ORIGINAL ARTICLE

Diabetes mellitus patients in Indonesia: management in a tertiary hospital compared to primary health care

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ABSTRACT

BACKGROUND

The increasing prevalence of diabetes mellitus (DM) requires that patients have greater access to care, which is yet lacking in many low- and middle-income countries and the quality of which varies between health care facilities. We compare the characteristics, complications, and risk profile of diabetes in patients receiving care in primary and tertiary level health facilities in Bandung, Indonesia.

METHODS

Adult DM patients were recruited from 25 community health centres (CHCs) and the outpatient clinic at one referral hospital. Key data collected and compared to national guidelines were DM history, treatment, complications, blood pressure, height, weight, and laboratory examinations on glycated haemoglobin (HbA1c), lipid profile, and creatinine. Data analyses were conducted using Chi-square or Fisher's exact test for categorical variables and Student's t-test or Mann-Whitney test for numerical variables.

RESULTS

Of the 809 DM patients (median age 59 years, 63% female, 98% type 2 DM), 318 (39%) were from CHCs and 491 (61%) from the hospital. Overall median HbA1c was 8.3%, with no difference between CHC and hospital patients. Only 32% of patients with HbA1c ≥10% were on insulin (CHCs 5.9%, hospital 42.9%), and only 18% of those on insulin had a good glycaemic control (<7%). Hypertension was common (CHCs 62%, hospital 51%, p<0.001), and only 44% of CHC and 34% of hospital patients received antihypertensive therapy. Among those with macrovascular complications, only 32% (CHCs) and 26% (hospital) were receiving aspirin. The numbers reaching the treatment targets were low for those on antihypertensives and lipid-lowering medications (80/251 and 11/105, respectively).

CONCLUSION

Glycaemic control and management of complications of DM patients at both health care levels need considerable improvement.

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INTRODUCTION

Diabetes mellitus (DM) is one of the most extensive global health problems of the 21st century. In 2019, there were 463 million adults estimated to be living with DM. This number is predicted to increase to 700 million by 2045.[1] An estimated 79% of these people are thought to be living in low- or middle-income countries, the majority of whom have type 2 diabetes.[2] Patients with DM often present with cardiovascular and other complications that require more careful and often specialist care.[3] Diabetes mellitus and its complications often constitute a significant financial burden to patients and their families.[4] The care of DM patients in low-resource countries is challenging as health care systems are less equipped to manage people with chronic conditions.

With an estimated 10.7 million people with DM, Indonesia is ranked 7th in the world.[1] The provision of quality care for DM patients, from early diagnosis to treatment, and prevention of complications, is hampered by a fragile and poorly resourced health system. Currently, only 113 endocrinologists provide specialist care for DM patients, mainly concentrated at secondary and tertiary care levels in the main urban centres.[5] At the primary level, there is one community health centre (CHC) for every 27,000 people.[6] However, the number of general physicians is 3.8 per 10,000 population, far below the world average of 17.4,[7] and there is a significant geographical variation with poorer access and a limited number of general practitioners and nurses in remote areas. DM patients are primarily managed in CHCs, where they can be diagnosed through random or fasting blood glucose, treated with oral DM medications, and receive regular monitoring. In 2014, the Indonesian government started an insurance system to enable universal health coverage to strengthen primary care capacity, particularly in chronic diseases – including DM.[3] Since then, it has been recommended that patients with DM who have no uncontrollable hyperglycaemia or complications should be referred to a secondary or tertiary hospital. While the Indonesian Society of Endocrinology has established guidelines for the management of DM patients,[8] the definitions and processes for referral are not always clear or easy to understand. Further studies urgently need to be carried out in Indonesia because current DM therapy is focused almost solely on the clinical aspects. Furthermore, the present study can be used as a scientific base for the government of Indonesia in organizing DM programs, especially in supporting the government program to strengthen the primary service in Indonesia.

Our study aims to describe the severity and complications of DM, the risk factors for cardiovascular disease, and the medication management of DM patients, and to investigate any difference in these characteristics between patients cared for at the tertiary level hospital compared to primary health care level.

METHODS

Research design

This cross-sectional study was part of the TANDEM research project on tuberculosis and diabetes (www.tandem-fp7.eu) [9] and was conducted at Dr Hasan Sadikin General Hospital and Community Health Centres (CHCs) situated throughout the city between December 2013 and February 2015.

