoglycaemic agent.

*Based on available data: age: 1999 (336), 2003 (842), 2008 (987), 2016 (1,028). Diabetes duration: 2008 (848), 2016 (1005). GMS: 2016 (1027). BMI: 1999 (203), 2003 (470), 2008 (725), 2016 (736). Smoking status: 1999 (230), 2003 (629), 2008 (759), 2016 (813). Diabetes treatment: 1999 (332), 2003 (843), 2008 (985), 2016 (1026). Statins: 2008 (987), 2016 (1028). Aspirin: 2008 (986), 2016 (1027). ACE inhibitor: 2008 (984), 2016 (1017). HbA_{1c}: 1999 (284), 2003 (799), 2008 (967), 2016 (1021). Blood pressure: 1999 (311), 2003 (836), 2008 (979), 2016 (1008). Cholesterol: 1999 (267), 2003 (815), 2008 (973), 2016 (1018). Triglycerides: 1999 (226), 2003 (771), 2008 (968), 2016 (1012). Creatinine: 1999 (234), 2003 (695), 2008 (971), 2016 (1016).

Table 2 Profile of participants who were referred to a diabetes nurse specialist* in 2016

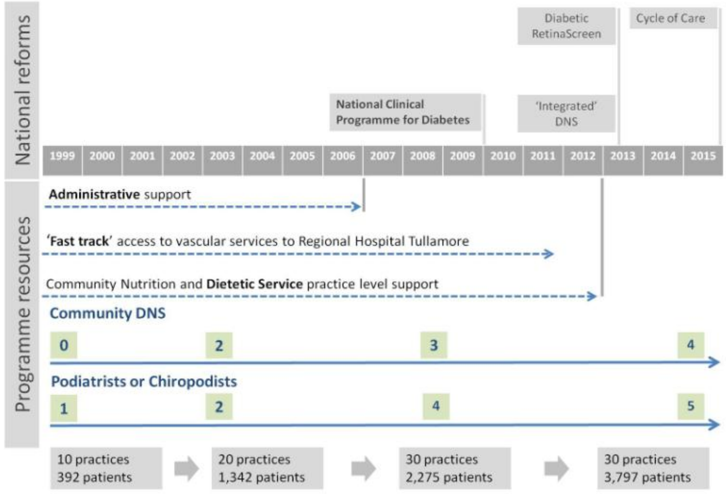
	Referred to diabetes nurse specialist		
	Yes *n* = 153	No *n* = 866	Yes, but did not attend *n* = 9
Median (IQR) age†, years	65 (56–71)	69 (61–76)	58 (53–63)
Men, *n* (%)	88 (58)	511 (59)	4 (44)
Median (IQR) diabetes duration†, years	10 (6–14)	9 (5–12)	9.5 (9–12)
Mean (SD) BMI, kg/m^2	32.1 (6.1)	31.0 (5.9)	32.6 (4.4)
Smoker, *n* (%)	21 (18)	99 (14)	1 (13)
Diabetes control†, *n* (%)			
Diet only	3 (2.0)	168 (19)	1 (11)
OHA only	71 (47)	569 (66)	3 (33)
Insulin only	5 (3.3)	15 (1.7)	1 (11)
Insulin and OHA	57 (38)	81 (9.3)	2 (22)
Injectables and OHA	16 (11)	31 (3.6)	2 (22)
OHA or injectable†‡	149 (98)	696 (81)	8 (89)
HbA_{1c} > 58 mmol/mol (7.5%), *n* (%)	80 (50)	172 (20)	4 (50)
Median (IQR) HbA_{1c}†			
mmol/mol	60 (50–69)	50 (44–57)	64 (52–69)
%	7.6 (6.7–8.5)	6.7 (6.2–7.4)	8.0 (6.9–8.5)
Mean (SD) systolic blood pressure, mmHg	133.7 (14.2)	135.4 (16.3)	127.2 (12.2)
Complications, *n* (%)			
Retinopathy†	54 (41)	197 (30)	3 (50)
Macrovascular	8 (5.2)	89 (10)	2 (22)
Peripheral neuropathy	7 (4.6)	29 (3.4)	0 (0)
Autonomic neuropathy	5 (3.3)	28 (3.2)	0 (0)
High-risk foot†	2 (1.9)	14 (4.4)	1 (17)
Ulcer	4 (2.7)	20 (2.3)	0 (0)

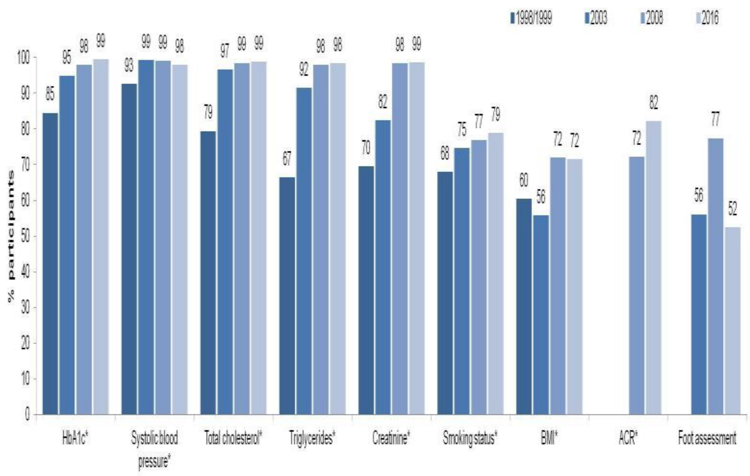
IQR, interquartile range; OHA, oral hypoglycaemic agent.

*People with complicated Type 2 diabetes should attend a diabetes nurse specialist. This includes people requiring insulin, people with HbA_{1c} >58 mmol/mol (7.5%) on two or more glucose-lowering agents (not insulin), and people with complications or graded as having a high-risk foot [23].

†$P < 0.05$; difference in people attending and not attending diabetes nurse specialist visit were analysed using Student's *t*-test or Wilcoxon–Mann–Whitney test for continuous data and Pearson’s chi-squared for categorical data.

‡OHA, insulin or other injectable.


National reforms
Diabetic RetinaScreen
Cycle of Care
National Clinical Programme for Diabetes
'Integrated' DNS
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Programme resources
Administrative support
'Fast track' access to vascular services to Regional Hospital Tullamore
Community Nutrition and Dietetic Service practice level support
Community DNS
0
2
3
4
Podiatrists or Chiropodists
1
2
4
5
10 practices 392 patients
20 practices 1,342 patients
30 practices 2,275 patients
30 practices 3,797 patients


1998/1999
2003
2008
2016
% participants
HbA1c*
Systolic blood pressure*
Total cholesterol*
Triglycerides*
Creatinine*
Smoking status*
BMI*
ACR*
Foot assessment