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International Journal of Collaborative Research on Internal Medicine & Public Health
Vol. 3 No. 1 (January 2011)

Special Issue on "Chronic Disease Epidemiology"
Lead Guest Editor: Professor Dr. Raymond A. Smego
Coordinating Editor: Dr. Monica Gaidhane

International Journal of Collaborative Research on Internal Medicine & Public Health (IJCRIMPH)

ISSN 1840-4529 | Journal Type: Open Access | Volume 3 Number 1

Journal details including published articles and guidelines for authors can be found at:
http://www.iomcworld.com/ijcrimph/

To cite this Article: Mastura I, Chew BH, Lee PY, Cheong AT, Sazlina SG, Jamaiyah H, Syed Alwi SAR, Sri Wahyu T, Zaiton A. Control and Treatment Profiles of 70,889 Adult Type 2 Diabetes Mellitus Patients in Malaysia - A Cross Sectional Survey in 2009. *International Journal of Collaborative Research on Internal Medicine & Public Health*. 2011; 3:98-113.

Article URL: http://iomcworld.com/ijcrimph/ijcrimph-v03-n01-10.htm

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Paper publication: 20 February 2011

Control and Treatment Profiles of 70,889 Adult Type 2 Diabetes Mellitus Patients in Malaysia - A Cross Sectional Survey in 2009

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ABSTRACT

Background: Understanding the current diabetes care in Malaysia is the first step towards successful control. Many local studies have contributed toward knowledge of diabetes control and treatment profile but none had reported from such a large cohort of patients as in this registry.

Aim & Objectives: To describe glycaemic control, risk factors, and treatment profile for quality assessment of diabetes care in Malaysia.

Methods: This is a descriptive study based on secondary data from the online Adult Diabetes Control and Management (ADCM) looking into the control and treatment profiles of type 2 diabetes mellitus patients aged 18 years old and above from 1st January until 31st December 2009. Clinical characteristics included were age, sex, diabetes duration and treatment, glycaemic control, blood pressure, body mass index, and treatment for co-morbidity.

Results: A total of 303 centres contributed a total of 70889 patients. Fifty-nine percent was female. The study population included 61.9% Malay, 19% Chinese and 18% Indian. The mean age at diagnosis was 52.3 years old (SD 11.10) and the mean duration of diabetes was 5.9 years (SD 5.56). The mean of HbA1c was 8.3% (SD 2.10); only 18.1% attained HbA1c < 6.5%. There were 61.8% diabetic hypertensive patients based on blood pressure measurements and about one third were treated to target BP ≤ 130/80 mmHg. The mean of low density lipoprotein-cholesterol was 3.2 mmol/L (SD 1.10); one-third achieved the target of ≤ 2.6 mmol/L. Eighteen percent was on more than two anti-hypertensive agents and 41.6% were on anti-lipid agents. Metformin (83.2%), angiotensin-converting enzyme inhibitors (63.9%) and statin (89.8%) were the mostly prescribed anti-diabetic, anti-hypertensive and anti-lipid agents respectively.

Conclusion: Diabetes and its co-morbidities (hypertension and hyperlipidaemia) were less satisfactorily controlled. The choice of drugs was appropriate but probably inadequate. More effort and resources are needed to improve diabetes care in this country especially in the primary healthcare.

Keywords: Type 2 Diabetes Mellitus, Hypertension, Dyslipidaemia, Registry, Disease Management

Introduction

As the prevalence of diabetes mellitus is rapidly rising so does the challenge of managing the condition. World Health Organization predicted that the number of adults aged ≥ 20 years with diabetes will increase from 135 million in 1995 to 300 million in 2025.[1] The report also stated that the projected increase for developing countries is from 84 to 228 million which is an increase of about 170%. Similarly, the Third National Health and Morbidity Report, 2006 in Malaysia showed that the prevalence has increased from 8.3 to 14.9% among adults aged 30 years and above. This was actually an increase of almost 80% over the last ten years.[2,3] The International Diabetes Federation (IDF) predicts a 100% rise of global cost of diabetes to USD 490 billions from year 2010 to 2030.[4] The impact is so great that the IDF had classified diabetes mellitus as an "International Disaster" and convinced the United Nation to pass the landmark Resolution on 21st December 2006 to recognize the global threat of the diabetes epidemic.[5]

Poorly controlled diabetes greatly increases the risks of macro and microvascular complications, with similar proportional effects on disease risk observed in Western and Asian populations.[6-8] Diabetes mellitus, hypertension, hyperlipidaemia, and obesity often cluster together. The prevalence of these cardiometabolic risk factor clusters (CMRFCs) had witnessed an alarmed increment for all sociodemographic groups along with its detrimental complications that incurred a lot of public health resources and economic effect both in the world and this country.[9-12] In the UK, it has also been shown that minimizing diabetic complications were associated with considerable cost savings, the mean costs per patient per year with no complications were £434, and for one, two, and three complications, the costs were £999, £1641, and £2642 respectively. Therefore, early and sustained glycaemic control is essential to reduce patient morbidity and mortality as well as saving health care cost.[13]

