Original Article

# Measuring the Quality of Care of Diabetic Patients at the Specialist Outpatient Clinics in Public Hospitals in Singapore

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## Abstract

**Introduction: This study aims to measure the quality of care for patients with diabetes mellitus at selected Specialist Outpatient Clinics (SOCs) in the National Healthcare Group. Materials and Methods: The cross-sectional study reviewed case-records of patients from 6 medical specialties who were on continuous care for a minimum of 15 months from October 2003 to April 2005. Disproportionate sampling of 60 patients from each specialty, excluding those co-managed by Diabetes Centres or primary care clinics for diabetes, was carried out. Information on demographic characteristics, process indicators and intermediate outcomes were collected and the adherence rate for each process indicator compared across specialties. Data analysis was carried out using SPSS version 13.0. Results: A total of 575 cases were studied. The average rate for 9 process indicators by specialty ranged from 47.8% to 70.0%, with blood pressure measurement consistently high across all specialties (98.4%). There was significant variation ($P$ <0.001) in rates across the specialties for 8 process indicators; HbA1c, serum creatinine and lipid profile tests were over 75%, while the rest were below 50%. The mean HbA1c was 7.3% ± 1.5%. "Optimal" control of HbA1c was achieved in 51.2% of patients, while 50.6% of the patients achieved "optimal" low-density lipoprotein (LDL)-cholesterol control. However, 47.3% of patients had "poor" blood pressure control. Adherence to process indicators was not associated with good intermediate outcomes. Conclusions: There was large variance in the adherence rate of process and clinical outcome indicators across specialties, which could be improved further.**

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**Key words: Assessment, Indicators, Outcome, Process**

## Introduction

Singapore is a country with a high prevalence of diabetes mellitus,[1] 8.2% amongst its population aged between 18 and 69 years,[2] and is joint second in the world for "pre-diabetes" after Nauru.[3] About 17% of all patients admitted to 3 acute hospitals in the National Healthcare Group (NHG) have coexisting diabetes. The heavy burden of morbidity and mortality from macrovascular and microvascular complications makes it imperative that comprehensive and appropriate management of patients with diabetes should include early screening for complications.

Indicators for good management of diabetes include those of structure, process and outcome.[4] Structure refers to the environment of care; process refers to how things are organised and done; and outcome refers to the impact of health services on the patients. The Ministry of Health (MOH) published the Clinical Practice Guidelines (CPG) on Diabetes Mellitus in 1999 and the revised CPG in 2006. It recommended a series of 9 quality indicators for good management of diabetes mellitus.[5] In 2002, MOH conducted the first National Diabetes Care Audit in 6 public acute-care hospitals and 17 polyclinics in the 2 public sector healthcare groups based on the CPG and found that both

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groups had good structural programmes, protocols and linkages across the continuum of care at both the hospital and primary care (polyclinic) levels. Monitoring of process and outcomes such as glycated haemoglobin (HbA1c), blood pressure (BP) and weight were conducted conscientiously. However, there remained gaps in the screening and early detection for major early macro- and microvascular complications; i.e. dyslipidaemia, cardiovascular, renal, eye and foot complications, at both hospitals and polyclinics.

Within the NHG, patients with diabetes mellitus are managed at primary care polyclinics and specialist outpatient clinics (SOCs), including Diabetes Centres in the acute-care hospitals. The NHG Polyclinics perform a clinical audit of diabetes care twice a year. Patients managed by Diabetes Centres of the hospitals have been surveyed in 1998 and 2003, as part of the Diabcare-Asia survey.[6] However, little is known about the quality of care in other medical specialty clinics such as in Cardiology, General Medicine, Geriatric Medicine, Neurology, Respiratory Medicine or Rheumatology.

*Aim*

This study aimed to determine the quality of care for the management of patients with diabetes mellitus at medical SOCs in 3 acute hospitals of the NHG, and identify areas for quality improvement. This study was sanctioned by the NHG Chairman Medical Board Committee.