Study participants

A total of 809 DM patients were eligible and consented to participate in this study, consisting of 491 subjects from the hospital and 318 subjects from the CHCs). Patients eligible to participate were aged 18 years and over with known DM (either under care for DM or on DM medication). Patients who had gestational or steroid-induced diabetes were excluded. Recruitment was conducted among patients from the outpatient endocrine clinic of Dr Hasan Sadikin General Hospital – a tertiary level public referral hospital for the West Java region of Indonesia, located in

Bandung City, or from 25 CHCs situated throughout the city.

Data collection

The research physicians interviewed each patient asking about their socio-demographic characteristics (age, gender, and education), behavioural characteristics such as smoking status and alcohol consumption, and diabetic characteristics such as DM history, complications, medication, and management. The research nurses followed a standard operating procedure measuring height, weight (using digital scales), and waist circumference to calculate body mass index (BMI) and central obesity. Patients' weight and height were classified based on the Asia Pacific BMI criteria,[10] namely underweight (<18.5 kg/m^2); normal (18.5-22.9 kg/m^2); overweight (23.0-24.9 kg/m^2); obese I (25.0-29.9 kg/m^2); obese II (≥30 kg/m^2). Central obesity was categorized as a waist circumference (WC) of ≥80 cm for females and ≥90 cm for males.

Laboratory analysis

The research nurses followed a standard operating procedure for taking patients' blood pressure using a digital device. Blood was taken for laboratory glycated haemoglobin (HbA1c) examinations and urine for albumin creatinine ratio (ACR) examinations. Lipid profile and creatinine concentrations, tested in Dr Hasan Sadikin General Hospital laboratory, as the most recent test undertaken within the previous month, were obtained from electronic medical records for a subset of patients under regular care in the endocrine clinic.

Laboratory HbA1c was categorized into three groups: $<7.0\%$; 7.0-9.9%; and $\geq10\%$ for analysis and also dichotomized into two groups: $<10\%$ and $\geq10\%$. Albumin creatinine ratio categories were: normal (<30 mg/g); microalbuminuria (30-300 mg/g), and macroalbuminuria (>300 mg/g).[8,11] Low-density lipoprotein (LDL) was categorized as uncontrolled if the result was ≥100 mg/dL.[8,11] Estimated

glomerular filtration rate (eGFR) was calculated according to the CKD-EPI creatinine equation 2009 [12] which was then categorized according to the US National Kidney Foundation guidelines for chronic kidney disease (CKD): stage 1 (eGFR ≥90), stage 2 (eGFR 60-89), stage 3 (eGFR 30-59), stage 4 (eGFR 15-29), stage 5 (eGFR <15).[13]

Key measures

Key measures sought are related to guidelines set by the Indonesian Society of Endocrinology as follows: 1) patients with HbA1c $\geq10\%$ should have insulin added to their medications; 2) patients with systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg should be managed with anti-hypertensive medication; 3) patients with macrovascular complications should be managed with aspirin; and 4) patients with LDL ≥100 mg/dL should be managed with statin therapy.[8]

Blood pressure was categorized according to the Indonesian guidelines (Box 1) and also the JNC VII[14] i.e. normal (systolic and diastolic $<120/80$ mmHg); pre-hypertension (systolic 120-139 or diastolic 80-89 mmHg); stage I hypertension (systolic 140-159 or diastolic 90-99 mmHg); stage II hypertension (systolic ≥160 or diastolic ≥100 mmHg).

Complications

Complications were self-reported by patients and cross-checked for patients who had a medical record in the hospital. Complications were then classified according to the Charlson Morbidity Index (CMI).[15] Macrovascular complications included a history of heart disease: heart attack, angina pectoris, coronary artery bypass grafting (CABG), percutaneous transluminal coronary intervention (PTCI), history of cardiovascular disease, or history of other vascular diseases. Microvascular complications included a history of renal disease or eye problems (blindness, decreased visual acuity, cataract operation or laser treatment, glaucoma).

Data management

Demographic and clinical data were entered onto a case report form and then into a secure, centrally managed electronic database (REDCap).[16] Data such as laboratory results, diabetes history, smoking status, and complications were entered directly into REDCap. Data quality was checked monthly for accuracy and completeness.

Statistical analysis

Descriptive data are presented as mean and standard deviation for normally distributed data, median and inter-quartile range (IQR) for abnormally distributed data, and proportions for categorical data. Chi-square or Fisher's exact tests of association were used to compare groups where appropriate, and Student's t-test was used to compare mean values. Statistical analyses were performed using Stata v13 (StataCorp, College Station, TX, USA).