Clinical audit is one of the measures, which health care providers may use to assess and monitor their care to the patients.[14] It enables an effective regular monitoring of self-performance and hence continual improvement.[15-17] This feedback is important to the involved health care professional in providing complex diabetes care and follow-up services in order to achieve good CMRFCs control amongst the type 2 diabetes (T2D) patients.[18] The online Adult Diabetes Control and Management (ADCM) was started in 2007 to provide information to facilitate health care policy making in this area.[19] Availability of these data will better inform about outcomes of diabetes care and improve services, budget planning, health education for both the physician and patients, and provide information to facilitate health care policy making in this area. It also served as a tool to increase awareness of the potential serious impact of this disease on the country.[19,20]

Methods

This study was approved by the Medical Research Ethics Committee (MREC), Ministry of Health, Malaysia. The data were retrieved from the Malaysian diabetes registry database; the ADCM. ADCM is an on-line registry database started in May 2007 which included all T2D patients aged 18 years old and above from both health clinics and hospitals in Malaysia. In this first report, we aim to present data from T2D patients irrespective of health care level: regarding age, sex, diabetes duration and treatment,

glycated haemoglobin (HbA1c), blood pressure (BP), body mass index (BMI) and treatment for co-morbidities in particular hypertension (HPT) and dyslipidaemia in the year 2009.

Data collection

A standard paper case report format was used for data collection by site data providers (SDP). Data were collected from the patients' diabetes record in the respective health care facilities and entered at point of care onto an on-line standard case record form (CRF) made available in the ADCM website by the attending physicians and paramedics who were trained prior for this data entry. All diabetes patients aged 18 years old and above were included in this study. Other demographic data, diabetes duration, type of diabetes, weight, height, BP, treatment modalities, as well as various risk factors and diabetes complications were reported and updated as when changes occurred or information available. Results of laboratory assessments and clinical examination were accepted only if they were performed within 12 months from data collection. Laboratory data collected included measurements of fasting or random blood glucose, HbA1c, serum creatinine, albuminuria, microalbuminuria, fasting plasma level of total cholesterol, LDL- Cholesterol, HDL-Cholesterol and triglyceride. Current diabetes treatment was classified into diet and/or exercise only; or one or more forms of medication. Information was also collected on self blood glucose monitoring. If any data were not available, data field was left as missing. The methodology of this project has been described previously.[21]

Definitions

Patients with diabetes were defined as when their case record fulfilled all these criteria: (i) either documented diagnosis of diabetes mellitus according to the WHO criteria or (ii) those whose current treatment consisted of life-style modification, on oral anti-hyperglycaemic agents (AHA) or insulin. The definition on type of diabetes was carried out at individual centers based on doctors' clinical judgment. Estimated glomerular filtration rate (eGFR) was calculated using Cockroft-Gault formula.

Statistical methods

Analyses were performed using Data Analysis and Statistical Software (Stata) version 9. Data were presented descriptively as mean and standard deviation (SD), range, or percentage. The estimated numbers of diabetes patients in each state were obtained from the reported diabetes prevalence and projected population (vital statistic 2006) according to each state as reported in the National Health Morbidity Survey 2006 (NHMSIII).[22] These numbers were further adjusted according to the proportion (two thirds) of the diabetes population who sought their care from the public health centres.[22] A total of 1168 (1.6%) patients had missing data on basic patient information (date of birth, duration or type of diabetes) and another 685 (0.94%) type 1 diabetes patients, they were reported as missing and/or excluded from some analyses.

Results

Demographics

A total of 303 public health centres participated at the time of this report. A total of 72,742 patients were notified to the ADCM on-line system from 1st January until 31st December 2009. Of these, the population of T2D patients for analyses were 70,889 (97.5%). Nine out of fourteen states in the country submitted data into the ADCM website as shown in Table 1. Fifty-nine percent were female. The study population

included 61.9% Malay, 19.0% Chinese and 18.0% Indian. The proportion of the three main ethnic groups was almost similar to the Malaysian national population distribution. The clinical characteristics of the patients were summarized in Table 2. The mean age of T2D patients was 58.3 years (SD 11.30) with the majority (18.5%) aged between 55 and 59 years. The mean age at diagnosis was 52.3 years (SD 11.10).

The percentage of male and female patients was 40.8% and 59.0% respectively. The mean BMI was 27.28 kg/m^2 (SD 5.96) (Table 2). BMI was measured in 53,915 subjects, but only 18.1% had a normal BMI and 81.9% exceeded the Asian cut-off for obesity (BMI > 23kg/m^2).

