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# **A Longitudinal Analysis of Type 2 Diabetes Data in the Southern Highlands Division of General Practice**

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# 1 Executive summary

Diabetes has been recognized by the Australian Health Ministers since 1996 as one of the five top National Health Priority Areas due to its personal and public health impact. Although Divisions have run diabetes programs for a number of years, there has been no research that investigates change in diabetes care associated with division diabetes programs over a long period, eg more than 10 years. The Southern Highlands Division of General Practice (SHDGP) has been in operation since 1995 and was the second division to use CARDIAB in Australia. The aim of this study was to examine the change in process, quality and outcomes of general practice care for people with diabetes in this unique data base over the 11 years from 1995 to 2005. A total of 8622 de-identified diabetic patient records (6450 of type 2 diabetes) were extracted from the SHDGP CARDIAB register. All the patients could only have one evaluation record in each of the 11 years. The focus of the analysis in this study was on patients with type 2 diabetes.

## **Key findings:**

1. Data on demographics, diabetes history, diabetes therapy method and participation in Division Programs was recorded reliably across all 11 years. Only about half of the physical examinations and pathology tests were fully recorded. Records of other medications (antihypertensive and lipid lowering therapy) and other management such as education and referral were very incomplete. Few complications were reliably recorded.
2. In the SHDGP, there were new patients continuously registered in the Division Program each year. Evaluations increased each year and were greatest in 2005. It is estimated that 86.7% of people with diagnosed diabetes were recorded as being evaluated on the Division register in 2004. Although the number of individual GPs did not change much since 1996 (range: 41-51), the number of individual patient evaluation records persistently increased each year over the 11 years. The patient records at registration in type 2 diabetes doubled for patients over 45-54 years of age, reaching a peak at 65-74 years of age.
3. There was some variability in the quality of care for patients with type 2 diabetes during the 11 year study period. After an initial increase in the frequency of all quality of care measures except for smoking, during 1998 – 2000 the number of quality care measures

declined and then increased again between 2001 and 2005. The indicators' assessment rate most often fluctuated between 50% and 80%.

4. The overall trend for each of the intermediate health outcome variables (HbA1c, total cholesterol, high density lipoprotein cholesterol, low density lipoprotein cholesterol, total triglycerides, systolic blood pressure and diastolic blood pressure) decreased over the 11 years. A comparison of health outcomes reported in 1995 with those reported in 2005, shows over this longer 11 year period there were significant improvements in total cholesterol (TC), Low Density Lipoprotein cholesterol (LDL), total triglycerides (TG), systolic blood pressure (SBP) and diastolic blood pressure (DBP).
5. The overall proportion of patients who achieved targeted health outcomes during the study period increased except for BMI which showed little change. The proportion of patients in the target range for BP, body mass index (BMI) and TC were less than 25% over the 11 years. 60 % to 90% of patients achieved targets for HDL over the 11 years. Since 2002, more than 50% of the HbA1c and TG assessments have met the targeted outcomes.
6. BMI and DBP tended to decrease and HDL tended to increase the longer patients attended the Diabetes Program. The proportion of patients meeting targets for HDL and TG tended to increase with increasing number of years in the Division Program. The trends for other indicators were not consistent over the study period.

## **Conclusions**

Up to 2004, an estimated 86.7% of patients aged 25+ who have been diagnosed with diabetes in the SHDGP were recorded on the Divisions Register. This demonstrates the success of the Division Diabetes Program in involving GPs and reaching patients in the Southern Highlands area. There was a large increase in the number of patients with diabetes after the age 45 registered in CARDIAB. This has implications for screening diabetic patients in the 45-54 year age group. Although the trend in quality of care was variable, the overall trend of most outcomes improved over the 11 year period. This is likely to have been due to the impact of the Divisions Diabetes Program over this period as well as incentives such as the (National Integrated Diabetes Program (NIDP) which was introduced late in 2001. However, there is still considerable room for improvement especially in relation to the control of weight and blood pressure which are important risk factors for stroke and myocardial infarction in patients with diabetes.

## **2 Background**

### **Diabetes in Australia**

In Australia, the AusDiab survey found that type 2 diabetes affects over 7.4% of the total population aged over 25 years<sup>1</sup>. Almost a million Australians have diabetes, but half of these people are unaware of it. In terms of expenditure, diabetes is a costly disease, associated with substantial morbidity and mortality, especially if undetected or poorly controlled. McCarty et al (1996) estimated that the direct annual health care costs of diabetes in Australia, as high as \$1.4 billion in 1995, will reach \$2.3 billion by 2010. In 1996, recognizing its personal and public health impact, the Australian Health Ministers made diabetes one of the five top National Health Priority Areas<sup>2</sup>.

Cardiovascular disease (CVD) is the leading cause of death in Australia. Diabetes is a major CVD risk factor<sup>3,4</sup>. People with diabetes are two to four times more likely to develop CVD<sup>5</sup>, with about 65% of persons with diabetes dying from it<sup>6</sup>. In addition, people with type 2 diabetes have high rates of other CVD risk factors such as hypertension, dyslipidemia and obesity. The risk of developing CVD increases when people have diabetes in conjunction with other risk factors. Poor control of diabetes also contributes to this risk and to the risk of microvascular complications including diabetic retinopathy and renal disease.

Diabetes affects an increasing number of people in Australia and the burden of serious complications and their sequelae can be considerable both for the individuals concerned and for health services in general. However, the impact of diabetes (and many aspects of diabetic complications can be prevented or limited with good management of the condition, including patient education to change lifestyle risk factors, monitoring of blood pressure, blood levels of glycaemia and lipids, monitoring for complications and providing appropriate therapy.

### **Division Diabetes Programs and CARDIAB**

Divisions of General Practice are local organisations of general practitioners. Divisions play an important role in assisting practices to provide high quality care as well as helping to integrate general practice with the rest of the health system. In order to support quality improvement in practices and encourage evidence based care, most Divisions of General Practice run diabetes programs either as a single disease program or as part of CVD risk prevention programs or broader chronic disease programs.

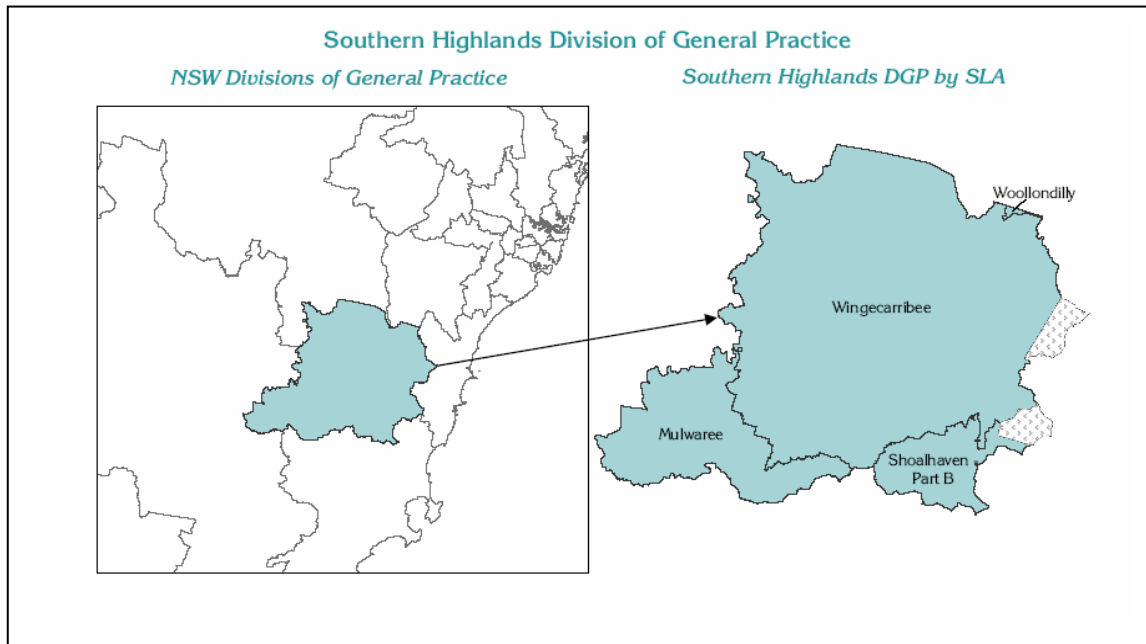
The National Divisions Diabetes Program (NDDP) was established in 1996. It is a co-ordinated national approach to diabetes care in Australian general practice. It involves a network of individuals and organisations with an interest in general practice diabetes care. This program helped to inform the policy underpinning the National Integrated Diabetes Program (NIDP) established in 2001, to develop an agreed minimum clinical data set for diabetes in general practice together with the National Diabetes Data Working Group and to assist Divisions to inform and support GPs to provide better quality of care for people with diabetes.

CARDIAB is a division-based electronic diabetes register. It was developed from an earlier version of the database developed by the Macarthur Divisions of General Practice (MDGP) and the Southern Highlands Divisions prior to 1998. Since then, CARDIAB has been used by up to 40 Divisions. Divisions use CARDIAB to support GPs management of diabetic patients through recalls, audits, identification of high risk patients, quality improvement activities and program planning and development<sup>7, 8</sup>. Harris et al found that GPs who used division-based electronic diabetes registers were more likely to provide better quality patient care than those who did not<sup>9</sup>.

### **The South Highlands Division of General Practice**

The Southern Highlands Divisions of General Practice (SHDGP) was established in 1994. The Division is located 130km south west of Sydney and comprises the Wingecarribee Shire plus Bargo and part of the Kangaroo Valley. The main centre is the town of Bowral (Figure 1). The SHDGP so far has 5.2 full time staff. There are 52 GPs in this area. 42 of them are located in 6 large practices, 3 in two GP units and 3 in sole units. 50 GPs join the division membership. During 1996-2001, Census data reports a population increase by 7.8% from 40449 to 43584 in the SHDGP area. In 2001, among the total population, there were 497 (1.2%) people identified as Aboriginal or Torres Strait Islander, and 5,952 (14.6%) who were residents born overseas<sup>10, 11</sup>.

**Figure 1: Southern Highlands Division of General Practice**



(Picture source: PHIDU. Population health profile of the Southern Highlands Division of General Practice. Population Profile Series: No. 32. Public Health Information Development Unit (PHIDU), Adelaide, 2005)

In 1995, the SHDGP began collecting diabetes clinical data in CARDIAB from local general practices and employed a Diabetes Educator. The entire GP membership of the Division participates in the Division Diabetes Program. Over the past 11 years the Division has provided various services and activities including:

- one-to-one and group education to patients with diabetes and now also those patients identified with pre-diabetes;
- an exercise and lifestyle program;
- ongoing professional development to GPs;
- assistance with care planning, the Diabetes Incentive Payments and the new Chronic Disease Management Items; and
- electronic messaging of diabetes data from practice software (Medical Director) to the Division.

### **Why do this study?**

Although Divisions have run diabetes programs for a number of years, there has been no research that investigates change in diabetes care associated with division diabetes programs over a long period. The SHDGP was the second division to use CARDIAB and has been in operation since 1995. The aim of this study was to examine the change in process and outcomes of general practice care for people with diabetes in this unique data base over the 11 years from 1995 to 2005. This study will provide useful and important information to assist

with improvements in diabetes care in general practice and the role of Division programs in promoting and supporting developments.

### **3 Aim and Objectives:**

#### **3.1 Aim**

- To investigate the changes in diabetes management in the Southern Highlands general practices over the last 11 years

#### **3.2 Objectives**

Over 11 years from 1995 to 2005 we will investigate:-

- the change of Division based diabetes register data quantity and quality
- the quality of diabetes care
- the clinical health outcomes relating to diabetes

## 4 Methods:

### 4.1 Ethics approval:

Ethics approval for this study was obtained from the human research ethics committee of the University of New South Wales (UNSW) for analysis of the de-identified data.

### 4.2 Data collection and management

A total of 11 years (1995-2005) of de-identified data was extracted from the Southern Highland Division of General Practice (SHDGP) CARDIAB register. All the patients could only have one evaluation record in each of the 11 years.

