The Status of Diabetes Mellitus in Primary Care Institution and Restructured Hospitals in Singapore

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ABSTRACT

The Diabcare-Asia Singapore 1998 project was carried out using data from 22 centres collected on paper forms to provide an overview of diabetes management and metabolic control status in 1697 diabetic patients from both primary health care clinic (PHC) (67%) and restructured hospital (RH) (33%) settings. PHC patients were on average older than RH patients (61.3 ± 11.2 years vs 51.5 ± 17.7 years), and had a shorter duration of diagnosed diabetes (9.2 ± 6.8 years vs 12.0 ± 8.5 years). The mean body mass index (BMI) for PHC patients was 25.5 ± 4.4 kg/m² vs 24.5 ± 4.2 kg/m² for RH patients. Proportionately more PHC than RH patients were overweight (BMI >25 kg/m²) (49% vs 42%). Patients with type 1 diabetes constituted 3.5% of PHC vs 18.1% of the RH cohort. HbA_{1c} information was available for 92.5 % of RH vs 69% of PHC patients. HbA_{1c} measurements were <1% above ULN in 50% of PHC vs 37% of RH patients, while FBG was >7.8 mmol/l in >61% of all patients. Proteinuria (>500mg/24 hrs) was reported in 13% of PHC vs 26% of RH patients tested. Microalbuminuria (20 - 300 mg/l) was noted in 36% of 171 RH patients tested. Oral hypoglycaemic agents were used as sole therapy in 83.5% of PHC vs 43% of RH patients. Eye, feet, renal and severe late complications were more commonly reported by RH than PHC patients. There is a variation in the patient profiles and care between PHC and RH patients.

Keywords: diabetes mellitus, glycaemic/metabolic control, complications, primary health care, restructured hospital

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INTRODUCTION

The prevalence of type 2 diabetes is on the increase worldwide[1], and represents a huge burden of disease which needs to be tackled at all levels, ranging from improvements in public health education and individual self care skills education, to improvements in primary health care and tertiary care facilities. In Singapore, the prevalence of diabetes mellitus increased from 1.99% in 1975[2] to 9.0% in 1998[3]. Diabetes was the sixth leading cause of deaths in Singapore in 1997-1999[3]. The results of the Diabetes Control and Complications Trial and UK Prospective Diabetes Study (UKPDS) group have shown that with good glycaemic control, the development of diabetic complications could be delayed or prevented[4-7]. The status of diabetes mellitus care as managed in two different types of medical care facilities - primary health care (polyclinics and private clinics) and restructured hospitals is described in this article.

METHODS

The methodology pertaining to study population, data collection method and data handling and statistical analysis has been previously described elsewhere (in press). Briefly, the study was carried out between 1 March 1998 and 30 April 1998 in 22 diabetes centres that managed more than 100 diabetes patients per month. Recruitment was carried out such that a representative sample of patients was obtained from each participating centres. Data were collected on a retrospective basis by reviewing patient medical records as well as through interview and laboratory assessments. Information on patient demography, type of diabetes, frequency and nature of interventions received, cardiovascular risk factors, glycaemic control, renal function, eye, feet and severe late complications, diabetes management and glucose self-monitoring were collected in paper forms. Data were scanned electronically (TELEform Elite, version 5.2; Cardiff Software, San Marcos, USA) into a Statistical Analysis System (SAS, Version 6.12, SAS Institute Inc., Cary, USA) and data validation was carried out by the scanning software and the SAS system.

Although no centralised HbA_{1c} measurement was available, the majority of PHC centres had been using a single laboratory, shared with one of the RH centre. The normal ranges reported by the laboratories ranged from 4.6% - 6.4% in 14 centres, 4.5% - 6.5% in three centres, 4.6% - 6.3% in two centres and <6.1% in three centres. Since there was a slight variation in normal

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Table I. Patient Demographics.