Metabolic control

Overall, the diabetic control was poor with mean FBS of 8.6 mmol/L (SD 3.41), 2 hours post-prandial (2HPP) of 13.24 mmol/L (SD 4.77), mean RBS of 10.7 mmol/L (SD 4.41) and mean HbA1c of 8.34% (SD 2.20) (Table 3). The HbA1c test coverage was only 52.6% among the patients. Out of the total tested patients, the proportion of patients controlled to HbA1c < 7.0% and HbA1c < 6.5% was 30.9% and 18.1% respectively. The mean HDL-Cholesterol was (1.30 mmol/L (SD 0.52) and mean LDL-Cholesterol was 3.19 mmol/L (SD 1.10). The mean triglyceride was 1.9 mmol/L (SD 1.30). (Table 3). Out of 56,503 blood pressure measurements, 34,919 (61.8%) detected elevated values and about one third of the hypertensive patients were treated to target BP ≤ 130/80 mmHg.

Chronic diabetic complications

Table 4 shows the disease monitoring process; overall the performance was poor and this was especially for the screening of erectile dysfunction whereby only 9.6% of the patients were assessed. The highest screening that was done for the patients was the feet examination.

Figure 1 shows the reported prevalence of T2D complications and its co-morbidities from the total registry population. A total of 40659, 26794, 3436 and 21381patients were reported to have HPT, dyslipidaemia, neither of the co-morbids and both the co-morbids respectively.

Treatment profile

Only a small proportion of patients (1.5%) were managed on diet therapy alone. In the glycaemic management of patients with T2D, majority of the patients (85.6%) were prescribed with oral AHA therapy. Biguanides and sulphonylureas were the two most frequently prescribed oral AHA therapy, 83.2% and 69.9% respectively; while alpha-glucosidase inhibitors were prescribed in only 4.8% of patients. There was minimal use (< 1%) of other oral AHAs such as thiazolidinediones and meglitinides. There were 12.9% of the patients on insulin; either insulin only or combination with oral AHA (Figure 2). A total of 58.2% patients (41285/70889) were prescribed anti-hypertensive (anti-hpt) treatment. However, a slightly higher proportion (41.6%, 29489/70889) of patients received lipid lowering therapy when compared to the proportion of patients with dyslipidaemia, and this anti-lipid was primarily a statin as shown in Table 5. There were 3.4% (2410/70889) patients practising self-monitoring of blood glucose at home.

Discussion

In this first general report, we present data from nine states in Malaysia. The source data providers consisted of 303 public primary health clinics and hospitals. Previously, there have been many studies and audit in Malaysia;[16,23-26] however, this study is the largest cohort study, including 70,889 type 2

diabetes mellitus patients. Despite the huge number of patients, only 5.2% of the estimated number of T2D patients received their usual care at these public health centers. Its importance was seen from the demography data. The predominant groups were of 50 to 64 years old, female gender and Malay ethnicity. There was a large variation of contribution amongst the state's SDPs, Negeri Sembilan and Wilayah Persekutuan Kuala Lumpur were the two highest contributors as compared to Selangor and Terengganu who were the least.

Glycaemic control

Observational studies in patients with T2D have shown that level of glycaemic control was associated with development of complications.[27,28] Glycated haemoglobin (HbA_{1c}) is an accurate measurement of long term control. It was recommended to be done every 1 to 3 months if treatment changes were made.[29] In this study, HbA_{1c} was assessed only in 52.6% of patients. The mean HbA_{1c} was 8.3% and only 18.1% of the patients had achieved glycaemic control at the time of our study (HbA_{1c}<6.5%). Only 30.9% of the patients achieved HbA_{1c}<7.0%, according to the recommended HbA1c target by the American Diabetes Association.[30,31] This was comparable to Thai adult T2D patients in 2003, 26.3% of them achieved HbA1c of less than 7%.[32] Similarly, the results of the mean FBS and RBS were also poor and many were not achieving the targets of control. This was far from the control rate of 31% achieving HbA1c < 6.5% reported in the European Cost of Diabetes in Europe-Type II (CODE-2) study.[33] One of the urban academic centres in New York, US, 28.4% attained HbA1c ≤ 7%). In United Kingdom, 34% of patients in general practice had HbA1c ≤ 7%. [34,35]

