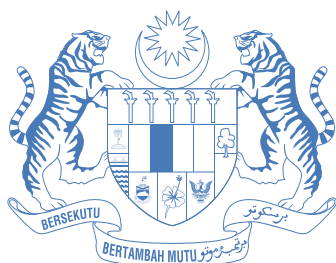




National Diabetes Registry Report 2013 - 2019



National Diabetes Registry



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Disease Control Division
Ministry of Health Malaysia

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1 Executive Summary

Globally, around 463 million people live with diabetes, while in Malaysia, it is estimated that 3.9 million (18.3%) of the adult population had raised blood sugar in 2019. These numbers are expected to grow. The National Diabetes Registry (NDR) was established to monitor clinical outcomes of diabetes patients managed at the Ministry of Health (MOH) primary health clinics. The NDR began in 2009 and is monitored via a web-based data collection system since 2011. All patients receiving diabetes care at participating health clinics (KCs) are required to be registered into the NDR, and the patient's status is regularly updated. A proportion of patient records are audited annually, and the clinical and treatment information is captured in NDR. This report analyzes and evaluates the clinical outcome, treatment, and complications among audited diabetes patient records for 2013 – 2019.

According to the registry dataset, there were 1,614,363 patients registered in the NDR, of which 99.3% were diagnosed with Type 2 Diabetes Mellitus (T2DM). The mean age of T2DM patients in the NDR was 63 years old, and the mean age at diagnosis for T2DM patients was 53 years old. The majority of patients were female (57.1%) and Malay (59.2%). As of 2019, there were 897,421 active diabetes patients in the NDR.

From the findings of the clinical audit, the mean glycosylated haemoglobin (HbA1c) for 2013-2019 ranged from 7.9% to 8.1%. The overall trend of patients achieving the Malaysian glycaemic target of HbA1c $\leq 6.5\%$ gradually increased over the years. In 2019, 32.41% patients achieved the target, an increase from 31.42% in 2018. Variation could be observed between states for the target achievements.

This report also found that the overall trend for comorbidities, including hypertension and dyslipidaemia, increased from 2013 to 2019. Based on audited patients for 2019, 80.4% had hypertension, and 74.3% had dyslipidaemia. As for total complications reported in 2019, 14.6% of patients had diagnosed nephropathy, 10.6% had presence of retinopathy and 5.9% were reported to have ischaemic heart disease (IHD).

Metformin was the most common oral anti-diabetic drug (OAD) used among T2DM patients, followed by sulphonylureas. Insulin use has increased consistently, with 23.1% of patients treated with insulin in 2013 compared to 30.3% in 2019. Calcium channel blockers (57.7%) and angiotensin converting enzyme inhibitor (ACE-I) (51.8%) were the most commonly used anti-hypertensive in 2019 whereas acetyl salicylic acid (19.2%) and statins (79.7%) were the most commonly used anti-platelet and anti-lipid drugs.

From 2013 to 2019, there are progresses made in terms of treatment target achievement and insulinisation among MOH patients with T2DM. There are several limitations to the NDR data. The NDR relies on the quality of documentation at the primary health clinics. In order to limit the burden of data collection, NDR audit is conducted via random sampling via a web-based data entry system. Automated random sampling has also enabled useful data collection and tracking with relatively minimal effort.

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Abbreviations

2HPP	2-hour post-prandial blood glucose
ACE-I	Angiotensin converting enzyme inhibitor
BMI	Body Mass Index
BP	Blood pressure
CVD	Cardiovascular disease
CI	Confidence interval
CPG	Clinical Practice Guideline
DM	Diabetes mellitus
ECG	Electrocardiogram
FBG	Fasting blood glucose
HbA1c	Glycosylated haemoglobin
HDL	High density lipoprotein
IHD	Ischaemic heart disease
IQR	Inter-quartile range
KK	Health Clinic (Klinik Kesihatan)
LDL	Low density lipoprotein
MOH	Ministry of Health
NCD	Non-communicable disease
NDR	National Diabetes Registry
NHMS	National Health and Morbidity Survey
OAD	Oral anti-diabetic drug
RBG	Random blood glucose
T1DM	Type 1 diabetes mellitus
T2DM	Type 2 diabetes mellitus
TG	Triglycerides

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Definitions

Active T2DM patients	Patients with Type 2 Diabetes with at least one visit to the health clinic within one year of the date of clinical audit
Registry patients	Patients diagnosed with diabetes and registered at any of the participating health clinics
Audit patients	Active T2DM patients who were sampled in the clinical audit year

4 Reviewers

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5 Acknowledgements

A special thanks to the staff of all the participating KVs for their dedication and support in the implementation of the registry. The NDR database and this report would not have been possible without their significant contribution. It is hoped that the clinic teams have found the data useful enabling them to observe improvements as well as monitor performance at the clinic level.