The data cleaning was conducted in the Centre for Primary Health Care and Equity<sup>12</sup>. All the missing and invalid data were identified based on the following criteria:

- Sex=unknown
- Male = Pregnant or GDM
- Female < 15 or > 50 = Pregnant or GDM,
- DOB>2005 or Year of diagnosis or Year of evaluation
- YearDx>YearEval
- Duration of diabetes>age
- On Insulin Since Year < Date of Diagnosis or DOB
- Type 1 and Rx = Diet or Tablets
- Type 1 and On Insulin Since Year >= 3 years after Date of Diagnosis
- Age at diagnosis < 18 and Diabetes status=type 2
- Diastolic BP > Systolic BP
- Systolic <70 mmHg or >240 mmHg or Diastolic <40 mmHg or >130 mmHg
- Age >14 and Height < 1.0 Metres or > 2.0 Metres
- Age >14 and Weight < 30 Kg or > 180 Kilograms
- Age < 14 and Height >2.0 metres or Age <14 and Weight> 180 Kg
- Weight < 20 Kg and height >1.5 Metres or Weight > 50kg and Height < 1.0 Metres
- Total cholesterol >30 or <0.4 mmol/l
- HDL cholesterol >2.5 or <0.4 mmol/l
- Triglycerides >50 or <0.5 mmol/l
- HbA1c >50 or <2.1

Those data identified as missing or invalid were sent back to the SHDGP for checking and correcting.

### 4.3 Criteria used in this study:

Since 2001, GPs can receive reimbursement from the Health Insurance Commission (HIC) if they implement a cycle of care over a 12 month period for diabetic patients as part of the National Integrated Diabetes Program (NIDP). The Royal Australian Collage of General Practitioners (RACGP) has set up goals for guiding the management of diabetes<sup>13</sup>. The 2004

guidelines were used to analyze the achievement of targeted health outcomes. Table 1 lists the criteria used in our study for judging the quality of care (QOC) delivered and health outcomes achieved during the study period.

**Table 1: Criteria used in this study**

|                | <b>NIDP (QOC)</b> | <b>RACGP (Health outcomes)</b>   |
|----------------|-------------------|--|
| HbA1c          | once per year     | ≤7 %   |
| Blood lipids   | once per year     | TC < 4.0 mmol/L<br>LDL < 2.5 mmol/L<br>HDL > 1.0 mmol/L<br>TG < 2.0 mmol/L |
| Ht/Wt/waist    | every 6 months    | BMI < 25 kg/m <sup>2</sup>   |
| Blood pressure | every 6 months    | < 130/80* mm Hg  |
| Smoking review | once a year       | Cigarette consumption zero   |

\*NHMRC Evidence-based Guidelines for the Management of Type 2 Diabetes, 2004.

HbA1c- glycosylated haemoglobin; TC- total cholesterol, HDL- high density lipoprotein cholesterol, LDL- low density lipoprotein cholesterol, TG-total triglycerides, BP- blood pressure, BMI- body mass index, Ht-height, Wt-weight

#### **4.4 Statistical methods:**

SPSS version 14.0 was used to analyze the data. Continuous variables were shown as mean ± standard deviation (SD) and categorical variables as frequency (%). Comparison was conducted by independent t-test between two groups and by ANOVA test among more than two groups. Significance level was set at  $\alpha = 0.05$ .

## **5 Results**

### **5.1 Data quality**

There were 8622 patient records extracted from CARDIAB for the period 1995 to 2005. Each record included 147 variables. These variables were divided into 7 main groups:

- Demographics,
- Diabetes history,
- Physical examinations,
- Pathology tests,
- Complications,
- Management
- Division program.

Data on demographics, diabetes history and patient participation in division programs was recorded reliably across all 11 years. Approximately half of the physical examinations and pathology tests were fully recorded over the study period. Diabetes therapy method was recorded well but other medication therapies (antihypertensive therapy, lipid lowering therapy) and other management such as patient education and referral were very incomplete. Only a few complications were reliably recorded (nephropathy, eye disease). Because of this we have focused our analysis on data that was reliably recorded during the study period.

The main reasons for poorly recorded data or missing/invalid/unknown values are likely to:

- Patient information had not been requested / recorded.
- Patient information was recorded incorrectly.
- Patient information was not provided by GPs to the Division
- Some GPs did not always follow the guidelines and check all the blood tests (ie: for lipids test, they just checked TC, but not LDL or HDL).

### **5.2 Registration and Evaluation:**

#### **5.2.1 Patient information**

There were a total of 8622 diabetes evaluation records from 1995 to 2005 recorded in the SHDGP database, covering 2018 individual patients. There were 6540 type 2 diabetes evaluation records, covering 1467 individual patients. (Please see Table 2)

**Table 2: Total patient evaluation records in 11 years (1995-2005)**

| Diabetes type                 | Number      | Percentage   |
|-------------------------------|-------------|--------------|
| Type 1                        | 1112        | 12.9         |
| <b>Type 2</b>                 | <b>6540</b> | <b>75.9</b>  |
| GDM                           | 31          | .4           |
| Previous GDM                  | 67          | .8           |
| Other (secondary diabetes)    | 128         | 1.5          |
| IFG                           | 3           | .0           |
| IGT                           | 326         | 3.8          |
| Not diagnosed (with diabetes) | 40          | .5           |
| Unknown                       | 141         | 1.6          |
| Subtotal                      | 8388        | 97.3         |
| Missing                       | 234         | 2.7          |
| <b>Total</b>                  | <b>8622</b> | <b>100.0</b> |

As the following tables show (Table 3 and Table 4), similar trends were found for all types of diabetic patients and patients with type 2 diabetes: The number of patient evaluation records increased during the study period. However, the number of new patient registrations records fluctuated, with a decline occurring over the last 4 years.

**Table 3: New Patient registration records over time**

| Year         | All DM      | %            | <b>Type 2</b> | %            |
|--------------|-------------|--------------|---------------|--------------|
| Up to 1995   | 623         | 7.2          | <b>517</b>    | 7.9          |
| 1996         | 1502        | 17.4         | <b>1098</b>   | 16.8         |
| 1997         | 1022        | 11.9         | <b>841</b>    | 12.9         |
| 1998         | 583         | 6.8          | <b>451</b>    | 6.9          |
| 1999         | 801         | 9.3          | <b>646</b>    | 9.9          |
| 2000         | 508         | 5.9          | <b>407</b>    | 6.2          |
| 2001         | 1172        | 13.6         | <b>943</b>    | 14.4         |
| 2002         | 877         | 10.2         | <b>696</b>    | 10.6         |
| 2003         | 714         | 8.3          | <b>445</b>    | 6.8          |
| 2004         | 566         | 6.6          | <b>330</b>    | 5.0          |
| 2005         | 254         | 2.9          | <b>166</b>    | 2.5          |
| <b>Total</b> | <b>8622</b> | <b>100.0</b> | <b>6540</b>   | <b>100.0</b> |

**Table 4: Patient evaluation records over time**

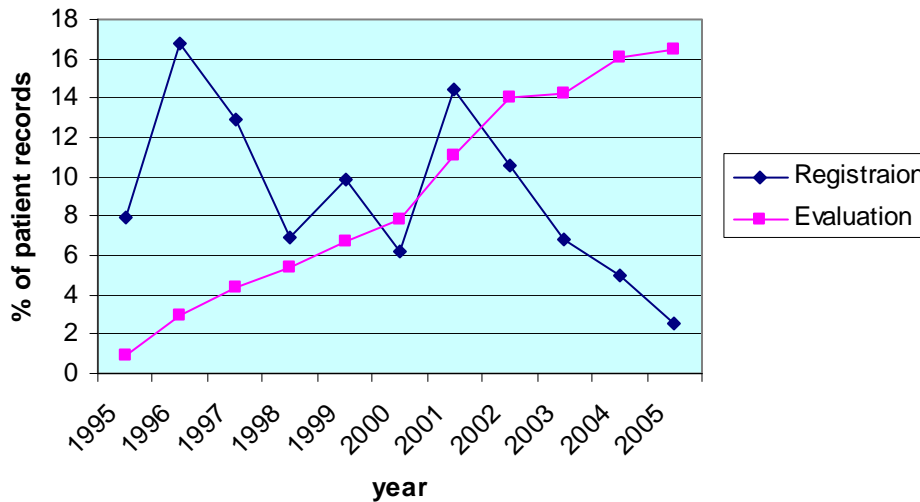
| Year         | All DM      | %            | Type 2      | %            |
|--------------|-------------|--------------|-------------|--------------|
| 1995         | 70          | .8           | 58          | .9           |
| 1996         | 259         | 3.0          | 197         | 3.0          |
| 1997         | 372         | 4.3          | 291         | 4.4          |
| 1998         | 448         | 5.2          | 350         | 5.4          |
| 1999         | 556         | 6.4          | 435         | 6.7          |
| 2000         | 647         | 7.5          | 508         | 7.8          |
| 2001         | 912         | 10.6         | 724         | 11.1         |
| 2002         | 1154        | 13.4         | 915         | 14.0         |
| 2003         | 1220        | 14.1         | 927         | 14.2         |
| 2004         | 1450        | 16.8         | 1053        | 16.1         |
| 2005         | 1534        | 17.8         | 1082        | 16.5         |
| <b>Total</b> | <b>8622</b> | <b>100.0</b> | <b>6540</b> | <b>100.0</b> |

For both all types of diabetic patients and patient with type 2 diabetes, there were new patients continuously registered in the Division Program each year throughout the study period. There were two peak periods of registration in 1996 and 2001. Evaluations increased each year and were the greatest in 2005. Registrations (all diabetes types: 58.4%, type 2 diabetes: 60.6%) were more frequent in the first 6 years (1995-2000) and evaluations (all diabetes types: 72.7%, type 2 diabetes: 71.9%) were more frequent in the last 5 years (2001 to 2005). For the first 5 years after registration, evaluations were recorded for most patients. After this time, an increasing number tended to drop out of the division register. (Please see Table 5, Figure 2 and Figure 3)

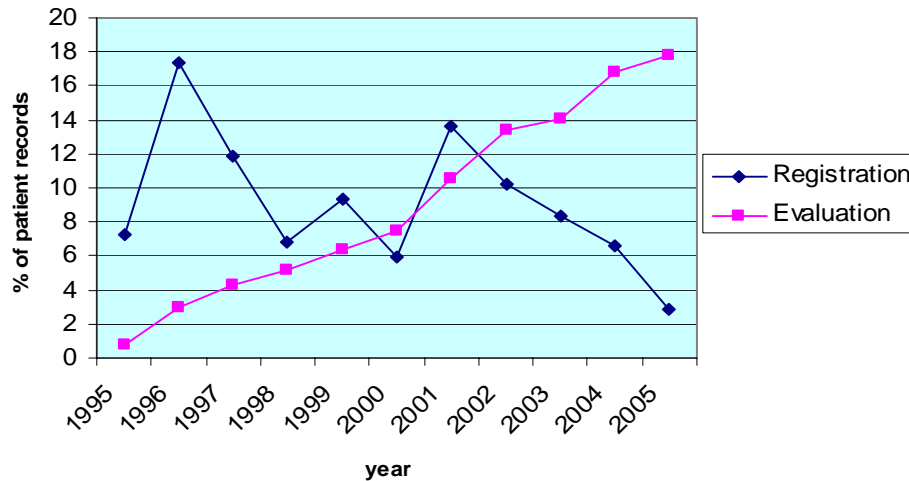
**Table 5: Patient registration records in 11 years by year of evaluation in type 2 diabetes**

| Registration | Evaluation |            |            |            |            |            |            |            |            |             |             | total       |
|--------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|
|              | 1995       | 1996       | 1997       | 1998       | 1999       | 2000       | 2001       | 2002       | 2003       | 2004        | 2005        |             |
| Up to 1995   | 58         | 56         | 55         | 52         | 50         | 49         | 49         | 49         | 35         | 34          | 30          | 517         |
| 1996         |            | 141        | 129        | 124        | 116        | 114        | 113        | 111        | 91         | 83          | 76          | 1098        |
| 1997         |            |            | 107        | 104        | 99         | 98         | 97         | 97         | 89         | 82          | 68          | 841         |
| 1998         |            |            |            | 70         | 63         | 63         | 62         | 61         | 49         | 45          | 38          | 451         |
| 1999         |            |            |            |            | 107        | 107        | 107        | 106        | 79         | 76          | 64          | 646         |
| 2000         |            |            |            |            |            | 78         | 78         | 78         | 65         | 61          | 48          | 407         |
| 2001         |            |            |            |            |            |            | 217        | 217        | 183        | 175         | 151         | 943         |
| 2002         |            |            |            |            |            |            |            | 195        | 179        | 171         | 152         | 697         |
| 2003         |            |            |            |            |            |            |            |            | 157        | 154         | 134         | 445         |
| 2004         |            |            |            |            |            |            |            |            |            | 174         | 155         | 329         |
| 2005         |            |            |            |            |            |            |            |            |            |             | 166         | 166         |
| <b>total</b> | <b>58</b>  | <b>197</b> | <b>291</b> | <b>350</b> | <b>435</b> | <b>508</b> | <b>724</b> | <b>915</b> | <b>927</b> | <b>1053</b> | <b>1082</b> | <b>6540</b> |

**Figure 2: Patient registration and evaluation records by year for all types of diabetes**



**Figure 3: Patient registration and evaluation records by year for type 2 diabetes**



In the SHDGP, based on Census data in 1996 (40449) and 2001 (43584), the proportion of the Southern Highlands population on the division diabetes register was 0.6% in 1996 and 2.1% in 2001. 1443 patients aged 25+ (with 7 aged <25 in 1450 patients) had evaluations recorded in 2004. This compares with the estimated number of people diagnosed with diabetes in the Southern Highlands of 1664 (estimate based on prevalence according to AusDiab of people with diagnosed diabetes adjusted for Aboriginality of population- total 3328 aged 25+, half of them might be undiagnosed)<sup>14</sup>. This suggests that 86.7% of diabetic patients aged 25+ in the SHDGP were recorded on the division diabetes register in 2004.