Among those prescribed oral AHAs, 34.7% were on monotherapy, others were on combination of oral AHAs (50.9%). The oral AHA prescription pattern was very much related to the prescriber category for these drugs that is instituted in the Ministry of Health in Malaysia, the latest and higher end of oral AHAs were being restricted to consultants in hospitals and unavailable to the primary care doctors. There were only about 10% and 13% of patients who were treated with insulin alone or combination of insulin and oral AHA respectively. This low employment of insulin regimen was also observed in Sweden's primary care centers in 2003 where prescription of AHA in combination with an insulin and insulin alone were only 13% and 12.5% respectively among the patients with T2D.[36] Intermediate-acting insulin was prescribed most frequently followed by premixed insulin and short-acting insulin (54.9%, 36.1% and 15.8% respectively). There was hardly any use of insulin analogues, rapid or long-acting, among the patients in this study. The pattern of insulin prescription reflects the likely pattern of insulin regimen followed by the patients. Most frequently basal or bedtime insulin therapy with intermediate acting insulin in combination with oral AHAs were prescribed. This was followed by premixed insulin regimen and least commonly the more intensive basal-bolus insulin regimen requiring multiple injections of pre-meal short-acting insulin in combination with bedtime basal insulin. The under-use of insulin in the treatment of these T2D patients may explain the poor glycaemic control because many studies had reported the use of exogenous insulin or combined use of oral AHA was often associated with improved glycaemic control in patients with type 2 diabetes.[37,38] This could be explained by the resistance of the healthcare provider to use insulin and the low acceptance of insulin therapy by patients due to misconception of insulin risk and interference of routine life-style.[39-41] This low control rate of the target HbA1c could also be due to poor adherence with medications for diabetes.[42]

It was also noted that the mean duration of diabetes was 5.9 years (SD 5.6) and 39.1% of patient had diabetes for more than 5 years duration. Expectedly, the longer the duration of disease, the harder and lesser proportion of the patients achieved the recommended targets as shown by the results of 6 years follow-up of the patients in the UK Prospective Diabetes Study.[38] Although the patients who received intensive treatment maintained significantly better glycaemic control, all groups showed progressive hyperglycaemia over the 6 years, with associated decrease in β-cell function.

Lipids

Characteristically, persons with T2D have elevated triglyceride, low HDL-Cholesterol and LDL-Cholesterol often found to be elevated as well.[43] Dyslipidaemia contributes significantly to development of atherosclerotic diseases and increased risk of coronary heart disease mortality.[43,44] The National Cholesterol Education Panel (NCEP) recommended that diabetic patients were to be screened annually of their lipid status.[45] Current clinical guidelines recommend that all diabetes patients who are over 40 years old should be treated with a statin regardless of baseline LDL-Cholesterol levels.[45] This recommendation was seem to be followed by the health centers in our study as the results showed that 37.8% of the patients had known dyslipidaemia with a slightly higher proportion of patients (41.6%) received lipid lowering therapy, primarily with a statin. However, there were only 30.4% attained LDL-Cholesterol targets of < 2.6 mmol/L as recommended in the current guidelines for patients with diabetes without prior cardiovascular event. Eliasson B et al reported rather similar proportion of Swedish T2D patients achieving LDL-Cholesterol target (47.2%) and lipid-lowering drugs prescription (37.6%) in their 2003 national diabetes register.[36] It was evident that the use of statins among adult diabetic patients in this study was inadequate and ineffective. The mean HDL-Cholesterol was 1.30 mmol/L (SD 0.52) and about 67.4% of patients achieved recommended level of ≥ 1.1 mmol/L. Apart from LDL-Cholesterol and HDL-Cholesterol, hypertriglyceridaemia is also a risk factor for coronary heart disease mortality.[43] Nearly half of the patients tested for TG had not achieved the target ≤ 1.7 mmol/L. This might be due to the very low treatment rate with a fibrate (9.2%) due to the lack of availability of fibrate at the public polyclinics from where most of our cohorts were coming from. Gemfibrozil, the fibrate that was widely available, was not encouraged to be used in combination with another statin and this might had contributed to the under-treatment of patients with dyslipidaemia.[46] Various studies also reported a treatment gap between the recommended standard of care and lipid lowering therapy.[47-49]

Hypertension

Hypertension commonly co-exists in patients with T2D.[50] Hypertension should be detected and treated early in the course of diabetes to prevent CVD and to delay the progression of renal disease and diabetic retinopathy.[30,50,51] Therefore, screening and treatment of hypertension are important components of diabetes care. In this study, 40659 (57.4%) of patients were reported to have co-existing hypertension and this was far lower compared to 84% prevalence of hypertension amongst the Swedish adult T2D patients.[36] The current recommendation for optimal treatment is to achieve a BP of less than 130/80 mmHg based on the fact that presence of BP higher than that level could significantly elevate the risk of cardiovascular disease in patients with T2D.[52] There were 38.2% of the patients with a blood pressure below or equal to 130/80 mmHg and this showed a marked improvement compared to the previous control rate at the community health

clinics,[23,24] and was comparable to hospitals.[26,53] This low proportion of controlled BP to target was also reported in US academic centers.[34]

More than half of the patients (58.2%) were prescribed antihypertensive treatment. The proportion was slightly higher than the proportion of patients reported to have hypertension (57.4%). We are uncertain whether there were anti-hypertensives given for other reasons such as renoprotection or cardioprotection or there were misclassification of controlled hypertensive as normotensive. The majority of patients on antihypertensive received monotherapy (46.5%) and this low use of combination antihypertensive therapy in these patients would likely to be the reason behind the poor control of hypertension amongst these T2D cohorts (38.2% of patients achieved BP target of ≤130 / 80 mmHg).