Ethical considerations

All patients provided written informed consent prior to inclusion. Ethical approval was received from the Observational/Interventions Research Ethics Committee, London School of Hygiene and Tropical Medicine on 18 December 2013 (LSHTM ethics ref: 6449, LSHTM amendment no: A473) and from the Health Research Ethics Committee, Faculty of Medicine, Universitas Padjadjaran, Bandung on 5 February 2014 (No: 05/UN6.C2.1.2/KEPK/PN/2014).

Table 1. Patient characteristics according by recruitment site

| Characteristics | Total n=809 n (%) | Recruitment site | | p-value* |
		CHC n=318 n (%)	Hospital n=491 n (%)	
Sex, Female	511 (63.2)	231(72.6)	280 (57.0)	<0.001
Mean age (SD) – years#	59 (10)	60 (9)	58 (11)	0.006
Age group (years)				
<40	33 (4.1)	8 (2.5)	25 (5.1)	0.008
40-49	100 (12.4)	32 (10.0)	68 (13.9)	
50-59	285 (35.2)	101 (31.8)	184 (37.5)	
60-69	276 (34.1)	129 (40.6)	147 (29.9)	
≥70	115 (14.2)	48 (15.1)	67 (13.6)	
Education				
No formal education/ primary	249 (30.8)	105 (33.0)	144 (29.3)	0.64
Junior high school	153 (18.9)	58 (18.2)	95 (19.3)	
Senior high school	229 (28.3)	84 (26.4)	145 (29.5)	
Higher education	178 (22.0)	71 (22.3)	107 (21.8)	
Smoking status				
Current	117 (14.5)	43 (13.5)	74 (15.1)	0.003
Past	235 (29.0)	73 (23.0)	162 (33.0)	
Never	457 (56.5)	202 (63.5)	255 (51.9)	
Alcohol consumption (current/past)	17 (2.1)	3 (0.9)	14 (2.8)	0.114
Duration of diabetes (years)				
<1	144 (17.8)	58 (18.2)	86 (17.5)	0.191
1-5	311 (38.4)	134 (42.1)	177 (36.0)	
6-15	286 (35.4)	105 (33.0)	181 (36.9)	
>15	68 (8.4)	21 (6.6)	47 (9.6)	
DM type †				
Type 1		ND	12 (2.4)	
Type 2		ND	479 (97.6)	

Abbreviations: CHC=community health center; DM=diabetes mellitus; ND=no data; SD=standard deviation
†DM type was only recorded from medical records for 491 patients recruited in the hospital
*Chi-square test; # Independent-t-test

RESULTS

Description of study participants

The mean age was 59 ± 10 years, and 63.2% were female. The majority of patients had type 2 DM (97.6%) and had DM for more than one year (82.2%). A total of 491 (61%) patients were recruited in the hospital and 318 (39%) from CHC. Patients recruited in the hospital were slightly younger (58 vs. 60 years (p=0.006), a smaller proportion were females (57.0% vs. 72.6%, p<0.001), and had never smoked (51.9% vs. 63.5%, p=0.003) (Table 1).

DM severity and complications

The overall median HbA1c was 8.3% (IQR 6.8-10.3), and there was no significant difference according to the recruitment site. A history of any macrovascular complications was reported by 20.3% of patients, and this proportion was higher in patients recruited in the hospital than in CHCs (23.2% vs 15.7%, p=0.010). The most common macrovascular complication reported was heart disease (34.1%). Fifteen (1.9%) patients had undergone foot amputation (Table 2).