Table 6 shows that patients were most likely to have evaluations within their first 5 years in the Division Program. Those patients who had been registered for a long period were found to be less likely to have an annual evaluation. This may be due to patients relocating,

withdrawing from the Program or cases where some GPs may have considered the ongoing submission of an evaluation report to the Division as not being important.

**Table 6: Patient records by number of years in the division diabetes program**

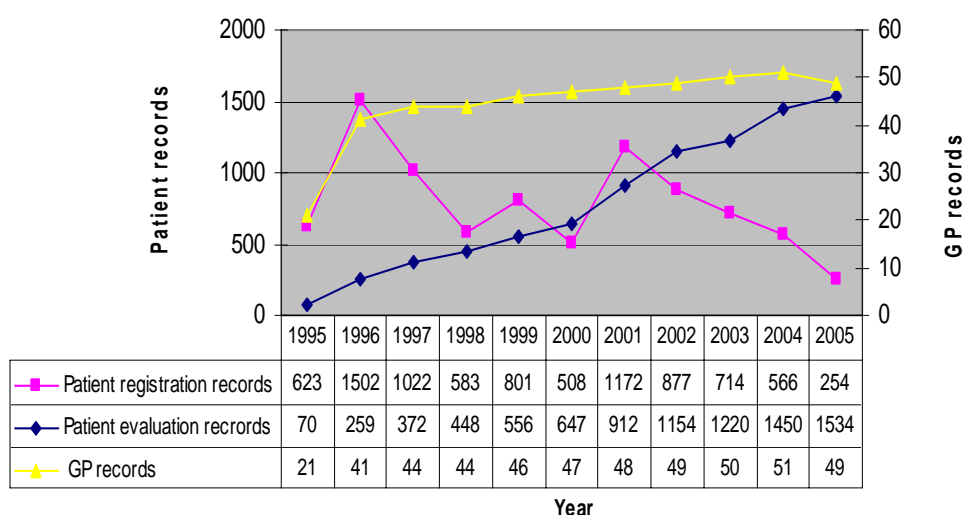
| No. of years | all types |      | type 2 |      |
|--------------|-----------|------|--------|------|
|              | n         | %    | n      | %    |
| 1            | 2018      | 23.4 | 1467   | 22.4 |
| 2            | 1693      | 19.6 | 1242   | 19.0 |
| 3            | 1331      | 15.4 | 1015   | 15.5 |
| 4            | 1042      | 12.1 | 827    | 12.6 |
| 5            | 782       | 9.1  | 614    | 9.4  |
| 6            | 552       | 6.4  | 431    | 6.6  |
| 7            | 461       | 5.3  | 358    | 5.5  |
| 8            | 330       | 3.8  | 260    | 4.0  |
| 9            | 236       | 2.7  | 186    | 2.8  |
| 10           | 140       | 1.6  | 110    | 1.7  |
| 11           | 37        | 0.4  | 30     | 0.5  |

### 5.2.2 GP information

There were 190 (individual) GPs recorded in the database over the study period. The number of GPs captured in CARDIAB in the SHDGP ranged from 41 in 1996 to 51 in 2005.

Since 1996, although the number of GPs tended to fluctuate (range: 41-51), the number of patient evaluation records recorded, persistently increased each year over the study period (Please see Figure 4).

**Figure 4: Patient and GP records at registration and evaluation in each year for all types of diabetes.**



### 5.3 Demographics:

(Note: the following analysis is for patients with type 2 diabetes)

Table 7 and Figure 5 show that the patient records at registration in type 2 diabetes doubled for patients between 45-54 years of age, and was most commonly found for patients between 65-74 years of age.

**Table 7: Patient records at registration by age and sex in type2 diabetes**

| Age group    | male        |             | female     |             | Total       |             |
|--------------|-------------|-------------|------------|-------------|-------------|-------------|
|              | n           | %           | n          | %           | n           | %           |
| <25          | 0           | 0.0         | 9          | 0.3         | 9           | 0.1         |
| 25-34        | 10          | 0.3         | 48         | 1.6         | 58          | 0.9         |
| 35-44        | 315         | 9.0         | 153        | 5.1         | 468         | 7.2         |
| <b>45-54</b> | <b>601</b>  | <b>17.3</b> | <b>510</b> | <b>16.8</b> | <b>1111</b> | <b>17.1</b> |
| 55-64        | 885         | 25.4        | 855        | 28.2        | 1740        | 26.7        |
| <b>65-74</b> | <b>1048</b> | <b>30.1</b> | <b>915</b> | <b>30.2</b> | <b>1963</b> | <b>30.2</b> |
| >=75         | 622         | 17.9        | 539        | 17.8        | 1161        | 17.8        |
| Total        | 3481        | 100.0       | 3029       | 100.0       | 6510        | 100.0       |

**Figure 5: Patient records at registration by age group in type 2 diabetes**

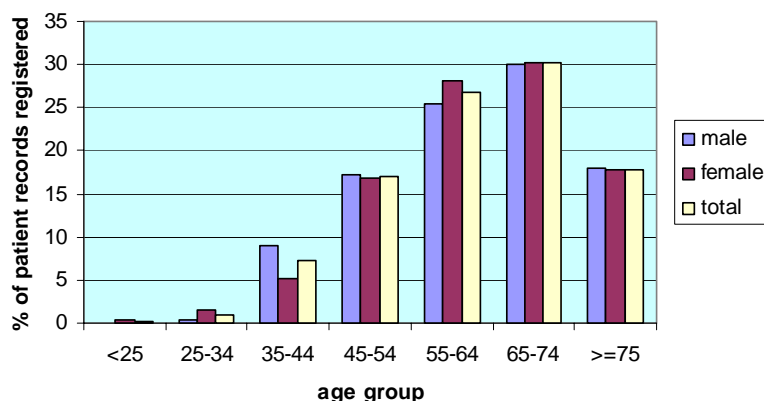
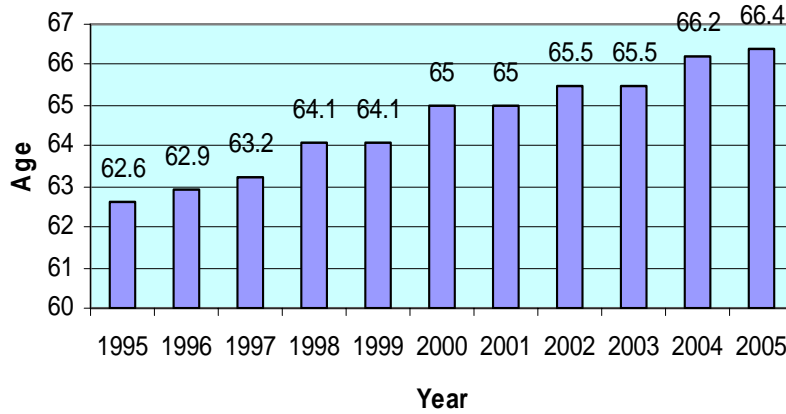


Table 8, Figure 6 and Figure 7 show that the mean patient age and duration of diabetes increased over the 11 years. The trend for age to increase was significant ( $P=0.000$ ) with an average increase of 3.8 years over the eleven period. The trend for duration of diabetes was not significant ( $P=0.64$ ).

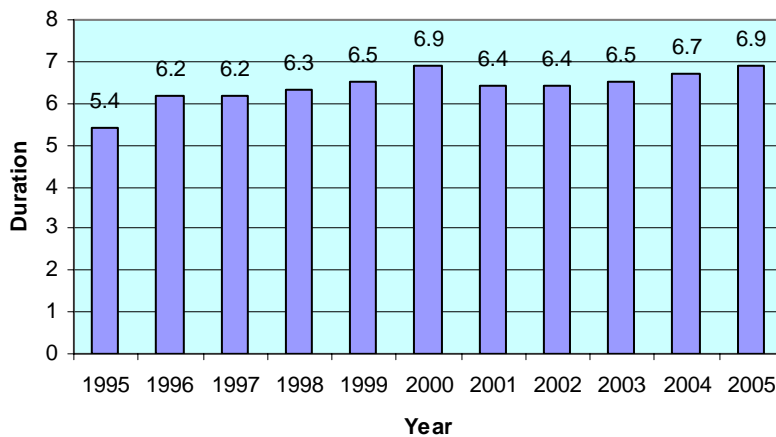
**Table 8: Mean age and duration by year of evaluation in type 2 diabetes**

| Year         | Age         |             |             | Duration    |            |            |
|--------------|-------------|-------------|-------------|-------------|------------|------------|
|              | N           | Mean        | SD          | N           | Mean       | SD         |
| 1995         | 56          | 62.6        | 12.7        | 58          | 5.4        | 5.6        |
| 1996         | 195         | 62.9        | 11.7        | 193         | 6.2        | 6.4        |
| 1997         | 289         | 63.2        | 12.0        | 282         | 6.2        | 6.6        |
| 1998         | 348         | 64.1        | 12.2        | 339         | 6.3        | 6.7        |
| 1999         | 432         | 64.1        | 12.1        | 414         | 6.5        | 6.7        |
| 2000         | 505         | 65.0        | 12.0        | 483         | 6.9        | 6.7        |
| 2001         | 720         | 65.0        | 12.3        | 677         | 6.4        | 6.6        |
| 2002         | 910         | 65.5        | 12.4        | 855         | 6.4        | 6.7        |
| 2003         | 924         | 65.5        | 12.4        | 847         | 6.5        | 6.6        |
| 2004         | 1050        | 66.2        | 12.1        | 939         | 6.7        | 6.5        |
| 2005         | 1081        | 66.4        | 12.0        | 949         | 6.9        | 6.5        |
| <b>Total</b> | <b>6510</b> | <b>65.3</b> | <b>12.2</b> | <b>6036</b> | <b>6.6</b> | <b>6.6</b> |