The most commonly prescribed antihypertensive agents were ACEI, followed by calcium channel blocker, beta blockers, and diuretics (63.9%, 37.0%, 36.5% and 23.4% respectively). Notably there was very little use of angiotensin receptor blocker (ARB) (3.7%) which was most likely reflecting the lack of availability of this group of antihypertensive in primary care facilities due to restriction in prescriber category at the time this study was performed. The high use of ACEI among the patients in this study is in keeping with current guidelines that strongly recommend ACEI as the first-line antihypertensive agents in patients with diabetes.[51] ACEI and ARB use in the treatment of diabetic hypertensive were also high in a tertiary care center in Riyadh, Saudi Arabia.[54]

Use of Aspirin

Anti platelet therapy was prescribed in one third of the patients in this study, primarily aspirin. Aspirin use has been shown to provide cardiovascular protection among people with diabetes.[55,56] The decision to start with low dose aspirin as a primary prevention of CVD should be individualized and is currently recommended for asymptomatic people with diabetes and high risk of developing CVD.[51] Recent studies reported the non-equivalence of diabetes and coronary heart disease and had discouraged the use of aspirin in T2D patients for primary prevention of cardiovascular disease citing the unacceptable risk of major bleeding.[57,58] However, others reiterated the recommendation of aspirin use based on cost effectiveness analysis.[59,60] This study showed that anti-platelets were probably still very much used for secondary prevention rather than primary prevention of cardiovascular disease. The ambivalence for aspirin use in our diabetes patients needs more attention.

Disease monitoring and diabetes complications

BMI was measured in 53,915 subjects, but only 18.1% had a normal BMI. The proportion of patients with normal BMI was 15.6% and 17.5% in females and male respectively. This is comparable with findings reported in United States urban academic centers[53] whereby there were 17% of diabetic patients had their BMI controlled to normal range. Atreya et. al. observed high association of obesity and diabetes amongst the South Indian patients attending a tertiary hospital general medical out-patient clinic.[61] In term of waist circumference, 35.9% (n=3711) males had waist circumference less than 90cm as compared to only 16.6% (n=2681) females attained target level of less than 80 cm. Our recent national health survey in 2006 a much higher prevalence of central obesity in women than men.[22]

A study of diabetes control and complications in private primary healthcare in Malaysia noted a high complication rate, the commonest being nephropathy 43.3% (albuminuria: 22.9% and microalbuminuria: 20.4%), neuropathy (30.1%) followed by background

retinopathy (23.5%).[25] In this study, out of those who had their investigations done or clinical examinations performed, one third of this populations had microalbuminuria (29.0%), one fifth had abnormal proteinuria (22.0%), 18.7% of the study population had calculated eGFR<60ml/min, abnormal fundus examination (19.9%) and erectile dysfunction (18.7%). The disproportionally high ED prevalence was most likely due to selective screening of high risk or symptomatic patients. The proportion of female (19.7%) who had GFR<60ml/min was higher than the male (17.4%). These results were partly due to lack of patient's screening and poor complication assessment done at busy primary care clinics, considering that more than half of the patients had no complications reported in the registry.

Self monitoring of blood glucose (SMBG) is the method of choice in monitoring day to day glycaemic control. SBGM should be carried out for patients on insulin and is desirable for those on oral AHA. Some recent reviews concluded that SBGM was associated with lower HbA1c levels in insulin-treated diabetic patients, but not with non-insulin-treated patients.[62-64] Frequency of blood glucose testing depends on the glucose status, glucose goals and type of therapy.[51] The number of patients (2427) performing SBGM was very low in this study, only 3.4%, 12.9% on either insulin alone or combination oral agent with insulin.

Study limitations

Since the participation in this registry was not mandatory, those clinics/hospitals which were more motivated in improving patients care were the majority of the participating SDPs. Some common limitations of retrospective studies were: data missing during data collection or filling and transfer between patient's record and CRF, as well as during data entry into the online database. Continuous training, good supervision and team work during the progress of the study was emphasized throughout in order to have good quality data.