Table 2. Diabetes severity and complications according by recruitment site

Characteristics	Total N=809 n (%)	Recruitment site		p-value*
		CHC N=318 n (%)	Hospital N=491 n (%)	
Median HbA1c (IQR) - %¶	8.3 (6.8-10.3)	8.4 (6.9-10.3)	8.2 (6.7-10.2)	0.663
History of macrovascular complications				
Any macrovascular complications	164 (20.3)	50 (15.7)	114 (23.2)	0.010
Heart disease:				
Myocardial infarction	110 (13.6)	27 (8.5)	83 (16.9)	0.001
CABG or PTCI	35 (4.3)	4 (1.3)	31 (6.3)	0.001
Angina pectoris or heart failure	131 (16.2)	33 (10.4)	98 (20.0)	0.001
Stroke	80 (9.9)	27 (8.5)	53 (10.8)	0.284
Foot amputation	15 (1.9)	6 (1.9)	9 (1.8)	0.956
History of microvascular complications				
Any microvascular complications	542 (67.0)	218 (68.6)	324 (66.0)	0.448
Renal failure	28 (3.5)	4 (1.3)	24 (4.9)	0.022
Eye problems:				
Blindness	34 (4.2)	5 (1.6)	29 (6.0)	0.003
Decreased visual acuity	232 (28.7)	113 (35.6)	119 (24.2)	0.001
Cataract operation/laser treatment	130 (16.1)	45 (14.2)	85 (17.3)	0.349
Glaucoma	7 (0.9)	2 (0.6)	5 (1.0)	0.439
Chronic kidney disease classification (n=301)				
Stage 1 (eGFR[a] ≥90)		ND	217 (44.2)	
Stage 2 (eGFR[a] 60-89)		ND	147 (29.9)	
Stage 3 (eGFR[a] 30-59)		ND	91 (18.6)	
Stage 4 (eGFR[a] 15-29)		ND	30 (6.0)	
Stage 5 (eGFR[a] <15)		ND	6 (1.3)	
Albuminuria				
Normal (ACR <30 ug/mg)	402 (49.7)	160 (50.3)	242 (49.3)	0.746
Micro-albuminuria (ACR 30-300 ug/mg)	241 (29.8)	97 (30.5)	144 (29.3)	
Macro-albuminuria (ACR >300 ug/mg)	166 (20.5)	61 (19.2)	105 (21.4)	

Abbreviations: CHC=community health center; ACR=Albumin to creatinine ratio; CABG=Coronary artery bypass grafting; eGFR=Estimated glomerular filtration rate; IQR=interquartile range; ND=no data; PTCI=Percutaneous transluminal coronary intervention

[a] eGFR mL/min/1.73 m^2

*Chi-square-test; ¶ Mann-Whitney test

Microvascular complications were reported by 67% of patients, with similar proportions in patients in the hospital and CHCs (66.0% vs 68.6%, p=0.448). The most common microvascular complication reported was decreased visual acuity (28.7%). Even though only 3.5% of patients reported renal failure, 29.8% patients had microalbuminuria, and 20.5%

had macroalbuminuria. There was no significant difference between recruitment sites for albuminuria (p=0.746). The mean eGFR was 78.24 ± 30.05 for the 491 patients recruited in the hospital. Almost half of the patients had a normal eGFR indicating preserved kidney function (stage 1 CKD classification). Patients indicated for dialysis or kidney replacement

Table 3. Cardiovascular risk profile and medication management of
patients according by recruitment site

| Characteristics | Total n=809 n (%) | Recruitment site | | p-value* |
		CHC n=318 n (%)	Hospital n=491 n (%)	
Body Mass Index (BMI, kg/m^2)				
Under weight (<18.5)	29 (3.6)	7 (2.2)	22 (4.5)	0.145
Normal (18.5-22.9)	205 (25.3)	75 (23.6)	130 (26.5)	
Overweight (23.0-24.9)	150 (18.5)	68 (21.4)	82 (16.7)	
Obese I (25.0-29.9)	312 (38.6)	128 (40.2)	184 (37.5)	
Obese II (≥30)	113 (14.0)	40 (12.6)	73 (14.9)	
Central Obesity				
Females WC ≥80 cm - yes	352 (68.9)	156 (67.5)	196 (70.0)	0.549
Males WC ≥90 cm - yes	110 (36.9)	30 (34.5)	80 (37.9)	0.577
Blood pressure classification[a]				
Normal	123 (15.2)	29 (9.1)	94 (19.1)	<0.001
Pre-hypertension	237 (29.3)	92 (28.9)	145 (29.5)	
Stage I hypertension	242 (29.9)	94 (29.6)	148 (30.1)	
Stage II hypertension	207 (25.6)	103 (32.4)	104 (21.2)	
Hyperlipidemia (mg/dL)				
LDL ≥100		ND	222 (81.9)	
HDL ≤40 (male); ≤50 (female)		ND	124 (45.6)	
Diabetes medication				
No medication[b]	65 (8.0)	28 (8.8)	37 (7.5)	<0.001
Insulin alone	172 (21.3)	10 (3.1)	162 (33.0)	
Insulin & any oral DM drugs[d]	58 (7.2)	9 (2.8)	49 (10.0)	
Metformin alone	166 (20.5)	96 (30.2)	70 (14.3)	
Metformin & other oral DM drugs[e]	233 (28.8)	111 (34.9)	122 (24.9)	
Other oral DM drugs alone[c]	115 (14.2)	64 (20.1)	51 (10.4)	
Anti-hypertensive drugs	251 (31.0)	114 (35.9)	137 (27.9)	0.017
Lipid-lowering drugs (statins)	194 (24.0)	55 (17.3)	139 (28.3)	<0.001
Anti-platelet drugs (aspirin)	67 (8.3)	25 (7.9)	42 (8.6)	0.727