Variables	Types of Clinics	
	PHC (N = 1145)	RH (N = 552)
Types of Diabetes		
n	1124	543
Type 1 (%)	3.5	18.1
Type 2 (%)	96.3	81.4
Others (%)	0.3	0.6
Sex		
n	1145	552
Male (%)	46.5	50.2
Female (%)	53.5	49.8
Age (years)		
n	1145	552
mean ± SD	61.3 ± 11.2	51.5 ± 17.7
Duration of Diabetes (years)		
n	1105	525
mean ± SD	9.2 ± 6.8	12.0 ± 8.5
Age at Onset (years)		
n	1105	525
mean ± SD	51.8 ± 11.6	39.2 ± 15.4
BMI (kg/m^2)		
n	901	511
mean ± SD	25.5 ± 4.4	24.5 ± 4.2
≤25 kg/m^2 (%)	51	58
>25 kg/m^2 (%)	49	42
Blood Pressure (mm Hg)		
n	1099	540
Systolic >140 mmHg (%)	31	26
Diastolic >90 mmHg (%)	4	7

BMI assessed for patients aged ≥21 years old
PHC : Primary health care
RH : Restructured hospital

Table II. Glycaemic and Metabolic Control.

Variables	Types of Clinics	
	PHC (N = 1145)	RH (N = 552)
GLYCAEMIA		
HbA$_{1c}$		
n	797	511
mean (%)	7.8 ± 1.9	8.2 ± 1.9
<1% ULN (%)	50	37
1 - 2% ULN (%)	18	25
>2% ULN (%)	32	38
FBG		
n	994	396
mean (mmol/l)	9.0 ± 2.8	9.5 ± 3.7
<6.1 mmol/l (%)	10	13
6.1 - 7.8 mmol/l (%)	29	24
>7.8 mmol/l (%)	61	62
METABOLIC		
Fasting Lipids		
Triglyceride		
n	933	470
<1.7 mmol/l (%)	49	59
1.7 - 2.2 mmol/l (%)	22	20
>2.2 mmol/l (%)	29	22
Total Cholesterol		
n	938	480
<5.2 mmol/l (%)	28	42
5.2 - 6.5 mmol/l (%)	52	43
>6.5 mmol/l (%)	20	15
HDL Cholesterol		
n	936	447
>1.1 mmol/l (%)	52	55
0.9 - 1.1 mmol/l (%)	38	31
<0.9 mmol/l (%)	10	14

ranges for HbA_{1c} measurements, HbA_{1c} values were expressed according to ≤1%, >1% but ≥2% and >2% above the upper limit of normal range (ULN) indicating good, borderline and poor glycaemic control respectively.

Restructured hospitals refer to government-owned hospitals which are run as private companies and also received government subventions for care of subsidised patients but have full management autonomy and flexibility.

The patient data set was 2001 from 22 centres, out of which 304 (15%) were excluded from statistical analysis due to missing data on basic patient information such as diabetes duration or inconsistency between basic data fields. Thus, 1697 patients constituted the analysis population.

RESULTS

Patient Demographic Characteristics

Table I summarises the patient demographics and characteristics in primary health care (PHC) clinics and restructured hospitals (RH). Overall, PHC contributed 67% of patients while RH contributed 33% of patients. The majority of patients seen in both PHC (96.3%) and RH (81.4%) were diagnosed as type 2 diabetes. The proportion of patients diagnosed with type 1 diabetes was higher in RH (18.1%) compared to PHC (3.5%). The male : female ratio among PHC patients was 1:1.15 , whereas among RH patients, it was 1:0.99.