Conclusion

This report would be able to assist the health care providers as well as the policy makers on the importance of diabetic epidemic. It is hope that it will encourage better participation of SDP and promote diabetes research, especially at the primary care level in the country. The case record format should be revised to include other clinically important variables to give more information on diabetes care and outcome in the country. The status of diabetes care and outcome need to be improved. Patients with T2D are at significant risk of developing microvascular complications and macrovascular diseases. Hence, health care providers should focus on implementing intervention as recommended in the national clinical practice guidelines in order to improve diabetes care and outcome.

List of abbreviations

Adult Diabetes Control and Management (ADCM)
International Diabetes Federation (IDF)
Cardiometabolic risk factor clusters (CMRFCs)
Type 2 diabetes (T2D)
Estimated glomerular filtration rate (eGFR)
Case record form (CRF)
Medical Research Ethics Committee (MREC)
Site data providers (SDP)
Blood pressure (BP)
Diastolic blood pressure (DBP)
Systolic blood pressure (SBP)

Body mass index (BMI)
Hypertension (HPT)
Anti-hyperglycaemic agents (AHA)
Anti-hypertensive (anti-hpt)
2 hours post-prandial (2HPP)
Fasting blood sugar (FBS)
Random blood sugar (RBG)
Ischaemic heart disease (IHD)
Erectile dysfunction (ED)
Angiotensin converting enzyme inhibitor (ACEI)
Angiotensin receptor blocker (ARB)
Triglyceride (TG)
High density lipoprotein (HDL)
Low density lipoprotein (LDL)
Cardiovascular disease (CVD)
Self monitoring of blood glucose (SMBG)

IRB permissions

Protocol Number from the National Medical Research Register: NMRR ID: 08-12-1167.
Medical Research Ethics Committee (MREC) approval on Dec 2008.

Grant Registration Number

Ministry of Health, Malaysia funding.

Competing interests
None.

Authors' contributions

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All the listed authors above 1) had made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; 2) were drafting the article or revising it critically for important intellectual content; and 3) had given final approval of the version to be published.

Acknowledgement

We would like to acknowledge the Director General of the Ministry of Health for his support in our effort in the registry. We would thank Clinical Research Centre, Kuala Lumpur for all the support especially to Ms Lena Yeap, Noor Akma Hassim and Tee Chin Kim from CRC, Kuala Lumpur who had handled the data well for this report.

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Table 1: Distribution of Type 2 diabetes patients notified in comparison to the estimated number of T2D patients by each state, DRM-ADCM, January 1st – December 31st 2009

No	State	Registry, n (%)	Estimated, n* (%†)
1	Kedah	6,668 (9.41)	170,625 (3.91)
2	Kelantan	9,904 (14.0)	119,395 (8.30)
3	Melaka	953 (1.34)	73,497 (1.30)
4	Negeri Sembilan	16,213 (22.9)	98,103 (16.5)
5	Pahang	8,145 (11.5)	117,362 (6.94)
6	Perak	6,830 (9.63)	191,772 (3.56)
7	Selangor	184 (0.30)	388,008 (0.05)
8	Terengganu	389 (0.55)	77,108 (0.50)
9	Wilayah Persekutuan Kuala Lumpur	20,972 (29.6)	132,720 (15.8)
10	Wilayah Persekutuan Putrajaya	631 (0.89)	NA‡
Total		**70,889 (100.0)**	**1,368,590 (5.2)**

*number of patients, †percentage of T2D patients in the registry over the estimated number of diabetes patients visited public health centres in each state, ‡Not Available.

Table 2: Socio-demographic profile of Type 2 Diabetes, DRM-ADCM

Variables	n (%)
Age (years),	
Mean (SD)	58.3 (11.27)
Range	18 – 104
Age groups	
• 18 – 19	40 (0.06)
• 20 – 24	148 (0.21)
• 25 – 29	413 (0.58)
• 30 – 34	881 (1.24)
• 35 – 39	1,816 (2.56)
• 40 - 44	4,173 (5.89)
• 45 – 49	7,451 (10.5)
• 50 – 54	10,773 (15.2)
• 55 – 59	13,105 (18.5)
• 60 – 64	11,694 (16.5)
• 65 – 69	8,546 (12.1)
• 70 – 74	6,512 (9.19)
• 75 – 79	3,271 (4.61)
• ≥ 80	2,066 (2.91)
Gender	
Male	28,939 (40.8)
Female	41,841 (59.0)
Missing	109 (0.15)
Ethnicity	
Malay	43,902 (61.9)
Chinese	13,451 (19.0)
Indian	12,739 (18.0)
Others and Non-Malaysian	676 (0.95)
Missing	121 (0.17)
Duration of diabetes (years)	
Mean (SD)	5.9 (5.56)
Range	0 - 59
<5 yrs	29,184 (41.2)
5-10 yrs	19,942 (28.1)
>10 yrs	8,336 (11.8)
Missing	13,427(18.9)