## Materials and Methods

This cross-sectional study involved a retrospective review of medical records of patients in the disciplines of Cardiology, General Medicine, Geriatric Medicine, Neurology, Respiratory Medicine and Rheumatology at 3 acute hospitals in NHG conducted between May and September 2005.

*Study Population*

To be included in this study, patients must have been diagnosed by physicians to have diabetes mellitus, been on continuous care for at least 15 months and received treatment for diabetes from these clinics only. The hospital pharmacies generated a list of patients who attended these clinics during the period from October 2003 to April 2005 and who were prescribed medications for the treatment of diabetes mellitus. A random sample of 60 patients was taken from each clinic. For those with fewer than 60 patients, all patients were included. Twenty-five (4%) patients who were co-managed by Diabetes Centres or primary care clinics for diabetes were excluded.

*Study Parameters and Data Collection*

A data collection form was developed to collect data on demographic characteristics (age, gender, ethnic group), clinical specialties (Cardiology, General Medicine, Geriatric Medicine, Neurology, Respiratory Medicine and Rheumatology), process and intermediate outcome indicators.

*(a) Process indicators*

These were based on the MOH Diabetes Mellitus CPG 1999 and included 9 components:

a. HbA1c test (once in 6 months)
b. Body weight or body mass index (BMI) measurement (in the previous 4 months)
c. Blood pressure measurement (in the previous 6 months)
d. Urine albumin test (once in 15 months)
e. Lipid profile (once in 15 months)
f. Serum creatinine test (once in 15 months)
g. Eye assessment (once in 15 months)
h. Foot assessment (once in 15 months)
i. Patient education (once in 15 months)

A process indicator was considered "achieved" if there was documentation of an order by the physician or laboratory result during the study period with the last recorded visit referenced as the fifteenth month visit. The adherence rate for each indicator is calculated as the number of patients who satisfied the indicator divided by the number of patients in each specialty. Performing a urine dipstix, albumin:creatitine ratio (ACR) or 24-hour urine total protein (UTP) satisfies the criteria for the urine albumin test. For eye assessment, either a fundal photography or fundoscopy satisfies the criteria for retinopathy screening. For foot assessment, any documentation by the physician or screening by nurse or podiatrist satisfies the criteria. For patient education, documentation of diabetes or dietary advice provided to patients or their carers by a member of the healthcare team meets the criteria.

*(b) Intermediate outcome indicators*

Three intermediate outcome measures were included; i.e. HbA1c, blood pressure [both systolic blood pressure (SBP) and diastolic blood pressure (DBP)] and low-density lipoprotein-cholesterol (LDL-c) levels, where the most recent result was taken. Glycaemic control was considered "optimal" if HbA1c was ≤7.0%, "sub-optimal" if HbA1c was 7.1% to 8.0%, and "poor" if HbA1c was ≥8.1%. Blood pressure (BP) control was considered "optimal" if SBP was ≤130 mm Hg and DBP was ≤80 mm Hg, "sub-optimal" if SBP was 131 to 139 mm Hg and DBP was 81 to 89 mm Hg, and "poor" if SBP was ≥140 mm Hg and DBP was ≥90 mm Hg. Dyslipidaemia control was considered "optimal" if LDL-c was <2.6 mmol/L, "sub-optimal" if LDL-c was 2.6 to 3.3 mmol/L and "poor" if LDL-c was ≥3.4 mmol/L.

Nine nursing staff and clinical coders, who were not involved in the clinical care of these patients, were recruited

and trained to collect data. The study coordinator checked the forms for missing data and revisited the medical records where necessary.

*Data Analysis*

Data were entered in Excel (version 2000) and analysed using SPSS (version 13.0). Significance testing of proportions was carried out using chi-square test, and of means using analysis of variance (ANOVA), where a probability (*P*) of less than 0.05 was considered significant.