Patients in PHC (61.3 ± 11.2 years) were on average older than patients in RH (mean age 51.5 ± 17.7 years). Patients treated at PHC had a later mean age at onset (51.8 ± 11.6 years) and a shorter mean duration of diabetes (9.2 ± 6.8 years) compared to patients treated in RH (mean age at onset: 39.2 ± 15.4 years and mean duration of diabetes: 12.0 ± 8.5 years). Mean body mass index (BMI) in patients from PHC was 25.5 ± 4.4 kg/m^2 and from RH was 24.5 ± 4.2 g/m^2. The proportion of patients who were overweight (BMI >25 kg/m^2) was higher in PHC (49%) compared to RH (42%). As for blood pressure assessment, slightly more patients in PHC than RH had systolic >140 mmHg (31% vs 26%) whereas more patients treated in RH than PHC had diastolic >90 mmHg (7% vs 4%).

Table III. Renal Function and Complications.

Variables	Types of Clinics	
	PHC (N = 1145)	RH (N = 552)
RENAL FUNCTION		
Serum creatinine		
n	877	438
>180 μmol/l (%)	1	7
Urine microalbumin		
n	3	171
Normal (<20 mg/l) (%)	67	61
Microalbuminuria (20-300 mg/l) (%)	33	36
Macroalbuminuria (>300 mg/l) (%)	0	3
Proteinuria		
n	822	247
>500 mg/24 h (%)	13	26
COMPLICATIONS		
Eye Complications[a]		
Photocoagulation (%)	4	13
Cataract (%)	13	21
Retinopathy (%)	9	17
Advanced eye disease (%)	1	1
Feet Complications[b]		
Absence of foot pulse (%)	0	0
Healed ulcer (%)	1	2
Acute ulcer/gangrene (%)	0	1
Neuropathy (%)	8	20
Angioplasty (%)	0	1
Severe Late Complications[c]		
Legal blindness (%)	0	1
MI/CABG/Angioplasty (%)	3	9
Cerebral stroke (%)	2	4
Renal failure (%)	0	1
Leg amputation (%)	0	3

[a] : Types of Clinics: data are available from >90% of patients
[b] : Types of Clinics: data are available from >88% of patients
[c] : Types of Clinics: data are available from >98% of patients

MI/CABG/angioplasty : Myocardial infarction/coronary artery bypass graft/angioplasty

PHC : Primary health care

RH : Restructured hospital

Glycaemic and Metabolic Control

The mean level of glycated HbA_{1c} was higher in patients from RH (8.2 ± 1.9%) than in patients from PHC (7.8 ± 1.9%) (Table II). As shown, 50% of patients treated in PHC had HbA_{1c} <1% ULN (indicative of good glycaemic control) compared to 37% of patients treated in RH. Proportionately more patients in RH vs PHC had borderline (25% vs 18%) and poor glycaemic control (38% vs 32%).

Similar to the HbA_{1c} assessment, patients in PHC (9.0 ± 2.8 mmol/l) had a slightly lower mean fasting blood glucose (FBG) level than patients in RH (9.5 ± 3.7 mmol/l). There was however, no considerable difference (61%) in the proportion of patients with FBG <7.8 mmol/l (indicative of good and borderline glycaemic control, according to the European NIDDM Policy Group[8]) between the two types of diabetes clinics (Table II). Although it appeared that diabetic patients attending polyclinics had better glycaemic control (HbA_{1c} and FBG) than patients attending restructured hospitals, the majority of patients in both groups had unsatisfactory or poor blood glucose control.

Information on fasting lipids was available in 81.9% of PHC and 85.1% of RH patients. The proportion of patients with good metabolic control of fasting lipids (TG <1.7 mmol/l, total cholesterol <5.2 mmol/l and HDL >1.1 mmol/l[8]) was relatively higher in the RH group compared to the PHC group.

Renal Function and Diabetes Complications

Table III summarises the renal function, eye, feet and severe late examinations in the past 12 months.

Renal Function

Overall, the data suggest that the level of screening for renal complications of patients in this study was not uniform between PHC centres and RH centres. However, in those patients for whom data were available, the level of renal complications was high. Proteinuria screening information was available in 71.7% of PHC patients and 44.7% of RH patients, but information on urine microalbuminuria screening in PHC was available in <1% of patients compared to 31% in RH. Response rates to screening for serum creatinine >180 μmol/l was comparable in both types of institutions (76.6% in PHC patients vs 79.3% in RH patients).