**Figure 6: Distribution of mean age by year of evaluation in type 2 diabetes**



**Figure 7: Distribution of mean diabetes duration by year of evaluation in type 2 diabetes**



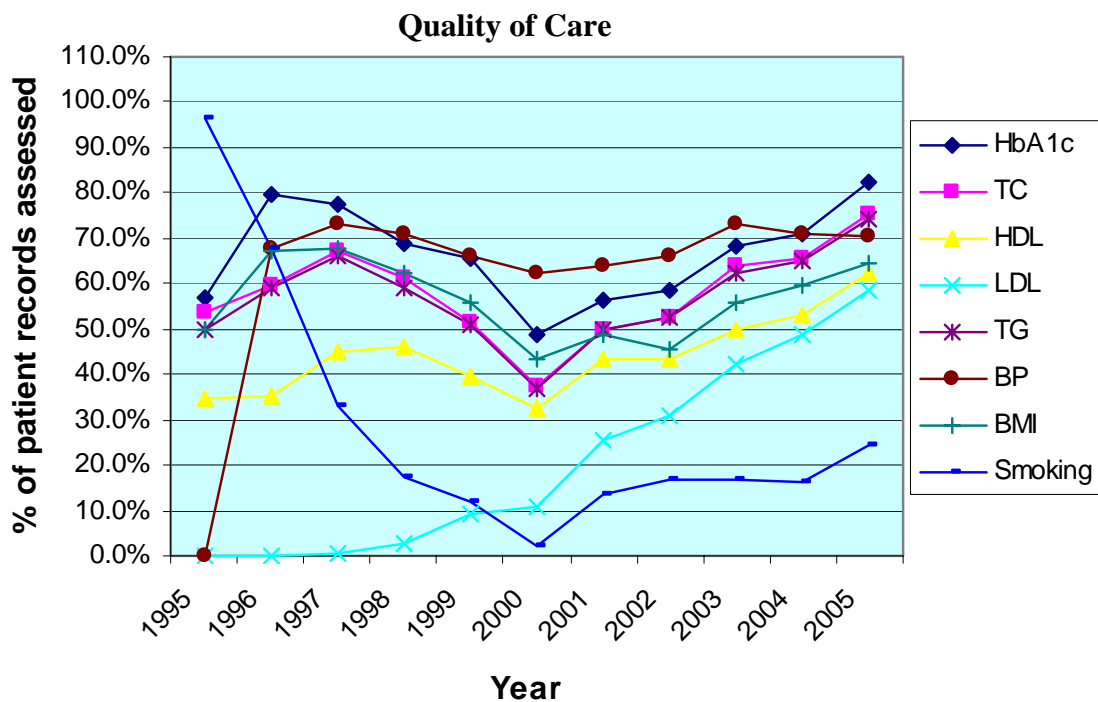
## 5.4 Quality of care:

### 5.4.1 Quality of care by year

There was some variability in the quality of care received by patients with type 2 diabetes over the 11 years (Please see Figures 8 and Table 9). After an initial increase in the frequency of all quality of care measures (except for smoking), most of the measures declined between 1998 and 2000 increasing steadily after that time. The indicators' assessment rate most often fluctuated between 50% and 80%.

LDL was not assessed in 1995 or 1996. After this, the frequency of LDL assessment increased steadily. Review of smoking status was less than 35% since 1997. By 2005, the frequency of assessment of HbA1c was highest (82.2%) followed by TC (75.3%), TG (74.3%), BP (70.5%), BMI (64.4%), HDL (62.5%) and LDL (58.6%). The frequency of review of smoking status was the lowest (24.5%) in 2005.

Figure 8: Frequency of patient records assessed by year of evaluation in type 2 diabetes



**Table 9: Quality of care by year of evaluation in the completion of cycle of care in type 2 diabetes**

| HbA1c assessed in a 12 month period in type 2 diabetes |                |          |      | BP assessed in a 12 months period in type 2 diabetes |                 |          |      | BMI assessed in a 12 month period in type 2 diabetes |                 |          |      | Smoking assessed in a 12 month period in type 2 diabetes |                |          |      |
|--|----------------|----------|------|--|-----------------|----------|------|--|-----------------|----------|------|--|----------------|----------|------|
| Year   | Total patients | Assessed | %    | Year   | Total patients. | Assessed | %    | Year   | Total patients. | Assessed | %    | Year   | Total patients | Assessed | %    |
| 1995   | 58             | 33       | 56.9 | 1995   | 58              | 0        | 0.0  | 1995   | 58              | 29       | 50.0 | 1995   | 58             | 56       | 96.6 |
| 1996   | 197            | 157      | 79.7 | 1996   | 197             | 115      | 58.4 | 1996   | 197             | 132      | 67.0 | 1996   | 197            | 134      | 68.0 |
| 1997   | 291            | 225      | 77.3 | 1997   | 291             | 168      | 57.7 | 1997   | 291             | 197      | 67.7 | 1997   | 291            | 96       | 33.0 |
| 1998   | 350            | 241      | 68.9 | 1998   | 350             | 177      | 50.6 | 1998   | 350             | 218      | 62.3 | 1998   | 350            | 61       | 17.4 |
| 1999   | 435            | 284      | 65.3 | 1999   | 435             | 182      | 41.8 | 1999   | 435             | 243      | 55.9 | 1999   | 435            | 51       | 11.7 |
| 2000   | 508            | 247      | 48.6 | 2000   | 508             | 157      | 30.9 | 2000   | 508             | 221      | 43.5 | 2000   | 508            | 10       | 2.0  |
| 2001   | 724            | 406      | 56.1 | 2001   | 724             | 267      | 36.9 | 2001   | 724             | 353      | 48.8 | 2001   | 724            | 96       | 13.3 |
| 2002   | 915            | 536      | 58.6 | 2002   | 915             | 353      | 38.6 | 2002   | 915             | 416      | 45.5 | 2002   | 915            | 155      | 16.9 |
| 2003   | 927            | 634      | 68.4 | 2003   | 927             | 460      | 49.6 | 2003   | 927             | 519      | 56.0 | 2003   | 927            | 158      | 17.0 |
| 2004   | 1053           | 747      | 70.9 | 2004   | 1053            | 511      | 48.5 | 2004   | 1053            | 628      | 59.6 | 2004   | 1053           | 170      | 16.1 |
| 2005   | 1082           | 889      | 82.2 | 2005   | 1082            | 541      | 50.0 | 2005   | 1082            | 697      | 64.4 | 2005   | 1082           | 265      | 24.5 |
| Total  | 6540           | 4399     | 67.3 | Total  | 6540            | 2931     | 44.8 | Total  | 6540            | 3653     | 55.9 | Total  | 6540           | 1252     | 19.1 |

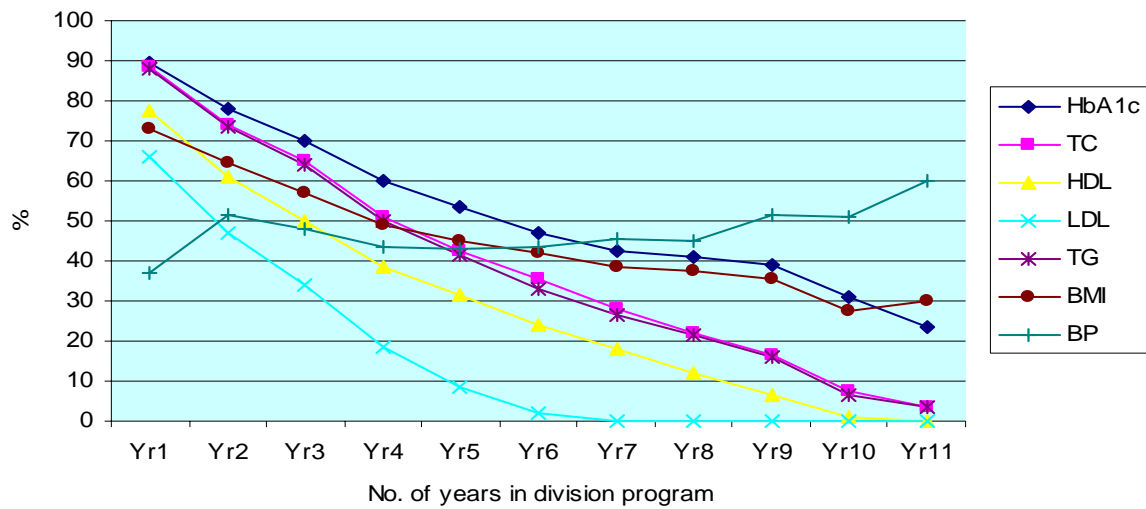
| TC assessed in a 12 month period in type 2 diabetes |                |          |      | HDL assessed in a 12 month period in type 2 diabetes |                |          |      | LDL assessed in a 12 month period in type 2 diabetes |                |          |      | TG assessed in a 12 month period in type 2 diabetes |                |          |      |
|---|----------------|----------|------|--|----------------|----------|------|--|----------------|----------|------|---|----------------|----------|------|
| Year  | Total patients | Assessed | %    | Year   | Total patients | Assessed | %    | Year   | Total patients | Assessed | %    | Year  | Total patients | Assessed | %    |
| 1995  | 58             | 31       | 53.4 | 1995   | 58             | 20       | 34.5 | 1995   | 58             | 0        | 0.0  | 1995  | 58             | 29       | 50.0 |
| 1996  | 197            | 117      | 59.4 | 1996   | 197            | 69       | 35.0 | 1996   | 197            | 0        | 0.0  | 1996  | 197            | 116      | 58.9 |
| 1997  | 291            | 195      | 67.0 | 1997   | 291            | 131      | 45.0 | 1997   | 291            | 1        | 0.3  | 1997  | 291            | 192      | 66.0 |
| 1998  | 350            | 215      | 61.4 | 1998   | 350            | 161      | 46.0 | 1998   | 350            | 10       | 2.9  | 1998  | 350            | 207      | 59.1 |
| 1999  | 435            | 225      | 51.7 | 1999   | 435            | 172      | 39.5 | 1999   | 435            | 40       | 9.2  | 1999  | 435            | 221      | 50.8 |
| 2000  | 508            | 189      | 37.2 | 2000   | 508            | 165      | 32.5 | 2000   | 508            | 54       | 10.6 | 2000  | 508            | 188      | 37.0 |
| 2001  | 724            | 361      | 49.9 | 2001   | 724            | 313      | 43.2 | 2001   | 724            | 184      | 25.4 | 2001  | 724            | 359      | 49.6 |
| 2002  | 915            | 483      | 52.8 | 2002   | 915            | 399      | 43.6 | 2002   | 915            | 284      | 31.0 | 2002  | 915            | 481      | 52.6 |
| 2003  | 927            | 591      | 63.8 | 2003   | 927            | 461      | 49.7 | 2003   | 927            | 389      | 42.0 | 2003  | 927            | 576      | 62.1 |
| 2004  | 1053           | 691      | 65.6 | 2004   | 1053           | 558      | 53.0 | 2004   | 1053           | 512      | 48.6 | 2004  | 1053           | 682      | 64.8 |
| 2005  | 1082           | 815      | 75.3 | 2005   | 1082           | 676      | 62.5 | 2005   | 1082           | 634      | 58.6 | 2005  | 1082           | 804      | 74.3 |
| Total   | 6540           | 3913     | 59.8 | Total  | 6540           | 3125     | 47.8 | Total  | 6540           | 2108     | 32.2 | Total   | 6540           | 3855     | 58.9 |

\* BP was assessed twice a year; the other indicators were assessed once a year. \* BMI- body mass index, BP- blood pressure, HbA1c- glycosylated haemoglobin, TC- total cholesterol, HDL- high density lipoprotein cholesterol, LDL- low density lipoprotein cholesterol, TG-total triglycerides

### 5.4.2 Quality of care by number of years in the Division Program

In general (except for BP), it was found that less evaluations or assessments were recorded for those patients who had been registered for a longer period on the diabetes database. (Please see Figures 9 and Table 10)