Abbreviations: CHC=community health centre; BMI=body mass index; DM=diabetes mellitus; WC=waist circumference; HDL=high density lipoprotein; LDL=low density lipoprotein; ND=no data
Data were complete (n=809) except for LDL /HDL, only measured in 272 patients recruited in the hospital.
[a] Blood pressure classification according to JNC VII:
- Normal = systolic and diastolic <120/80 mmHg;
- Pre-hypertension = systolic or diastolic 120/80-139/89 mmHg;
- Stage I hypertension = systolic or diastolic 140/90-159/99 mmHg;
- Stage II hypertension = systolic or diastolic e"160/100 mmHg
[b] Twenty-three patients with no medication (35.4%) had been diagnosed within the last 12 months.
[c] Using sulfonylurea, thiazolidinediones, acarbose, or DPP-4 inhibitors
[d] Using metformin, sulfonylurea, thiazolidinediones, acarbose, and/or DPP-4 inhibitor besides insulin
[e] Using sulfonylurea, thiazolidinediones, acarbose, and/or DPP-4 inhibitor beside using metformin
*Chi-square test

therapy (stages 4 and 5 CKD classification) accounted for less than 10% (Table 2).

Cardiovascular risk profile and medication management

Overall, more than half of the DM patients were in the BMI obese I and II categories (38.6% and 14.0%, respectively) and were centrally obese (57.1%), and this was similar in people recruited in both sites. In addition, stage I and II hypertension were similarly reported in more than half of the patients (55.5%), with more CHC patients having severe stage II hypertension (p<0.001) (Table 3). Of all DM patients in this study, half (56%) were on monotherapy for DM control (insulin 21.3%; metformin 20.5%, other oral DM medications 14.2%). Almost a third (28.8%) were on combined therapy of metformin with other oral DM medications, and 7.2% were on insulin combination therapy. The proportion of hospital patients on insulin was 43.0%, while most

CHC patients were on oral DM medication (85.2%) (Table 3).

The Indonesian Treatment Guidelines recommend that patients with HbA1c ≥10% have insulin added to their medications, but in our study, only 32.4% (n=77/238) of such patients were on insulin. Of the patients who were considered hypertensive according to guidelines, only 38.1% (n=171/449) were receiving antihypertensive therapy, and this proportion was higher in CHC patients (43.6%) compared to hospital patients (33.7%) (p=0.032). One hundred and sixty-four (20.3%) patients reported macrovascular complications, of whom only 28.1% (n=46/164) were receiving aspirin. This proportion was higher in CHC patients (32.0%) compared to hospital patients (26.3%) but not statistically significant (p=0.456). Of the patients with LDL ≥100 mg/dL, 42.3% (n=94/222) were on statin (Figure 1).

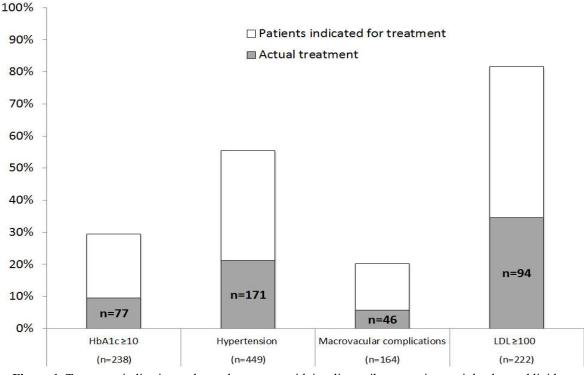Similarly, there were very small proportions of patients on treatment who were achieving the