## Results

A total of 575 patients from 3 hospitals were included in the study. Table 1 shows that females outnumbered males by a ratio of 3:2, but in Geriatric Medicine there were 3 times more females than males while males outnumbered females in Cardiology. Their ages ranged between 22 and 94 years, with 56% aged 65 years and older. As expected, patients under the care of Geriatric Medicine were generally older, with 24% aged 85 years and older. The disproportionately higher proportion of Indians (14%) in relation to the general Singapore population across all specialties reflected the higher incidence of diabetes mellitus in this racial group.

*(a) Process Indicators*

Table 2 shows the rates of all 9 process indicators by specialty. The average rate ranged from 47.8% to 70.0% among the specialties. General Medicine was the leader in 7 out of 9 indicators with an average of 70.0%, with 7 items scoring above 50% and 4 items above 75%. The best result was for blood pressure measurement (98.4%). All the patients under the care of the General Medicine and Geriatric Medicine specialties had their blood pressure measured. For the other 8 process indicators, there was significant variation ($P$ <0.001) in rates across the specialties. The rates for the HbA1c test, serum creatinine test and lipid profile were at least 75%, while the rest fell below 50%. The lowest was foot assessment at 18.1%.

The rate of HbA1c test performed within 6 months ranged from 75.0% to 91.3% and was higher among the Geriatric Medicine (91.3%) and General Medicine (90.6%) specialties than others. Lipid profile rates varied from 65.7% to 88.3% and were significantly higher in General Medicine (88.3%) and Cardiology (86.7%) than the other medical specialties. The serum creatinine test was more commonly performed among the General Medicine (95.9%) and Geriatric Medicine (93.0%) specialties. The urine albumin test was more frequently ordered in the General

Table 1. Demographic Characteristics of Patients by Specialty

| Demographic Characteristic | Specialty | | | | Total | *P* value |
|---|---|---|---|---|---|---|
| | Cardiology | General Medicine | Geriatric Medicine | Others* | | |
| | (n = 120) N (%) | (n = 171) N (%) | (n = 115) N (%) | (n = 169) N (%) | (n = 575) N (%) | |
| Gender | | | | | | |
| Male | 70 (58.3) | 61 (35.7) | 29 (25.2) | 69 (40.8) | 229 (39.8) | <0.001 |
| Female | 50 (41.7) | 110 (64.3) | 86 (74.8) | 100 (59.2) | 346 (60.2) | |
| Age (y) | | | | | | |
| <55 | 25 (20.8) | 42 (24.6) | – | 49 (29.0) | 116 (20.2) | <0.001 |
| 55-64 | 29 (24.2) | 62 (36.3) | 4 (3.5) | 43 (25.4) | 138 (24.0) | |
| 65-74 | 41 (34.2) | 44 (25.7) | 23 (20.0) | 47 (27.8) | 155 (27.0) | |
| 75-84 | 21 (17.5) | 18 (10.5) | 60 (52.2) | 25 (14.8) | 124 (21.6) | |
| 85+ | 4 (3.3) | 5 (2.9) | 28 (24.3) | 5 (3.0) | 42 (7.3) | |
| Ethnic group | | | | | | |
| Chinese | 94 (78.3) | 119 (69.6) | 94 (81.8) | 119 (70.4) | 426 (74.1) | 0.046 |
| Malay | 8 (6.7) | 24 (14.0) | 3 (2.6) | 24 (14.2) | 59 (10.3) | |
| Indian | 18 (15.0) | 25 (14.6) | 16 (13.9) | 24 (14.2) | 83 (14.4) | |
| Other | – | 3 (1.8) | 2 (1.7) | 2 (1.2) | 7 (1.2) | |