**Figure 9: Frequency of assessment by number of years in division program in type 2 diabetes**



**Table 10: Quality of care by number of years in division program in the completion of cycle of care in type 2 diabetes**

| <b>HbA1c assessed in a 12 month period in type 2 diabetes</b> |                |             |             | <b>BP assessed in a 12 months period in type 2 diabetes</b> |                |             |             | <b>BMI assessed in a 12 month period in type 2 diabetes</b> |                |             |             | <b>Smoking assessed in a 12 month period in type 2 diabetes</b> |                |             |             |
|---|----------------|-------------|-------------|---|----------------|-------------|-------------|---|----------------|-------------|-------------|---|----------------|-------------|-------------|
| No. of year in program  | Total patients | Assessed    | %           | No. of year in program                                      | Total Patients | Assessed    | %           | No. of year in program                                      | Total Patients | Assessed    | %           | No. of year in program  | Total Patients | Assessed    | %           |
| 1   | 1467           | 1314        | 89.6        | 1   | 1467           | 546         | 37.2        | 1   | 1467           | 1070        | 72.9        | 1   | 1467           | 1143        | 77.9        |
| 2   | 1242           | 968         | 77.9        | 2   | 1242           | 638         | 51.4        | 2   | 1242           | 801         | 64.5        | 2   | 1242           | 99          | 8.0         |
| 3   | 1015           | 713         | 70.2        | 3   | 1015           | 487         | 48.0        | 3   | 1015           | 579         | 57.0        | 3   | 1015           | 10          | 1.0         |
| 4   | 827            | 498         | 60.2        | 4   | 827            | 359         | 43.4        | 4   | 827            | 405         | 49.0        | 4   | 827            | 0.0         | 0.0         |
| 5   | 614            | 330         | 53.7        | 5   | 614            | 265         | 43.2        | 5   | 614            | 276         | 45.0        | 5   | 614            | 0.0         | 0.0         |
| 6   | 431            | 203         | 47.1        | 6   | 431            | 187         | 43.4        | 6   | 431            | 181         | 42.0        | 6   | 431            | 0.0         | 0.0         |
| 7   | 358            | 152         | 42.5        | 7   | 358            | 162         | 45.3        | 7   | 358            | 138         | 38.5        | 7   | 358            | 0.0         | 0.0         |
| 8   | 260            | 107         | 41.2        | 8   | 260            | 117         | 45.0        | 8   | 260            | 98          | 37.7        | 8   | 260            | 0.0         | 0.0         |
| 9   | 186            | 73          | 39.2        | 9   | 186            | 96          | 51.6        | 9   | 186            | 66          | 35.5        | 9   | 186            | 0.0         | 0.0         |
| 10  | 110            | 34          | 30.9        | 10  | 110            | 56          | 50.9        | 10  | 110            | 30          | 27.3        | 10  | 110            | 0.0         | 0.0         |
| 11  | 30             | 7           | 23.3        | 11  | 30             | 18          | 60.0        | 11  | 30             | 9           | 30.0        | 11  | 30             | 0.0         | 0.0         |
| <b>Total</b>  | <b>6540</b>    | <b>4399</b> | <b>67.3</b> | <b>Total</b>  | <b>6540</b>    | <b>2931</b> | <b>44.8</b> | <b>Total</b>  | <b>6540</b>    | <b>3653</b> | <b>55.9</b> | <b>Total</b>  | <b>6540</b>    | <b>1252</b> | <b>19.1</b> |
| <b>TC assessed in a 12 month period in type 2 diabetes</b>    |                |             |             | <b>HDL assessed in a 12 month period in type 2 diabetes</b> |                |             |             | <b>LDL assessed in a 12 month period in type 2 diabetes</b> |                |             |             | <b>TG assessed in a 12 month period in type 2 diabetes</b>      |                |             |             |
| No. of year in program  | Total patients | Assessed    | %           | No. of year in program                                      | Total patients | Assessed    | %           | No. of year in program                                      | Total patients | Assessed    | %           | No. of year in program  | Total patients | Assessed    | %           |
| 1   | 1467           | 1301        | 88.7        | 1   | 1467           | 1137        | 77.5        | 1   | 1467           | 965         | 65.8        | 1   | 1467           | 1292        | 88.1        |
| 2   | 1242           | 921         | 74.2        | 2   | 1242           | 755         | 60.8        | 2   | 1242           | 586         | 47.2        | 2   | 1242           | 913         | 73.5        |
| 3   | 1015           | 658         | 64.8        | 3   | 1015           | 510         | 50.2        | 3   | 1015           | 343         | 33.8        | 3   | 1015           | 649         | 63.9        |
| 4   | 827            | 423         | 51.1        | 4   | 827            | 318         | 38.5        | 4   | 827            | 152         | 18.4        | 4   | 827            | 415         | 50.2        |
| 5   | 614            | 260         | 42.3        | 5   | 614            | 193         | 31.4        | 5   | 614            | 53          | 8.6         | 5   | 614            | 254         | 41.4        |
| 6   | 431            | 153         | 35.5        | 6   | 431            | 104         | 24.1        | 6   | 431            | 9           | 2.1         | 6   | 431            | 143         | 33.2        |
| 7   | 358            | 100         | 27.9        | 7   | 358            | 64          | 17.9        | 7   | 358            | 0           | 0.0         | 7   | 358            | 95          | 26.5        |
| 8   | 260            | 57          | 21.9        | 8   | 260            | 31          | 11.9        | 8   | 260            | 0           | 0.0         | 8   | 260            | 56          | 21.5        |
| 9   | 186            | 31          | 16.7        | 9   | 186            | 12          | 6.5         | 9   | 186            | 0           | 0.0         | 9   | 186            | 30          | 16.1        |
| 10  | 110            | 8           | 7.3         | 10  | 110            | 1           | 0.9         | 10  | 110            | 0           | 0.0         | 10  | 110            | 7           | 6.4         |
| 11  | 30             | 1           | 3.3         | 11  | 30             | 0           | 0.0         | 11  | 30             | 0           | 0.0         | 11  | 30             | 1           | 3.3         |
| <b>Total</b>  | <b>6540</b>    | <b>3913</b> | <b>59.8</b> | <b>Total</b>  | <b>6540</b>    | <b>3125</b> | <b>47.8</b> | <b>Total</b>  | <b>6540</b>    | <b>2108</b> | <b>32.2</b> | <b>Total</b>  | <b>6540</b>    | <b>3855</b> | <b>58.9</b> |

\* BP was assessed twice a year, the other indicators were assessed once a year.

## **5.5 Health outcomes:**

### **5.5.1 The change of health outcomes by year of evaluation**

The trend for each of the intermediate health outcome variables (HbA1c, TC, HDL, LDL, TG, SBP and DBP) decreased over the 11 years. (Please see Table 11). HDL was the only measurement to meet the targeted outcome during the 11 year study period (HDL>1.0 mmol/L). Since 2001, the mean DBP has met the target outcome (DBP<80 mmHg). For the rest of the health outcomes, the mean values did not meet the target in all 11 years. Of concern, the mean BMI each year throughout the study period was more than 30 kg/m<sup>2</sup>.

Comparing the health outcomes in 1995 with those in 2000, between 1995 and 2000 HDL recordings became significantly lower (P=0.029), whilst none of the other health outcomes improved significantly. Between 2000 and 2005, there were significant improvements in HbA1c, TC, HDL, LDL, TG and DBP (P<0.05) (Please see Figure 10).

A Comparison of health outcomes over a longer period between 1995 and 2005 shows significant improvements in TC, LDL, TG, SBP and DBP measurements (P<0.05). (Please see Figures 10)

**Table 11: Changes of health outcomes by year of evaluation in type 2 diabetes**

| <b>HbA1c by year of evaluation in type 2 diabetes</b> |             |            |            | <b>SBP by year of evaluation in type 2 diabetes</b> |             |              |             | <b>DBP by year of evaluation in type 2 diabetes</b> |             |             |            | <b>BMI by year of evaluation in type 2 diabetes</b> |             |             |            |
|---|-------------|------------|------------|---|-------------|--------------|-------------|---|-------------|-------------|------------|---|-------------|-------------|------------|
| Year  | Assessed    | Mean       | SD         | Year  | Assessed    | Mean         | SD          | Year  | Assessed    | Mean        | SD         | Year  | Assessed    | Mean        | SD         |
| 1995  | 33          | 7.5        | 1.3        | 1995  | 36          | 141.6        | 18.7        | 1995  | 36          | 80.7        | 7.3        | 1995  | 29          | 33.1        | 8.8        |
| 1996  | 157         | 7.8        | 1.5        | 1996  | 169         | 139.3        | 18.5        | 1996  | 169         | 81.7        | 9.5        | 1996  | 132         | 31.3        | 6.2        |
| 1997  | 225         | 7.6        | 1.6        | 1997  | 230         | 137.1        | 16.7        | 1997  | 230         | 81.2        | 9.2        | 1997  | 197         | 30.6        | 5.9        |
| 1998  | 241         | 7.6        | 1.5        | 1998  | 249         | 138.6        | 17.0        | 1998  | 249         | 80.9        | 8.4        | 1998  | 218         | 30.7        | 6.1        |
| 1999  | 284         | 7.7        | 1.6        | 1999  | 275         | 137.4        | 17.1        | 1999  | 274         | 80.9        | 9.2        | 1999  | 243         | 30.7        | 6.2        |
| 2000  | 247         | 7.3        | 1.4        | 2000  | 251         | 136.2        | 16.4        | 2000  | 251         | 80.2        | 9.4        | 2000  | 221         | 30.7        | 6.5        |
| 2001  | 406         | 7.3        | 1.3        | 2001  | 416         | 135.7        | 16.1        | 2001  | 416         | 79.5        | 8.2        | 2001  | 353         | 31.0        | 6.2        |
| 2002  | 536         | 7.1        | 1.3        | 2002  | 535         | 135.4        | 14.7        | 2002  | 536         | 79.2        | 8.5        | 2002  | 416         | 30.8        | 6.1        |
| 2003  | 634         | 7.1        | 1.3        | 2003  | 630         | 135.6        | 16.5        | 2003  | 630         | 78.2        | 9.3        | 2003  | 519         | 31.2        | 6.5        |
| 2004  | 747         | 7.1        | 1.3        | 2004  | 721         | 134.3        | 15.6        | 2004  | 721         | 77.9        | 9.2        | 2004  | 628         | 31.2        | 6.5        |
| 2005  | 889         | 7.1        | 1.3        | 2005  | 767         | 135.6        | 15.5        | 2005  | 767         | 77.8        | 9.9        | 2005  | 697         | 31.6        | 6.7        |
| <b>Total</b>  | <b>4399</b> | <b>7.2</b> | <b>1.4</b> | <b>Total</b>  | <b>4279</b> | <b>136.0</b> | <b>16.1</b> | <b>Total</b>  | <b>4279</b> | <b>79.1</b> | <b>9.2</b> | <b>Total</b>  | <b>3653</b> | <b>31.1</b> | <b>6.4</b> |
| <b>TC by year of evaluation in type 2 diabetes</b>    |             |            |            | <b>HDL by year of evaluation in type 2 diabetes</b> |             |              |             | <b>LDL year of evaluation in type 2 diabetes</b>    |             |             |            | <b>TG by year of evaluation in type 2 diabetes</b>  |             |             |            |
| Year  | Assessed    | Mean       | SD         | Year  | Assessed    | Mean         | SD          | Year  | Assessed    | Mean        | SD         | Year  | Assessed    | Mean        | SD         |
| 1995  | 31          | 5.7        | 1.1        | 1995  | 20          | 1.6          | 0.6         | 1995  | 0           | 0.0         | 0.0        | 1995  | 29          | 2.8         | 1.5        |
| 1996  | 117         | 6.0        | 1.7        | 1996  | 69          | 1.4          | 1.0         | 1996  | 0           | 0.0         | 0.0        | 1996  | 116         | 2.9         | 2.7        |
| 1997  | 195         | 5.8        | 1.2        | 1997  | 131         | 1.1          | 0.4         | 1997  | 1           | 3.1         | 0.0        | 1997  | 192         | 2.7         | 1.8        |
| 1998  | 215         | 5.7        | 1.4        | 1998  | 161         | 1.2          | 0.4         | 1998  | 10          | 3.2         | 1.4        | 1998  | 207         | 2.7         | 2.9        |
| 1999  | 225         | 5.5        | 1.1        | 1999  | 172         | 1.2          | 0.3         | 1999  | 40          | 3.4         | 1.3        | 1999  | 221         | 2.3         | 1.6        |
| 2000  | 189         | 5.3        | 1.1        | 2000  | 165         | 1.3          | 0.4         | 2000  | 54          | 3.0         | 1.1        | 2000  | 188         | 2.3         | 1.8        |
| 2001  | 361         | 5.1        | 1.0        | 2001  | 313         | 1.2          | 0.4         | 2001  | 184         | 3.1         | 1.0        | 2001  | 359         | 2.2         | 1.4        |
| 2002  | 483         | 5.0        | 1.0        | 2002  | 399         | 1.3          | 0.5         | 2002  | 284         | 2.8         | 1.0        | 2002  | 481         | 2.1         | 1.4        |
| 2003  | 591         | 4.9        | 1.1        | 2003  | 461         | 1.4          | 0.4         | 2003  | 389         | 2.6         | 1.0        | 2003  | 576         | 2.1         | 1.6        |
| 2004  | 691         | 4.8        | 1.0        | 2004  | 558         | 1.3          | 0.3         | 2004  | 512         | 2.5         | 0.9        | 2004  | 682         | 2.0         | 1.2        |
| 2005  | 815         | 4.7        | 1.1        | 2005  | 676         | 1.3          | 0.4         | 2005  | 634         | 2.5         | 1.0        | 2005  | 804         | 2.0         | 1.4        |
| <b>Total</b>  | <b>3913</b> | <b>5.1</b> | <b>1.2</b> | <b>Total</b>  | <b>3125</b> | <b>1.3</b>   | <b>0.4</b>  | <b>Total</b>  | <b>2108</b> | <b>2.6</b>  | <b>1.0</b> | <b>Total</b>  | <b>3855</b> | <b>2.2</b>  | <b>1.6</b> |

\* All the patients could only have one record in each of the 11 years

**Figure 10: Comparison of health outcomes over time in type 2 diabetes**



\* All the patient could only have one record in each of the 11 years.