Figure 1. Treatment indication and actual treatment with insulin, antihypertensive, antiplatelet, and lipid-lowering medication
The proportion of diabetes patients with an indication for insulin, antihypertensive, antiplatelet, and lipid-lowering medication according to the Indonesian diabetes guideline. The grey bar represents those patients with a treatment indication actually receiving insulin (32.4%), antihypertensive drugs (38.1%), aspirin (28.0%) and statins (42.3%). Data were available for 809 patients, except for LDL (n=272)
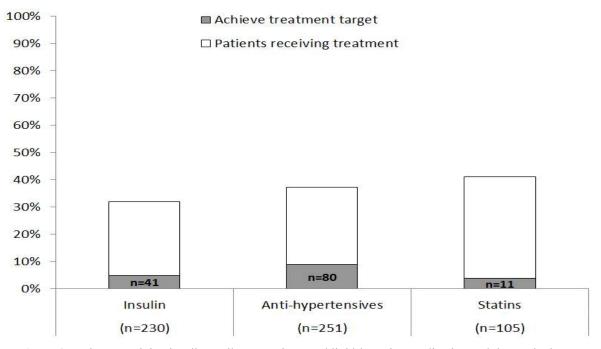
Figure 2. Patients receiving insulin, antihypertensives, and lipid-lowering medication and those who have reached the treatment target
The proportion of diabetes patients receiving insulin, antihypertensives, and lipid-lowering medication. The grey bar represents those patients who have reached the treatment target of HbA1c <7% (17.8%), systolic blood pressure <140 mmHg and diastolic blood pressure <90 mmHg (31.9%), and LDL <100 mg/dL (10.5%). Data were available for 809 patients, except for LDL (n=272)

expected treatment targets. Of the 230 patients on insulin, only 41 (17.8%) had an HbA1c of <7%. Of the 251 patients on antihypertensive medication, 80 (31.9%) reached the treatment target of systolic and diastolic blood pressure of <140 mmHg and <90 mmHg, respectively. Of the 105 patients who were on statins and for whom we had LDL information on, only 11 (10.5%) had an LDL <100 mg/dL (Figure 2).

DISCUSSION

In this study of patients under care for DM in an urban setting in Indonesia, a large proportion had uncontrolled blood glucose, macrovascular and microvascular complications, risk factors for cardiovascular disease, and unmet medication needs. While blood glucose levels, microvascular complications, and albuminuria in patients recruited from the hospital and CHC were similar, this was not so for macrovascular complications, hypertension, and obesity which were more common in patients recruited from the hospital.

Medication management was also different in the two recruitment sites, with fewer hospital patients on antihypertensive medication and more on lipid-lowering statins than patients from CHC.

The median HbA1c in our study was 8.3%, with almost three-quarters of patients not reaching the target set in the Indonesian Type 2 DM Management Guidelines [8] of having an HbA1c less than 7%. A similarly high mean HbA1c was reported by Soewondo et al.[17] (mean HbA1c 8.1%) and Cholil et al.[18] (mean HbA1c 8.3%) in their extensive studies of patients with diabetes in Indonesia. There was no difference in median HbA1c in hospital and CHC patients, despite routine and regular HbA1c monitoring in the hospital. However, in-depth reasons for this could not be explored. Still, our results which showed such a small number being on insulin as recommended and then those on insulin not achieving the treatment target, would indicate an overall lack of blood glucose monitoring, referral, and prescribing of appropriate medications from the health system perspective. From the patients'

perspective, further research is required to understand and estimate their knowledge about DM, medication adherence, and other barriers to their DM care.

Similar poor glycaemic and metabolic control among type 2 DM patients has also been reported in South-East Asian countries.[19–21] Misra et al.[22] categorized clinical management challenges of type 2 DM as patient-related challenges, physician-related challenges, and health care, infrastructure, and drug-related factors. Patient-related challenges included poor awareness, unhealthy choice of food, and low socioeconomic status. Physician-related challenges were inadequate skills in chronic disease management, poor communication with patients, too few specialized diabetes nurses, and the non-suitability of guidelines from high-income countries. For many years, public health services in many South Asian countries have primarily been designed to focus on infectious diseases. It is only recently that non-communicable conditions have been considered and appropriate programmes created. Overcrowded facilities at the primary health care level in Indonesia may contribute to poor diabetes care, as is also seen across the Western Pacific region.[23]

Almost a quarter of our patients had macrovascular complications, the most prevalent of which was heart disease, with a higher prevalence than that reported in an earlier study (2012) on DM patients in Indonesia.[18] Many low- and middle-income countries, including Indonesia, are undergoing a rapid transition in lifestyle, including work patterns, diet, and eating habits, with a subsequent increase in obesity, heart disease, and other chronic conditions.[24–26] A greater proportion of patients in the hospital had a history of macrovascular complications than did those in CHCs. This condition was expected because diabetes patients with complications are more likely to be referred to secondary and tertiary hospitals. Despite the larger number of patients with macrovascular complications, only a small proportion was using antiplatelet drugs (aspirin).