* included Neurology, Respiratory Medicine and Rheumatology

Table 2. Care Processes by Specialty

| Process indicator | Specialty | | | | Total | *P* value |
|---|---|---|---|---|---|---|
| | Cardiology | General Medicine | Geriatric Medicine | Others* | | |
| | (n = 120) N (%) | (n = 171) N (%) | (n = 115) N (%) | (n = 169) N (%) | (n = 575) N (%) | |
| HbA1c test | 90 (75.0) | 155 (90.6) | 105 (91.3) | 127 (75.1) | 477 (83.0) | <0.001 |
| Weight/BMI measurement | 19 (15.8) | 50 (29.2) | 49 (42.6) | 42 (24.9) | 160 (27.8) | <0.001 |
| Blood pressure measurement | 115 (95.8) | 171 (100) | 115 (100) | 165 (97.6) | 566 (98.4) | 0.015 |
| Urine albumin test | 21 (17.5) | 122 (71.3) | 52 (45.2) | 61 (36.1) | 256 (44.5) | <0.001 |
| Lipid profile | 104 (86.7) | 151 (88.3) | 76 (66.1) | 111 (65.7) | 442 (76.9) | <0.001 |
| Serum creatinine test | 96 (80.0) | 164 (95.9) | 107 (93.0) | 136 (80.5) | 503 (87.5) | <0.001 |
| Eye assessment | 23 (19.2) | 116 (67.8) | 39 (33.9) | 51 (30.2) | 229 (39.8) | <0.001 |
| Foot assessment | 13 (10.8) | 57 (33.3) | 12 (10.4) | 22 (13.0) | 104 (18.1) | <0.001 |
| Patient education | 35 (29.2) | 91 (53.2) | 41 (35.7) | 44 (26.0) | 211 (36.7) | <0.001 |
| Average (%) | 47.8 | 70.0 | 57.6 | 49.9 | 57.0 | |
| Number of indicators ≥50% | 4 | 7 | 4 | 4 | 4 | |
| Number of indicators ≥75% | 4 | 4 | 3 | 3 | 4 | |

BMI: body mass index

* included Neurology, Respiratory Medicine and Rheumatology

Medicine (71.3%) specialty and was lower in other specialties (17.5% to 45.2%).

About 4 in 10 patients had eye assessments, the rate being highest in General Medicine (67.8%) compared to the other specialties (19.2% to 33.9%). Only 18% of patients had their feet assessed, and this was significantly higher in General Medicine (1 in 3) than in other specialties (1 in 10). Only 27.8% of patients had a documented body weight or BMI measurement, ranging from 15.8% to 42.6% across the specialties. About 1 in 3 patients were documented to have received patient education, ranging from 26.0% to 53.2% across specialties.

### *(b) Intermediate Outcomes*

The intermediate outcomes are compared by specialty in Table 3.

#### *Glycaemic Control*

HbA1c was measured in 96% (553 out of 575) of the patients. The mean HbA1c was 7.3% ± 1.5% and lowest among the patients in Geriatric Medicine (6.9% ± 1.3%). While over half (51.2%) had "optimal" control, there were 22.8% with "poor" control. About 65% of patients from Geriatric Medicine had "optimal" control, compared with 40.9% in Cardiology and 47.3% in General Medicine. About 28% of patients in General Medicine had "poor" control of HbA1c, which was highest across the specialties.

#### *Blood Pressure Control*

Only 2 patients did not have a blood pressure record. The mean blood pressure was 137/78 ± 19/9 mm Hg, similar across all specialties. About 26.2% of the patients had "optimal", 26.5% had "sub-optimal" and 47.3% had "poor" blood pressure control. There was no significant difference in blood pressure control across the specialties.

#### *LDL-c Control*

The mean LDL-c was 2.72 ± 0.85 mmol/L among the 470 (81.7%) patients with a record and was lower among patients managed under the Cardiology (2.56 ± 0.83 mmol/L) and Geriatric Medicine (2.60 ± 0.94 mmol/L) specialties than those under General Medicine (2.88 ± 0.92 mmol/L). Correspondingly, about half (50.6%) of the patients achieved "optimal" control, 33.6% "sub-optimal" control and 15.7% "poor" LDL-c control. A higher proportion of the patients in the Cardiology and Geriatric Medicine specialties had "optimal" LDL-c control.