\* LDL record was 0 in 1995 and 1996, and 1 in 1998.

### 5.5.2 The change of health outcomes by number of years in the Division Program

The following tables show the change of health outcomes recorded by number of years in the division program. BMI and DBP tended to decrease and HDL tended to increase for those patients who attended the diabetes program over a longer period. There was not a consistent trend for the remaining indicators over the study period. (Please see Table 12 and Table 13)

Appendix 1 shows the comparison of HbA1c between the SHDGP report and the UKPDS study.

**Table 12: Mean of health outcomes by number of years in the division programs in type 2 diabetes**

|      | HbA1c | TC  | HDL | LDL | TG  | BMI  | SBP   | DBP  |
|------|-------|-----|-----|-----|-----|------|-------|------|
| Yr1  | 7.3   | 5.3 | 1.3 | 2.8 | 2.3 | 31.4 | 135.7 | 80.1 |
| Yr2  | 7.1   | 5.0 | 1.3 | 2.6 | 2.1 | 31.3 | 135.6 | 79.7 |
| Yr3  | 7.3   | 5.0 | 1.3 | 2.4 | 2.1 | 31.0 | 136.2 | 79.4 |
| Yr4  | 7.3   | 4.9 | 1.4 | 2.3 | 2.1 | 30.6 | 135.7 | 78.4 |
| Yr5  | 7.3   | 4.8 | 1.4 | 2.4 | 2.1 | 30.7 | 134.9 | 78.2 |
| Yr6  | 7.5   | 4.8 | 1.4 | 2.7 | 2.1 | 31.2 | 137.2 | 78.5 |
| Yr7  | 7.4   | 4.7 | 1.4 | 0.0 | 2.1 | 31.4 | 137.7 | 79.1 |
| Yr8  | 7.3   | 4.7 | 1.4 | 0.0 | 2.0 | 30.4 | 136.3 | 76.6 |
| Yr9  | 7.3   | 5.0 | 1.7 | 0.0 | 1.7 | 29.9 | 136.3 | 76.3 |
| Yr10 | 7.2   | 5.3 | 1.8 | 0.0 | 1.4 | 28.8 | 138.5 | 77.4 |
| Yr11 | 7.3   | 5.6 | 0.0 | 0.0 | 1.8 | 28.8 | 133.8 | 74.6 |

**Table 13: Change of health outcomes by number of years in the division programs in type 2 diabetes**

| <b>Hba1C</b> |             |            |            | <b>SBP</b>   |             |              |             | <b>DBP</b>   |             |             |            | <b>BMI</b>   |             |             |            |
|--------------|-------------|------------|------------|--------------|-------------|--------------|-------------|--------------|-------------|-------------|------------|--------------|-------------|-------------|------------|
| No. of years | assessed    | Mean       | SD         | No. of years | assessed    | Mean         | SD          | No. of years | assessed    | Mean        | SD         | No. of years | assessed    | Mean        | SD         |
| 1            | 1314        | 7.3        | 1.5        | 1            | 1125        | 135.7        | 16.2        | 1            | 1125        | 80.1        | 9.2        | 1            | 1070        | 31.4        | 6.6        |
| 2            | 968         | 7.1        | 1.3        | 2            | 823         | 135.6        | 15.7        | 2            | 824         | 79.7        | 8.7        | 2            | 801         | 31.3        | 6.5        |
| 3            | 713         | 7.3        | 1.3        | 3            | 645         | 136.2        | 16.5        | 3            | 644         | 79.4        | 9.2        | 3            | 579         | 31.0        | 6.2        |
| 4            | 498         | 7.3        | 1.4        | 4            | 498         | 135.7        | 16.2        | 4            | 498         | 78.4        | 8.6        | 4            | 405         | 30.6        | 6.4        |
| 5            | 330         | 7.3        | 1.3        | 5            | 356         | 134.9        | 15.8        | 5            | 356         | 78.2        | 9.3        | 5            | 276         | 30.7        | 6.5        |
| 6            | 203         | 7.5        | 1.4        | 6            | 248         | 137.2        | 15.9        | 6            | 248         | 78.5        | 9.1        | 6            | 181         | 31.2        | 6.4        |
| 7            | 152         | 7.4        | 1.3        | 7            | 211         | 137.7        | 14.6        | 7            | 211         | 79.1        | 9.2        | 7            | 138         | 31.4        | 6.3        |
| 8            | 107         | 7.3        | 1.3        | 8            | 153         | 136.3        | 16.1        | 8            | 153         | 76.6        | 9.9        | 8            | 98          | 30.4        | 6.0        |
| 9            | 73          | 7.3        | 1.2        | 9            | 120         | 136.3        | 19.1        | 9            | 120         | 76.3        | 10.4       | 9            | 66          | 29.9        | 6.3        |
| 10           | 34          | 7.2        | 1.3        | 10           | 75          | 138.5        | 18.4        | 10           | 75          | 77.4        | 11.1       | 10           | 30          | 28.8        | 5.0        |
| 11           | 7           | 7.3        | 0.8        | 11           | 25          | 133.8        | 14.1        | 11           | 25          | 74.6        | 11.5       | 11           | 9           | 28.8        | 4.4        |
| <b>Total</b> | <b>4399</b> | <b>7.2</b> | <b>1.4</b> | <b>Total</b> | <b>4279</b> | <b>136.0</b> | <b>16.1</b> | <b>Total</b> | <b>4279</b> | <b>79.1</b> | <b>9.2</b> | <b>Total</b> | <b>3653</b> | <b>31.1</b> | <b>6.4</b> |
| <b>TC</b>    |             |            |            | <b>HDL</b>   |             |              |             | <b>LDL</b>   |             |             |            | <b>TG</b>    |             |             |            |
| No. of years | assessed    | Mean       | SD         | No. of years | assessed    | Mean         | SD          | No. of years | assessed    | Mean        | SD         | No. of years | assessed    | Mean        | SD         |
| 1            | 1301        | 5.3        | 1.3        | 1            | 1137        | 1.3          | 0.5         | 1            | 965         | 2.8         | 1.0        | 1            | 1292        | 2.3         | 1.7        |
| 2            | 921         | 5.0        | 1.1        | 2            | 755         | 1.3          | 0.4         | 2            | 586         | 2.6         | 0.9        | 2            | 913         | 2.1         | 1.5        |
| 3            | 658         | 5.0        | 1.2        | 3            | 510         | 1.3          | 0.4         | 3            | 343         | 2.4         | 0.9        | 3            | 649         | 2.1         | 1.8        |
| 4            | 423         | 4.9        | 1.1        | 4            | 318         | 1.4          | 0.4         | 4            | 152         | 2.3         | 0.8        | 4            | 415         | 2.1         | 1.6        |
| 5            | 260         | 4.8        | 1.1        | 5            | 193         | 1.4          | 0.4         | 5            | 53          | 2.4         | 0.9        | 5            | 254         | 2.1         | 1.5        |
| 6            | 153         | 4.8        | 0.9        | 6            | 104         | 1.4          | 0.3         | 6            | 9           | 2.7         | 0.8        | 6            | 143         | 2.1         | 1.4        |
| 7            | 100         | 4.7        | 0.9        | 7            | 64          | 1.4          | 0.4         | 7            | 0           | 0.0         | 0.0        | 7            | 95          | 2.1         | 1.4        |
| 8            | 57          | 4.7        | 0.9        | 8            | 31          | 1.4          | 0.4         | 8            | 0           | 0.0         | 0.0        | 8            | 56          | 2.0         | 1.5        |
| 9            | 31          | 5.0        | 1.1        | 9            | 12          | 1.7          | 0.6         | 9            | 0           | 0.0         | 0.0        | 9            | 30          | 1.7         | 1.9        |
| 10           | 8           | 5.3        | 2.5        | 10           | 1           | 1.8          | 0.0         | 10           | 0           | 0.0         | 0.0        | 10           | 7           | 1.4         | 0.5        |
| 11           | 1           | 5.6        | 0.0        | 11           | 0           | 0.0          | 0.0         | 11           | 0           | 0.0         | 0.0        | 11           | 1           | 1.8         | 0.0        |
| <b>Total</b> | <b>3913</b> | <b>5.1</b> | <b>1.2</b> | <b>Total</b> | <b>3125</b> | <b>1.3</b>   | <b>0.4</b>  | <b>Total</b> | <b>2108</b> | <b>2.6</b>  | <b>1.0</b> | <b>Total</b> | <b>3855</b> | <b>2.2</b>  | <b>1.6</b> |

All the patients could only have one record in each of the 11 years.

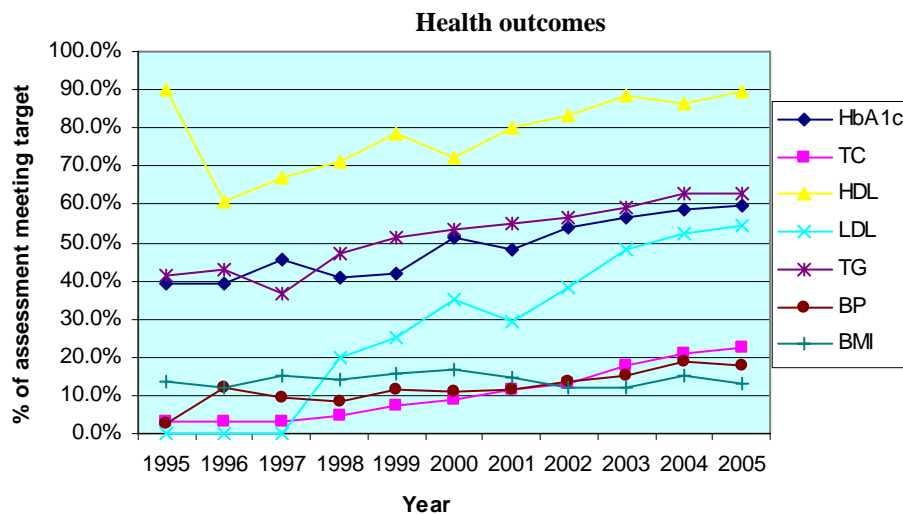
### 5.5.3 Health outcomes within target by year of evaluation

The overall proportion of patients that achieved health outcomes within the targeted ranges increased over the 11 years except for BMI which showed little change (please see Figure 11).

As shown in the table, approximately 60 -90% of patients achieved targets for HDL over the 11 years. The proportion of patients in the target range for BP, BMI and TC were less than 25% over the 11 years. Since 2002, more than 50% of HbA1c and TG assessments met the targets (please see Table 14).

Since 2000, the proportion of patients conducting assessment and meeting health outcome targets all increased, except for BMI (please see Figure12) .