Table 3: Clinical Characteristics of Type 2 Diabetes patients DRM-ADCM

Waist circumference (cm)	n= 26,513
Mean (SD)	91.32 (12.27)
Range	50 - 200
Male <90cm	3,711 (35.9%)
Female <80 cm	2,681 (16.6%)
BMI (kg/m^2)	n= 53,915
Mean (SD)	27.28 (5.96)
Range	11.0 - 56.1
≤ 23.0	9,727 (18.1%)
Blood pressure (mmHg)	n=56,503
BP ≤ 130/ 80	21,584 (38.2%)
SBP (mmHg)	
Mean (SD)	136.72 (19.53)
Range	60 - 250
≤ 130	25,426 (45.0%)
DBP (mmHg)	
Mean (SD)	78.76 (10.64)
Range	30 -150
≤ 80	36,109 (63.9%)
Glycaemic control	
FBS (mmol/L)	n=37,947
mean (SD)	8.59 (3.41)
2 Hrs Post-prandial (mmol/L)	n= 9,325
mean (SD)	13.24 (4.77)
RBS (mmol/L)	n=44,676
mean (SD)	10.71 (4.41)
HbA1c (%)	n=37,263
mean (SD)	8.34 (2.20)
<7.0%	11,510 (30.9%)
<6.5%	6,754 (18.1%)
Lipid profile	
Total Cholesterol (mmol/L)	n=46,289
mean (SD)	5.32 (1.23)
< 4.5	11,101 (24.0%)
TG (mmol/L)	n=45,717
mean (SD)	1.94 (1.25)
≤ 1.7	23,962 (52.4%)
HDL (mmol/L)	n=39,277
mean (SD)	1.30 (0.52)
≥1.1	26,492 (67.4%)
LDL (mmol/L)	n=38,848
mean (SD)	3.19 (1.10)
≤ 2.6	12,028 (31.0%)

Serum Creatinine (mmol/L) mean (SD)	n= 46,121 88.45 (49.84)

Table 4: Clinical Examination of Type 2 Diabetes DRM-ADCM

Clinical Examination	Done, n (%)	Presence of Abnormal Result, n (%)*
Microalbuminuria	25,208 (35.6%)	7,313 (29.0%)
Proteinuria	33,815 (47.7%)	7,440 (22.0%)
Fundus examination	18,526 (26.1%)	3,687 (19.9%)
Foot examination	38,036 (53.7%)	2,321 (6.1%)
Electrocardiography	25,765 (36.3%)	2,039 (7.9%)†
Erectile dysfunction (male only)	2,786 (9.6%)	522 (18.7%)
eGFR	45,062 (63.5%)	13,276 (18.7%)‡
Male	17,725 (61.2%)	5,045 (17.4%)‡
Female	27,337 (65.3%)	8,231 (19.7%)‡

*percentage out of number of examination done,
† Any ECG tracing that was out of normal specification and characteristics. These include the rate, rhythm, PQRST waves abnormality,
‡ eGFR <60 ml/min