## Discussion

Despite the availability of published guidelines and the evidence from clinical trials supporting their use,[7-16] physician compliance with a number of diabetes management recommendations in a variety of healthcare delivery systems falls short of national standards.[17-20] As a result, the quality of healthcare for patients with diabetes

Table 3. Glycaemic, Blood Pressure and Cholesterol Control by Specialty

| Clinical parameter | Specialty | | | | Total | *P* value |
|---|---|---|---|---|---|---|
| | Cardiology | General Medicine | Geriatric Medicine | Others* | | |
| | (n = 120) N (%) | (n = 171) N (%) | (n = 115) N (%) | (n = 169) N (%) | (n = 575) N (%) | |
| **HbA1c†** | | | | | | 0.003‡ |
| Optimal | 45 (40.9) | 79 (47.3) | 74 (64.9) | 85 (52.5) | 283 (51.2) | |
| Sub-optimal | 40 (36.4) | 41 (24.6) | 25 (21.9) | 38 (23.5) | 144 (26.0) | |
| Poor | 25 (22.7) | 47 (28.1) | 15 (13.2) | 39 (24.1) | 126 (22.8) | |
| Total | 110 (100) | 167 (100) | 114 (100) | 162 (100) | 553 (100) | |
| Mean (%) | 7.5 ± 1.4 | 7.5 ± 1.6 | 6.9 ± 1.3 | 7.3 ± 1.6 | 7.3 ± 1.5 | 0.016§ |
| **Blood pressure‖** | | | | | | ns‡ |
| Optimal | 33 (27.7) | 42 (24.6) | 25 (21.7) | 50 (26.2) | 150 (26.2) | |
| Sub-optimal | 36 (30.3) | 42 (24.6) | 28 (24.3) | 46 (27.4) | 152 (26.5) | |
| Poor | 50 (42.0) | 87 (50.9) | 62 (53.9) | 72 (42.9) | 271 (47.3) | |
| Total | 119 (100) | 171 (100) | 115 (100) | 168 (100) | 573 (100) | |
| Mean SBP (mm Hg) | 134.5 ± 18.0 | 140.0 ± 22.9 | 138.1 ± 17.7 | 135.4 ± 17.0 | 137.1 ± 19.4 | ns§ |
| Mean DBP (mm Hg) | 77.2 ± 9.2 | 78.6 ± 9.5 | 75.0 ± 8.4 | 78.8 ± 8.3 | 77.6 ± 9.0 | |
| **Fasting LDL-c¶** | | | | | | 0.022‡ |
| Optimal | 63 (56.8) | 70 (45.2) | 49 (62.0) | 56 (44.8) | 238 (50.6) | |
| Sub-optimal | 39 (35.1) | 52 (33.5) | 20 (25.3) | 47 (37.6) | 158 (33.6) | |
| Poor | 9 (8.1) | 33 (21.3) | 10 (12.7) | 22 (17.6) | 74 (15.7) | |
| Total | 111 (100) | 155 (100) | 79 (100) | 125 (100) | 470 (100) | |
| Mean (mmol/L) | 2.56 ± 0.83 | 2.88 ± 0.92 | 2.60 ± 0.94 | 2.75 ± 0.68 | 2.72 ± 0.85 | 0.011§ |

DBP: diastolic blood pressure; LDL-c: low-density lipoprotein-cholesterol; SBP: systolic blood pressure
* included Neurology, Respiratory Medicine and Rheumatology
† 22 subjects did not have a HbA1c record
‡ using chi-square test
§ using ANOVA
‖ 2 subjects did not have blood pressure record
¶ 105 subjects did not have LDL-c record

has been found to be low across multiple health systems.[21,22] In the United States, Saaddine et al[23] reported a major gap between recommended diabetes care and the care that patients actually receive. Adherence to quality standards varied widely and the rates of adherence to process measures of quality were relatively low compared to the targets established by the American Diabetes Association.[24-32] In 1999, Bernard et al[33] measured the performance of 5 key indicators – referral for dilated eye examinations, measurement of lipids, screening for proteinuria, performance of foot examinations and inquiries regarding self-monitoring of blood glucose – and all fell short of recommendations when assessed by record review. Other countries and regions that have examined the quality of diabetes care have reported similar findings. In Asia, the Diabcare-Asia project from Singapore, India and Taiwan showed that one-third to one-half of the diabetic population had poor glycaemic control and suboptimal lipid control.[6,34,35]