**Figure 11: Proportion of patients meeting targets by assessment and by year of evaluation**



**Table 14: Health outcome within target by year of evaluation in type 2 diabetes**

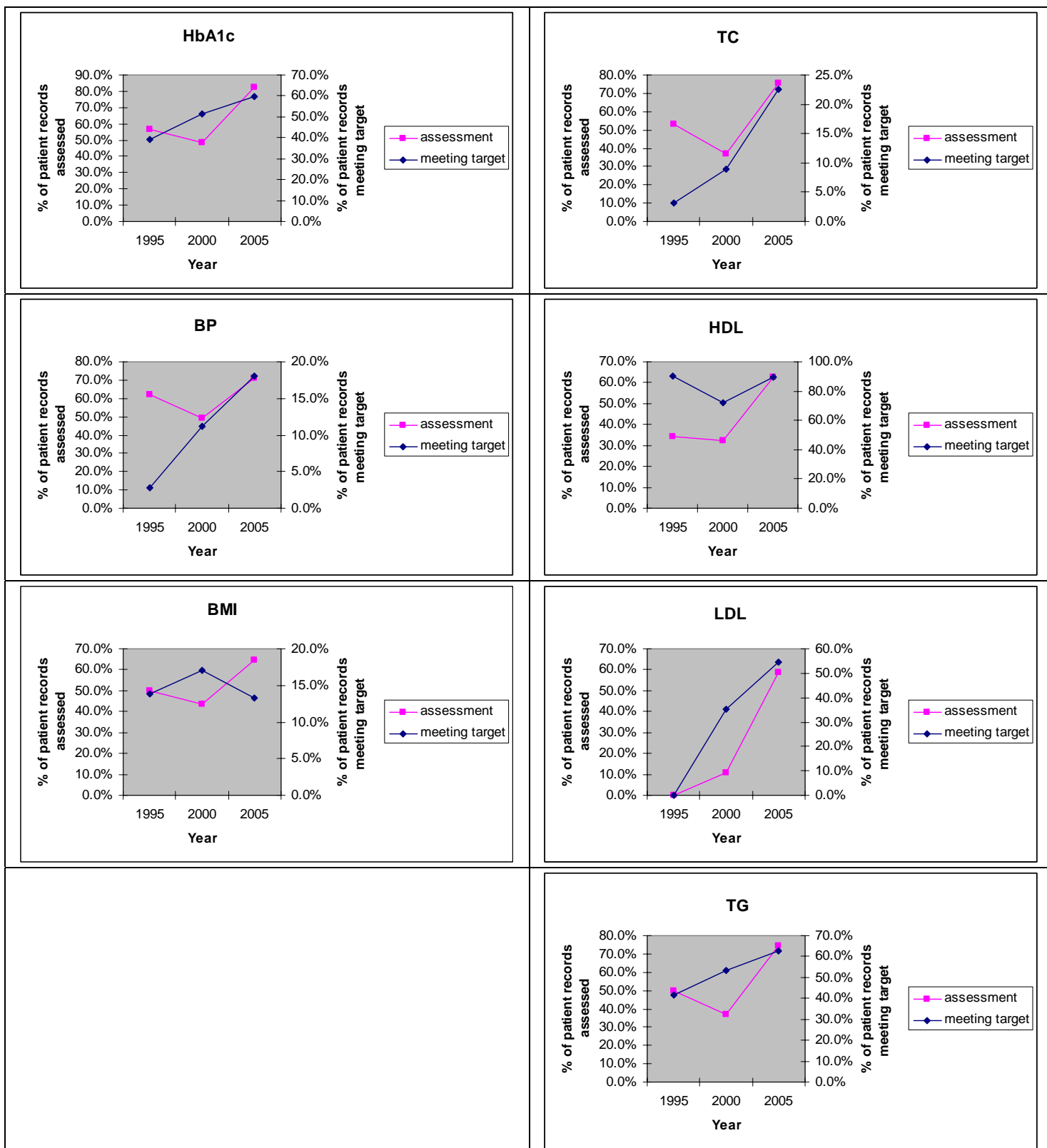
| HbA1c        |             |               |             | BP           |             |               |             | BMI          |             |               |             |
|--------------|-------------|---------------|-------------|--------------|-------------|---------------|-------------|--------------|-------------|---------------|-------------|
| Year         | Assessed    | Within target | %           | Year         | Assessed    | Within target | %           | Year         | Assessed    | Within target | %           |
| 1995         | 33          | 13            | 39.4        | 1995         | 36          | 1             | 2.8         | 1995         | 29          | 4             | 13.8        |
| 1996         | 157         | 62            | 39.5        | 1996         | 169         | 20            | 11.8        | 1996         | 132         | 16            | 12.1        |
| 1997         | 225         | 102           | 45.3        | 1997         | 230         | 22            | 9.6         | 1997         | 198         | 30            | 15.2        |
| 1998         | 241         | 98            | 40.7        | 1998         | 249         | 21            | 8.4         | 1998         | 219         | 31            | 14.2        |
| 1999         | 284         | 119           | 41.9        | 1999         | 275         | 31            | 11.3        | 1999         | 244         | 38            | 15.6        |
| 2000         | 247         | 127           | 51.4        | 2000         | 251         | 28            | 11.2        | 2000         | 223         | 38            | 17.0        |
| 2001         | 406         | 196           | 48.3        | 2001         | 416         | 48            | 11.5        | 2001         | 357         | 52            | 14.6        |
| 2002         | 536         | 290           | 54.1        | 2002         | 536         | 73            | 13.6        | 2002         | 420         | 51            | 12.1        |
| 2003         | 634         | 360           | 56.8        | 2003         | 630         | 95            | 15.1        | 2003         | 520         | 62            | 11.9        |
| 2004         | 747         | 437           | 58.5        | 2004         | 721         | 134           | 18.6        | 2004         | 630         | 95            | 15.1        |
| 2005         | 889         | 531           | 59.7        | 2005         | 767         | 138           | 18.0        | 2005         | 699         | 93            | 13.3        |
| <b>total</b> | <b>4399</b> | <b>2335</b>   | <b>53.1</b> | <b>total</b> | <b>4280</b> | <b>611</b>    | <b>14.3</b> | <b>total</b> | <b>3671</b> | <b>510</b>    | <b>13.9</b> |

| TC           |             |               |             | HDL          |             |               |             | LDL          |             |               |             | TG           |             |               |             |
|--------------|-------------|---------------|-------------|--------------|-------------|---------------|-------------|--------------|-------------|---------------|-------------|--------------|-------------|---------------|-------------|
| Year         | Assessed    | Within target | %           | Year         | Assessed    | Within target | %           | Year         | Assessed    | Within target | %           | Year         | Assessed    | Within target | %           |
| 1995         | 31          | 1             | 3.2         | 1995         | 20          | 18            | 90.0        | 1995         | 0           | 0             | 0.0         | 1995         | 29          | 12            | 41.4        |
| 1996         | 117         | 4             | 3.4         | 1996         | 69          | 42            | 60.9        | 1996         | 0           | 0             | 0.0         | 1996         | 116         | 50            | 43.1        |
| 1997         | 195         | 6             | 3.1         | 1997         | 131         | 88            | 67.2        | 1997         | 1           | 0             | 0.0         | 1997         | 192         | 70            | 36.5        |
| 1998         | 215         | 10            | 4.7         | 1998         | 161         | 115           | 71.4        | 1998         | 10          | 2             | 20.0        | 1998         | 207         | 98            | 47.3        |
| 1999         | 225         | 16            | 7.1         | 1999         | 172         | 135           | 78.5        | 1999         | 40          | 10            | 25.0        | 1999         | 221         | 113           | 51.1        |
| 2000         | 189         | 17            | 9.0         | 2000         | 165         | 119           | 72.1        | 2000         | 54          | 19            | 35.2        | 2000         | 188         | 100           | 53.2        |
| 2001         | 361         | 41            | 11.4        | 2001         | 313         | 250           | 79.9        | 2001         | 184         | 54            | 29.3        | 2001         | 359         | 198           | 55.2        |
| 2002         | 483         | 63            | 13.0        | 2002         | 399         | 333           | 83.5        | 2002         | 284         | 109           | 38.4        | 2002         | 481         | 272           | 56.5        |
| 2003         | 591         | 105           | 17.8        | 2003         | 461         | 408           | 88.5        | 2003         | 389         | 188           | 48.3        | 2003         | 576         | 342           | 59.4        |
| 2004         | 691         | 144           | 20.8        | 2004         | 558         | 481           | 86.2        | 2004         | 512         | 269           | 52.5        | 2004         | 682         | 427           | 62.6        |
| 2005         | 815         | 183           | 22.5        | 2005         | 676         | 604           | 89.3        | 2005         | 634         | 347           | 54.7        | 2005         | 804         | 505           | 62.8        |
| <b>total</b> | <b>3913</b> | <b>590</b>    | <b>15.1</b> | <b>total</b> | <b>3125</b> | <b>2593</b>   | <b>83.0</b> | <b>total</b> | <b>2108</b> | <b>998</b>    | <b>47.3</b> | <b>total</b> | <b>3855</b> | <b>2187</b>   | <b>56.7</b> |

\* BP was assessed twice a year; the other indicators were assessed once a year

Figure 12: Comparison of frequency of patient records assessed & meeting target health outcomes in type 2 diabetes

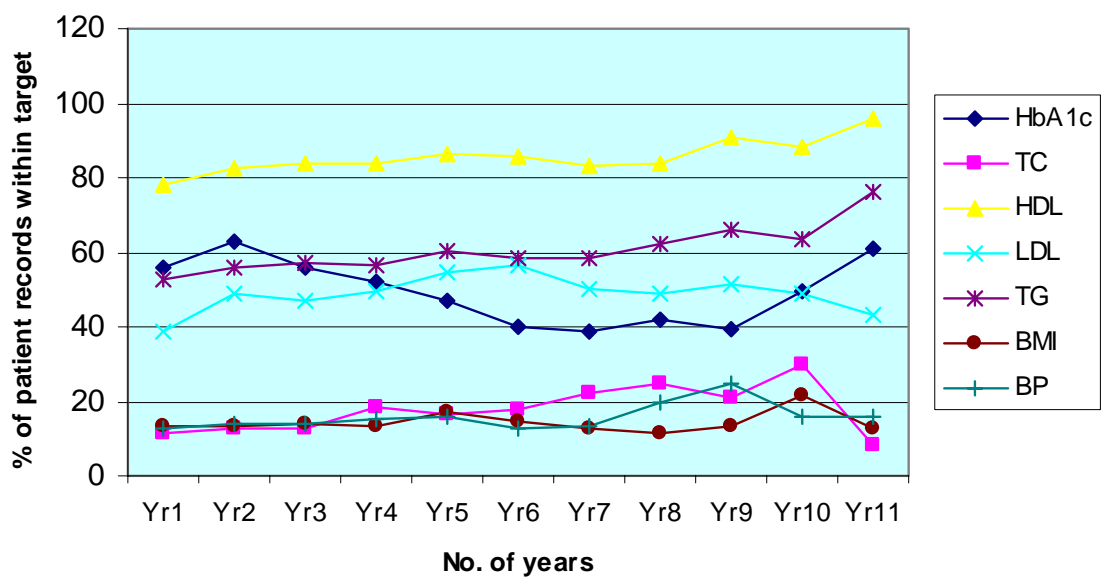


\* BP was assessed twice a year; the other indicators were assessed once a year.

### 5.5.4 Health outcomes within target by number of years in the Division Program

The following Table 15 and Figure 13, show that the proportion of patients meeting health targets for HDL and TG tended to increase in association with the increasing number of years the patient had been registered in the Divisions Diabetes Program. The trends for other indicators were not consistent over the 11 years.