Proteinuria (>500mg/24hrs) was reported in 13% of PHC vs 26% of RH patients tested, while microalbuminuria (20 - 300 mg/l) was noted in 36% of 171 RH patients, with 61% having normal levels of albumin in the urine (<20 mg/l) and 36% having microalbumin (20 - 300 mg/l). Of all the data available, 7% of patients treated in RH had serum creatinine >180 μmol/l compared to 1% of patients treated in PHC. Overall, assessment of renal function through serum creatinine and proteinuria showed that RH had a higher proportion of patients who had elevated levels of serum creatinine and protein in the urine compared to PHC.

Eye Complications

Eye complication examination included screening for photocoagulation, cataract, retinopathy and advanced eye disease (Table III). The response rate to eye examination was good with >90% of data available. Of all complications, cataract (13% vs 21% in PHC vs RH) and retinopathy (9% vs 17% in PHC vs RH) were most commonly reported. Four per cent of patients in

Table IV. Diabetes Treatment.

Variables	Types of Clinics	
	PHC (N = 1145)	RH (N = 552)
Types of treatment	n = 1136	n = 531
Diet only	10.0	4.3
Insulin only	3.9	38.8
Insulin + OHA	2.5	13.7
OHA only	83.5	43.1
Others	0.1	0
Types of OHA treatment	n = 977	n = 302
≥2 types of OHAs	54.0	49.7
Biguanides only	8.3	19.5
Glucosidase inhibitors only	0.1	2.3
Sulphonlyureas only	37.6	28.5

Others : Patients who are not treated with insulin, OHA or diet
OHA : Oral Hypoglycaemic Agent
PHC : Primary health care
RH : Restructured hospital

PHC had reported photocoagulation compared to 13% of patients in RH. Overall, except for advanced eye disease, the frequencies of the other eye complications were considerably higher in RH than PHC.

Foot Complications

Foot complication examination included screening for foot pulse, healed ulcer, acute ulcer/gangrene, neuropathy, amputation and leg angioplasty (Table III). The response rate was good with >88% of data available. With the exception of absence of foot pulse, the frequencies of reported feet complications were higher in RH group compared to PHC group. Neuropathy was highest in frequency for both PHC (8%) and RH (20%).

Severe Late Complications

Severe late complications examined were legal blindness, myocardial infarction/coronary artery bypass graft/angioplasty (MI/CABG/angioplasty), cerebral stroke, renal failure and leg amputation (Table III). The overall response rate was good with >98% of data available. The frequencies of reported severe late complications were higher in RH. There were no instances of legal blindness, renal failure or leg amputation in patients attending PHC. MI/CABG/angioplasty was the most frequently reported complication in both RH (9%) and PHC (3%).

Treatment

The treatment regimen received by patients is summarised in Table IV. The proportion of patients receiving insulin treatment alone or in combination with oral hypoglycaemic agent (OHA) was higher in RH (52.5%) compared to PHC (6.4%). However, the proportion of patients using OHA singly or in combination with insulin was higher in PHC (86%) than RH (56.8%).

In both PHC and RH, the majority of patients used two or more than two OHAs (54% and 49.7% respectively). The proportion of patients using sulphonylureas alone was higher in PHC (37.6%) whereas more patients in RH used biguanides alone (19.5%). This is because the denominator used was the number of subjects on OHAs and not all subjects receiving all forms of treatment. It is interesting to note that the proportion of overweight patients in RH (42%) was lower than PHC (49%) (Table I).