In this study, the medical SOCs had not achieved good adherence with all the process indicators and there was large variance with the rates achieved for 8 of 9 process indicators across the various medical specialties. Blood pressure measurement was the most achievable process indicator as clinicians measured the patient's blood pressure during each consultation. In other studies too, physicians widely assessed the blood pressure of patients with diabetes during each office visit.[36,37]

The HbA1c test should be ordered at least once in 6 months to objectively assess long-term glycaemic control

in patients with diabetes mellitus. The urine microalbumin test, the best early indicator of renal decline and the most sensitive means to detect proteinuria, should be ordered at least once annually.[38,39] A practical way to improve adherence to the main indices would be to bundle individual components into an annual "Diabetes Panel" test that the patient could undergo in one sitting.

In general, the rates for non-laboratory assessments such as weight or BMI measurement, eye and feet assessments, and the provision of patient education were much lower than laboratory-based tests. A patient's weight was often unrecorded and it might help if the BMI measurement can be performed while in the waiting area before clinical consultation. The rates for eye and foot assessments could be improved with the availability of diabetic retinopathy photography and diabetic foot screening in the hospitals to complement the care by the principal clinician. To complete the clinical management of patients, dietary advice or general information on diabetes provided by any member of the healthcare team could assist the patient to be empowered towards better self-care. It is important to document patient education and review targets of control with the patient at every encounter.

The intermediate outcome measures of the patients were satisfactory. Only half of the patients had "optimal" glycaemic and blood cholesterol levels, and a quarter had "optimal" blood pressure control. It may be possible to reduce the proportion of patients with "poor" blood pressure control through more aggressive therapy. Fewer patients under the care of the Cardiology specialty continued to have "poor" blood pressure or LDL-cholesterol control compared to patients in other specialties. Conversely, the General Medicine specialty had high rates for the majority of the process indicators as well as the highest proportion of patients with "poor" glycaemic and LDL-cholesterol levels.

This study suggests that adherence to process indicators is not always associated with good intermediate outcomes. A balanced measure of the overall quality of diabetes care should include both process and intermediate outcome measures as recommended by most international and MOH guidelines. The MOH in Singapore is fostering greater transparency in the entire healthcare ecosystem through the publication of performance and quality indicators. This will presumably foster patient empowerment in choosing the right providers for each individual patient. The medical profession should take the lead to ensure that good quality data, properly risk-adjusted and simplified, be presented appropriately to the public.

There are several limitations in this retrospective, cross-sectional study. Firstly, data depended on the completeness and accuracy of the medical records. Incomplete documentation could result in a lower rate for the process indicators. Patient factors, such as reluctance to take a test, could result in a lower recorded rate of laboratory tests performed, and this may not be due to the doctor's lack of care. Secondly, limited resources restricted this study to patients followed-up by only 6 medical specialties that manage the vast majority of patients with diabetes in the hospital setting. Thirdly, the case-mix of patients was unadjusted when comparing the process indicators and intermediate outcomes, and equal weightage was accorded to the 9 process indicators. Although patients in Geriatric Medicine were older and could have multiple co-morbid conditions, with the exception of blood pressure control, the clinical outcomes were comparable to other specialties.

## Conclusion

The quality of care for patients with diabetes in the SOCs can be further improved. Healthcare providers can be overwhelmed by the complexity of issues associated with the management of patients with diabetes mellitus and often fail to adequately address both diabetes-related and non-diabetes-related healthcare screening.[37] Appropriate management of patients with diabetes mellitus requires that a number of healthcare screenings be performed on a regular basis. The healthcare system can be re-engineered to facilitate all physicians, regardless of their sub-specialty, to provide holistic and patient-centred care.

This study provides the baseline for quality improvement and serves as an impetus for further qualitative and quantitative studies to investigate the socio-cultural and patient-related factors affecting the outcomes of diabetes care, which will yield new perspectives and knowledge regarding diabetes management.

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