**Figure 13: Frequency of health outcomes within target by number of Years in the Division Diabetes Program in type 2 diabetes**



**Table 15: Health outcomes within target by number of years in the division diabetes program in type 2 diabetes**

| HbA1c        |             |               |             | BP           |             |               |             | BMI          |             |               |             |
|--------------|-------------|---------------|-------------|--------------|-------------|---------------|-------------|--------------|-------------|---------------|-------------|
| No. of year  | Assessed    | Within target | %           | No. of year  | Assessed    | Within target | %           | No. of year  | Assessed    | Within target | %           |
| 1            | 1101        | 615           | 55.9        | 1            | 1125        | 139           | 12.4        | 1            | 885         | 117           | 13.2        |
| 2            | 829         | 523           | 63.1        | 2            | 824         | 115           | 14.0        | 2            | 691         | 93            | 13.5        |
| 3            | 662         | 371           | 56.0        | 3            | 645         | 90            | 14.0        | 3            | 563         | 78            | 13.9        |
| 4            | 525         | 273           | 52.0        | 4            | 498         | 75            | 15.1        | 4            | 449         | 60            | 13.4        |
| 5            | 388         | 182           | 46.9        | 5            | 356         | 56            | 15.7        | 5            | 321         | 56            | 17.4        |
| 6            | 265         | 106           | 40.0        | 6            | 248         | 32            | 12.9        | 6            | 224         | 32            | 14.3        |
| 7            | 222         | 86            | 38.7        | 7            | 211         | 28            | 13.3        | 7            | 192         | 25            | 13.0        |
| 8            | 162         | 68            | 42.0        | 8            | 153         | 30            | 19.6        | 8            | 140         | 16            | 11.4        |
| 9            | 132         | 52            | 39.4        | 9            | 120         | 30            | 25.0        | 9            | 113         | 15            | 13.3        |
| 10           | 85          | 42            | 49.4        | 10           | 75          | 12            | 16.0        | 10           | 69          | 15            | 21.7        |
| 11           | 28          | 17            | 60.7        | 11           | 25          | 4             | 16.0        | 11           | 24          | 3             | 12.5        |
| <b>total</b> | <b>4399</b> | <b>2335</b>   | <b>53.1</b> | <b>total</b> | <b>4280</b> | <b>611</b>    | <b>14.3</b> | <b>total</b> | <b>3671</b> | <b>510</b>    | <b>13.9</b> |

| TC           |             |               |             | LDL          |             |               |             | HDL          |             |               |             | TG           |             |               |             |
|--------------|-------------|---------------|-------------|--------------|-------------|---------------|-------------|--------------|-------------|---------------|-------------|--------------|-------------|---------------|-------------|
| No. of year  | Assessed    | Within target | %           | No. of year  | Assessed    | Within target | %           | No. of year  | Assessed    | Within target | %           | No. of year  | Assessed    | Within target | %           |
| 1            | 1076        | 124           | 11.5        | 1            | 501         | 194           | 38.7        | 1            | 791         | 620           | 78.4        | 1            | 1054        | 555           | 52.7        |
| 2            | 701         | 90            | 12.8        | 2            | 343         | 167           | 48.7        | 2            | 543         | 448           | 82.5        | 2            | 690         | 387           | 56.1        |
| 3            | 572         | 72            | 12.6        | 3            | 284         | 133           | 46.8        | 3            | 459         | 385           | 83.9        | 3            | 563         | 321           | 57.0        |
| 4            | 459         | 83            | 18.1        | 4            | 256         | 127           | 49.6        | 4            | 380         | 319           | 83.9        | 4            | 454         | 257           | 56.6        |
| 5            | 329         | 54            | 16.4        | 5            | 184         | 101           | 54.9        | 5            | 269         | 233           | 86.6        | 5            | 328         | 198           | 60.4        |
| 6            | 221         | 39            | 17.6        | 6            | 127         | 72            | 56.7        | 6            | 187         | 160           | 85.6        | 6            | 219         | 128           | 58.4        |
| 7            | 190         | 42            | 22.1        | 7            | 114         | 57            | 50.0        | 7            | 158         | 131           | 82.9        | 7            | 186         | 108           | 58.1        |
| 8            | 145         | 36            | 24.8        | 8            | 113         | 55            | 48.7        | 8            | 130         | 109           | 83.8        | 8            | 142         | 88            | 62.0        |
| 9            | 118         | 25            | 21.2        | 9            | 95          | 49            | 51.6        | 9            | 110         | 100           | 90.9        | 9            | 117         | 77            | 65.8        |
| 10           | 77          | 23            | 29.9        | 10           | 70          | 34            | 48.6        | 10           | 75          | 66            | 88.0        | 10           | 77          | 49            | 63.6        |
| 11           | 25          | 2             | 8.0         | 11           | 21          | 9             | 42.9        | 11           | 23          | 22            | 95.7        | 11           | 25          | 19            | 76.0        |
| <b>total</b> | <b>3913</b> | <b>590</b>    | <b>15.1</b> | <b>total</b> | <b>2108</b> | <b>998</b>    | <b>47.3</b> | <b>total</b> | <b>3125</b> | <b>2593</b>   | <b>83.0</b> | <b>total</b> | <b>3855</b> | <b>2187</b>   | <b>56.7</b> |

\* BP was assessed twice a year; the other indicators were assessed once a year.

## 6 Conclusions/implications:

### For all types of diabetes:

- Although there was little change in the number of GPs in the SHDGP from 1996 to 2005, new patients continuously registered in the Divisions Diabetes Program each year. The number of patient evaluations undertaken increased each year and were most frequent in the last 6 years (from 2001 to 2005). This confirms the importance of maintaining division diabetes programs over the long term in order to make a consistent improvement in the quality of care for the local population.
- In the first 5 years after registration, most patients tended to continue evaluations. After 5 years, they tended to drop out of the Division Diabetes Program (possibly due to death or relocation away from the Southern Highlands areas).
- With the Southern Highlands experiencing an increase in population during the study period, the proportion of diabetes patients registered with the Divisions Program also increased. 86.7% of diabetic patients aged 25+ in SHDGP in 2004 were on the Divisions Register. This shows that the SHDGP Diabetes Program and CARDIAB had been implemented successfully in the Southern Highlands area.

### For type 2 diabetes:

- The number of patient records registered doubled from the age of 45-54. This suggests that screening for type 2 diabetes needs to be considered for many patients after the age of 45. Current recommendations suggest that screening for type 2 diabetes is from the age of 55<sup>15</sup>. Currently screening in the age range of 45 – 54 years is recommended only for “high risk” patients (those with hypertension, obesity, family history etc).
- For quality of care, there was an obvious drop between 1998 and 2000 for all analyzed indicators except for LDL. The reasons for this are unclear. It may have been because of a waning of enthusiasm by the GPs over this period or a dilution effect as new cases were registered. However, most indicators have risen steadily between 2000 and 2005 possibly because of improvements to the Division Program and the introduction of the National Integrated Diabetes Program incentives in 2001. The level of assessment most often fluctuated between 50%-80%, emphasizing the importance of further efforts to implement the cycle of care.
- Smoking had the highest assessment rate in 1995 (96.6%), but reduced sharply after that and had the lowest rate among all the indicators assessed (<25%) from 1998 to 2005. This implies

that GPs are unwilling to reassess patients smoking status once they have asked about it at registration. Smoking is one of the main risk factors for CVD and diabetes, so this implies the need to review smoking annually especially among those who smoke or whose smoking status is unknown.

- Between 1995-2000 most health outcomes did not improve significantly. However, between 2000 and 2005, there were improvements in HbA1c, DBP, TC, LDL and TG. Over the entire 11 year period only BP and TC, LDL and TG had a significant improvement. Improvement in some health outcomes may have been related to improvements in the Division Program over this period and the introduction of the NIDP.
- There was an overall trend of targeted health outcomes being achieved year by year (except for BMI which changed very little). The proportions of patients whose BP, BMI and TC were well controlled were less than 25% over the 11 year study period. More than half of the patients' HbA1c and TG assessments met targets from 2002. This implies:
  - The control of BMI/weight is very difficult to achieve in patients with type 2 diabetes
  - Concerted efforts to improve diabetes care at the Division and National levels resulted in improvements in blood pressure and some lipids in the longer term (11 years), but further effort is needed to achieve the higher control rate for all health outcomes. This is more difficult as the targets for both BP and TC have been lowered considerably over the period.
- The longer the patients attended the Division Program, the fewer registered patients maintained regular evaluation records. It may also be that patients or their GPs become somewhat complacent. This underscores the importance of maintaining good information systems and reinforcing quality of care through feedback of audit data and quality improvement.

## **7 Limitations of study**

It has to be acknowledged that there are some limitations in this study.

### **Data quality**

In some fields there are too many missing/invalid /unknown values in the extracted records (eg: smoking, complications, medications and referral). The reasons for this have been discussed in the data quality section (Please see page 8, paragraph 2). For some of those variables, the present values are few to be analyzed (excluded from this study). For others, too many missing /invalid/unknown values might lead to the underestimation of the actual values.

### **Guidelines**

Guideline targets become stricter over time. However, 2004 targets were used in the analysis and this may lead to an underestimation of the proportion of patients meeting targeted health outcomes.

### **Study design**

Our study is a repeated cross sectional study over time. Our Data is extracted from one Division over the study period of 11 years. Each year new patients joined the Program; meanwhile some registered patients dropped out because they possibly moved outside the Division or died. Therefore, an analysis of cohort of patients from this data is recommended to investigate the cause of changes in quality of care and health outcomes associated with long term diabetes management within a Division Program.

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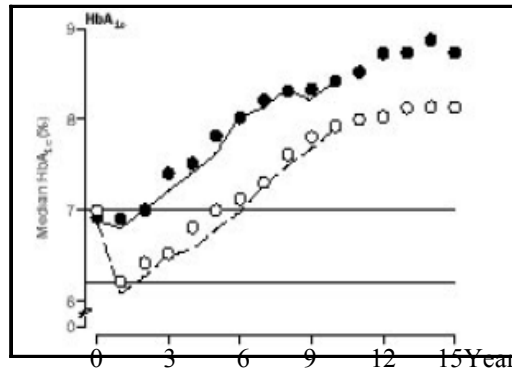
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## Appendix 1: Comparison of HbA1c between the SHDGP report and the UKPDS study

### Results:

The median HbA1c trend in the UKPDS 33 fifteen year longitudinal study is shown below:

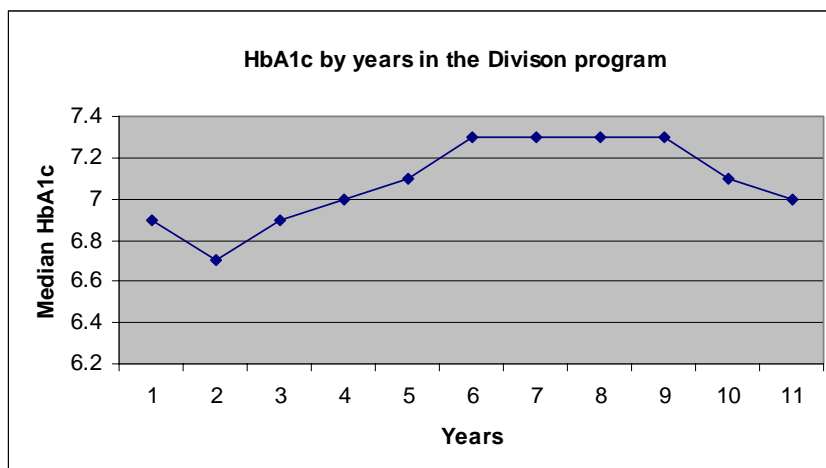


-O-O-O-: Cross-sectional data in the conventional treatment group  
 -●-●-●-: Cohort data in the intensive treatment group

Findings from the SHDGP report are shown in the following table and graph:

Number of patients assessed for HbA1c and median HbA1c by years in the Division Program

| Yrs in program | No. of patients assessed for HbA1c | Median HbA1c |
|----------------|------------------------------------|--------------|
| 1              | 1101                               | 6.9          |
| 2              | 829                                | 6.7          |
| 3              | 662                                | 6.9          |
| 4              | 525                                | 7.0          |
| 5              | 388                                | 7.1          |
| 6              | 265                                | 7.3          |
| 7              | 222                                | 7.3          |
| 8              | 162                                | 7.3          |
| 9              | 132                                | 7.3          |
| 10             | 85                                 | 7.1          |
| 11             | 28                                 | 7            |



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**Discussion:**

1. For the first 6 years, the overall trend in the median HbA1c for SHDGP is consistent with that of the UKPDS.
2. From 6-9 years, the SHDGP result seems to flatten out at a lower level compared with the UKPDS. This may indicate the success of the SHDGP Diabetes Program given the treatments between the two studies were slightly different
3. After 9 years the numbers of patients assessed for HbA1c in each year for SHDGP are too small, so the drop down trend may not reflect the true change in HbA1c.