Figure 1: Percentages of Reported Diabetes Complications and Co-morbidities

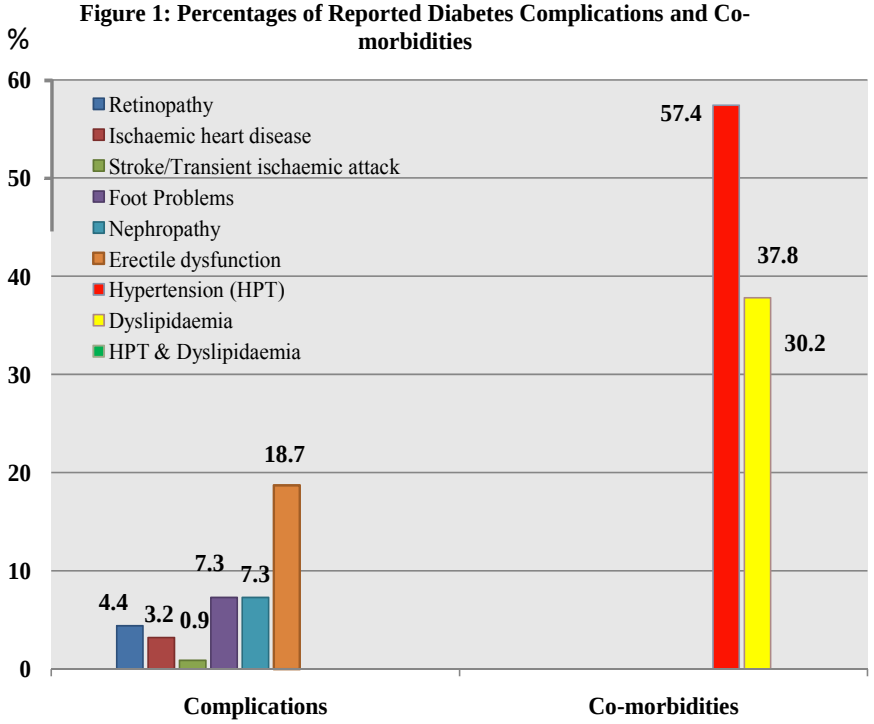

Figure 2: Profile of Current Glycaemic and Hypertensive Management

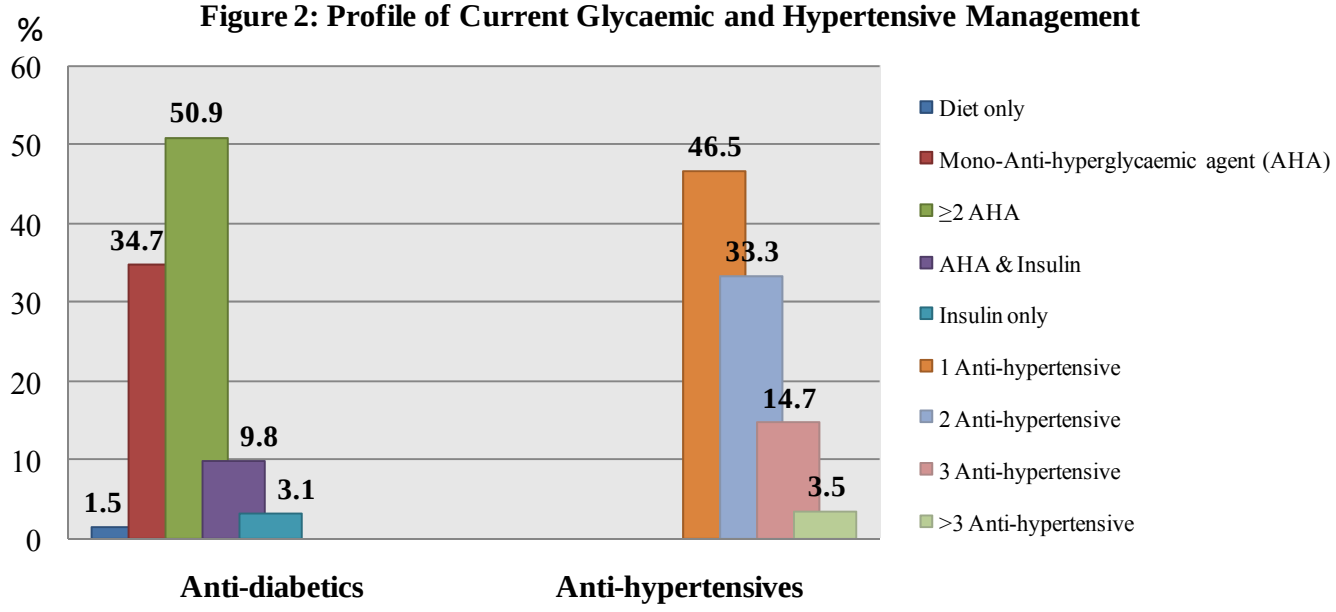

Table 5: Treatment profile of T2DM patients

Management	n (%)
Oral Anti-Hyperglycaemic Agent	54,080 (76.2)
Sulphonylureas	37,809 (69.9)
Alpha glucosidase inhibitor	2,611 (4.83)
Thiazolidinediones	81 (0.15)
Meglitinides	162 (0.30)
Biguanidas	45,005 (83.2)
Others	73 (0.13)
Insulin	7,064 (9.96)
Regular short acting	1,114 (15.8)
Rapid acting	6 (0.08)
Intermediate acting	3,878 (54.9)
Long acting	42 (0.59)
Pre - mixed	2,548 (36.1)
Others	12 (0.17)
Anti hypertensive	41,286 (58.2)
Angiotensin Converting Enzyme Inhibitor (ACEI)	26,389 (63.9)
Angiotension Receptor Blocker (ARB)	1,515 (3.67)
Centrally acting	223 (0.54)
Alpha-blockers	2,612 (6.33)
Calcium channel blocker	15,270 (37.0)
Diuretic	9,647 (23.4)
Beta-blocker	15,084 (36.5)
Others	179 (0.43)
Lipid lowering agent	29,489 (41.6)
Statin	26,483 (89.8)
Fibrate	2,709 (9.19)
Others	2 (0.01)
Antiplatelet	17,900 (25.3)
Acetyl salicylate acid	16,626 (92.9)
Ticlopidine	609 (3.40)
Clopidogrel	118 (0.66)
Others	247 (1.38)