The high proportion of patients in our study with microvascular complications such as blindness, macroalbuminuria, and microalbuminuria is comparable to the 2012 Indonesian study. In addition,[18] microvascular complications require more intensive measurement by physicians, which is not routinely carried out in either site. Hence there was no difference between hospital and CHC patients. Also, patients do not usually present with signs and symptoms of microvascular complications, especially for microalbuminuria.

More than half of the patients in our study were obese, combined with hypertension and a high LDL, which together increases the risk for cardiovascular complications, with only a small proportion receiving the relevant antihypertensive, lipid-lowering (statin), or antiplatelet (aspirin) drugs. This limited use of preventive therapy was found at both hospital and CHC levels. At the CHC level, there is often a limited supply of medications which may contribute to this finding. In the hospital, the national insurance system requires that patients using insurance be referred to the relevant clinic to obtain their medication. For example, those with hypertension are referred to the renal and hypertension clinic to get antihypertensive drugs, and those needing statins as dyslipidaemia drugs must be referred to the cardiology clinic. In each clinic, patients have to queue, often for a long time which is likely to impact their medication uptake and ongoing adherence.

Of those receiving antihypertensive and dyslipidaemia drugs, only a small proportion reached the blood pressure control target according to Indonesian Type 2 DM Management Guidelines.[8] Reasons for this are unclear and need to be explored further, but possible explanations could be that medications are not regularly taken because of their side effects, or patients have too many drugs to take daily (polypharmacy). Other reasons may be that in a busy clinic, physicians may not be aware that the dose they are prescribing is inadequate. In addition, the number of drugs allowed to be prescribed at

one time is limited by the insurance restrictions, or there may be a limited drug supply.

In keeping with national guidelines, most of the patients on insulin were under care in the hospital. However, it appeared that more referrals were necessary, with many of the patients with an HbA1c ≥10% not being referred and not receiving insulin. Introducing insulin is not an easy task, with many patients being reluctant due to the insulin needing to be injected. Even amongst those receiving insulin, many did not achieve the HbA1c target of below 7%. This is likely due to a combination of patient, prescriber, and health system management issues as mentioned earlier, but requires further studies to explore this in more detail. On the other hand, many patients with HbA1c <7% and without complications were still receiving their medication in the hospital while they were supposed to be referred back to primary care. This may cause an extra burden for clinicians, preventing them from being focused on individual treatment indicators of patients.

To our knowledge, this is the first study comparing diabetes care in primary and tertiary health care in Indonesia at the individual patient level and with relatively large sample size. However, the study's limitation was that much of the data was self-reported, particularly that of DM complications, rather than having been collected and confirmed from medical records. Also, some data was only available for Also, some data was only available for patients recruited in the hospital and could not be compared to those of CHC patients.

Based on the results of this study, complications in people living with DM may be avoided by improving care, i.e., routine monitoring of key laboratory indicators and medication adjustments. Chronic disease management trainings may be required for the physicians at the primary health care levels.

Our study has identified gaps in care, but further research is required to determine the gaps, the key difficulties and barriers for patients and those in the health care system, and how best to address these gaps. Moreover, data obtained for this study was from the early stages of the national insurance scheme implementation. Since then, several new regulations have been added,[27,28] to ensure better treatment pathways. Further evaluation should be done to see whether the improvements have led to better patient care. Regular auditing and benchmarking against evidence-based guidelines will be essential to track progress. [26]

CONCLUSIONS

Overall, the control of diabetes and its complications appears to be poor for patients cared for at both health care levels. Many patients need to use insulin but have no access in primary care, and even though hypertensive drugs are more used in primary care, their blood pressure control remained poor. These conditions suggest a need for input and improvement within the health system, and better integration of services both within the hospital and between the primary and tertiary levels of care, particularly for those using national insurance.

CONFLICT OF INTEREST

All authors declare that there was no conflict of interests relevant to the subject of this study.

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