DISCUSSION

Patients with diabetes are looked after by a variety of caregivers, from primary health care doctors in the Family Health Services' 16 government polyclinics to general practitioners' clinics to Diabetes Centres in government restructured hospitals and also by private medical specialists. In this Diabcare Singapore 1998 study, we included a large cohort from PHC centres to reflect the diversity of caregivers and the relative importance of the PHC centres in health care delivery in Singapore. However, patients from solo and small group practice family physicians were not represented in the sample, and conclusions drawn from this study population should reflect these study limitations.

Data outcomes from Singapore were analysed according to two types of medical care facilities – PHC and RH – as it was felt that these could represent two different but overlapping patient populations seeking treatment. In general, patients newly diagnosed with diabetes are more likely to seek treatment at a PHC centre near their homes. Complicated cases would then be referred to restructured hospitals. Patients with type 1 diabetes would likely have been diagnosed at a younger age and treated initially by paediatricians, or would be more likely to have needed admission to hospital at first presentation, and thus be more likely to be on follow-up at restructured hospitals.

The patient populations studied from both PHC and RH centres seem to have characteristics in keeping with the above assumptions. A small cohort (3.5%) of diabetes patients attending PHC were type 1 diabetes mellitus compared to 18.1% attending RH. Diabetes patients seeking treatment at PHC were older and slightly more patients (49%) were overweight (BMI >25 kg/m^2) compared to patients in RH (42%). They were also likely to have had diabetes diagnosed more recently and may have represented patients with milder disease.

Glycaemia (HbA_{1c} and FBG) appeared to be slightly better-controlled in PHC than RH but the mean levels in both still fell short of the guidelines

for good control. Also, the majority of patients in both PHC and RH had unsatisfactory or poor blood glucose control. The proportion of patients who had complications of the eye (photocoagulation, cataract, retinopathy), feet (neuropathy) and MI/CABG/ angioplasty was slightly higher in RH than PHC. However, fasting lipids profile appeared to be better in RH. The incidence of reported severe late complications was low, varying from nil for legal blindness, renal failure and leg amputation in PHC to 9% for MI/CABG/ angioplasty in RH. Unlike the restructured hospitals, the primary health care facilities attend to relatively fewer cases with severe late complications as they are generally referred to tertiary centres. Since two-thirds of the patients were from the primary health care, it probably explains the low incidence of severe late complications observed. The decreased mobility of patients with blindness, lower limb amputations and stroke may also have contributed to a lower likelihood of attendance at any diabetes centre for care, and may also partly explain the lower numbers of severe complications observed in this study.

Although patients in RH appear to have poorer control, this must be balanced against the difference in demographic profiles between the two patient population and differences in referral patterns. The RH in Singapore serves the function of referral centres for PHC facilities like family physicians and government-run family health services. The higher prevalence of complications in RH could be due to greater severity of diabetes which were referred to RH and the poorer glycaemic control of patients. On the other hand, the data also suggest that there were clear differences in practice between PHC and RH centres in terms of screening for diabetes complications and the use of HbA_{1c} in managing patients with long-standing diabetes.

The response rate to screening for albumin in the urine in PHC (0.3%) and RH (31%) was low compared to other methods of assessments of renal function. The development of microalbuminuria in diabetes patients had been reported to be related to poor long-term glycaemic control[9]. Increased awareness towards albumin screening to identify patients at risk is needed, especially among care providers in PHC.

Whether diabetes is better managed in the primary health care setting or hospital-based services is debatable. A meta-analysis of the effectiveness of diabetes care in general practice versus hospital care, found unstructured care in general practice associated with worse glycaemic control and greater mortality than in hospital care[10]. However, in certain circumstances, general practitioners achieved standards of care as good as or better than hospital outpatient care[10-13]. In a comprehensive diabetes programme where primary care and diabetes specialty care were integrated, morbidity and mortality were found to be lowered in type 1 and type 2 patients[14].

The Singapore Diabcare-Asia study revealed that the level of diabetes care among patients appeared to vary between PHC and RH. Better communication and facilitation of exchange of data between physicians in PHC and RH is essential to provide more uniform standards of care.

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