We would also like to extend our gratitude to all State NCD Epidemiology Officers who have contributed their time and thoughts to making the annual clinical audit a successful one over the years.



Klinik Kesihatan Bandar Seri Putra
Source: MOH/Amy Fareena



Introduction

Burden of Diabetes

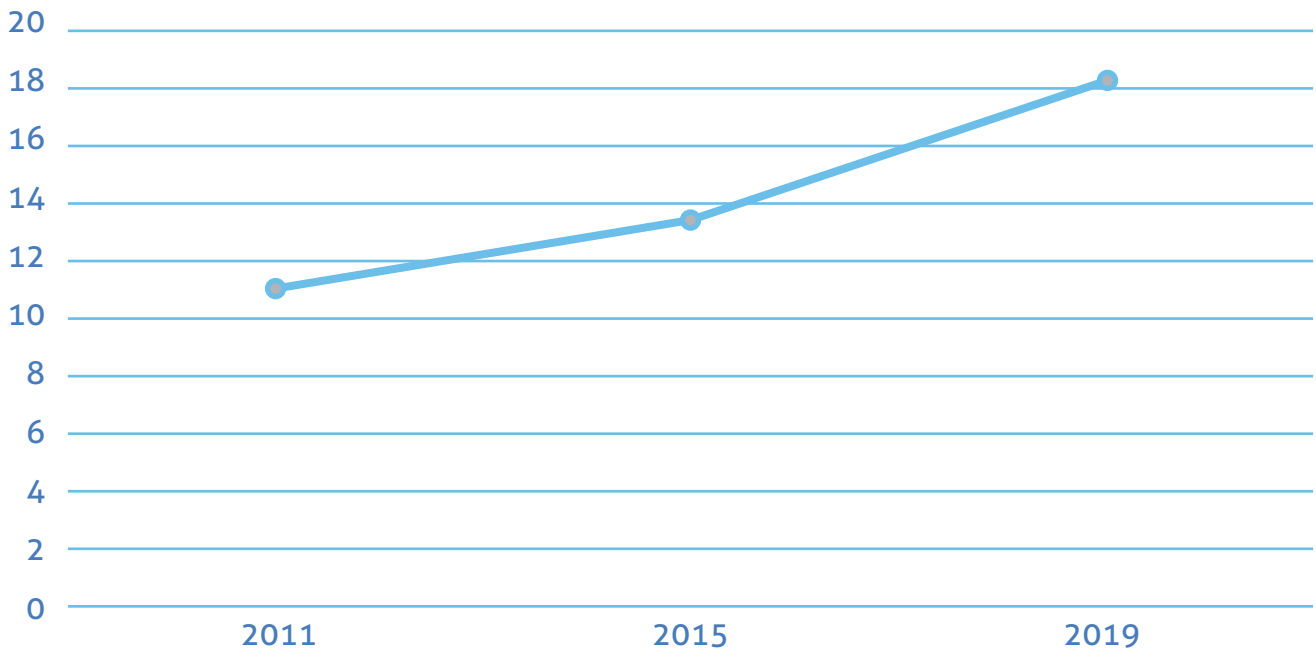


Figure 1

Prevalence of Overall Diabetes (≥ 7 mmol/L) in adults aged 18 years and above

Data from National Health and Morbidity Survey (NHMS) 2019 also shows that about 74.3% of patients diagnosed with diabetes seek treatment primarily at public primary care facilities, while the remaining seek treatment in public hospitals, private general practitioners, take complementary and alternative medicines as the primary mode of treatment, and self-medicate.

About this Report

This publication is the second NDR report since the establishment of the registry. It is intended to share the data contained within the NDR for clinicians, public health specialists and researchers and all those who are interested in the clinical management of diabetes.

About the National Diabetes Registry

The objectives of the NDR are:

- To enable tracking of glycaemic control and clinical outcomes of patients with diabetes managed at MOH health clinics
- To enable comparisons over time and across geographical locations
- Enable research to improve the quality of care provided to patients

The Diabetes Clinical Audit is conducted on randomly sampled active Type 2 Diabetes Mellitus (T2DM) patients on follow-up at MOH health clinics. Universal data entry for clinical variables is not currently feasible as the medical records in the majority of MOH health clinics are still paper-based.

The NDR has allowed greater efficiency to conduct the annual Clinical Audit of diabetes. The NDR has been a collaborative effort among MOH health clinics and hospitals that leverages upon existing data collection requirements and processes. The registry is a useful tool to better understand patterns of disease and clinical management of patients managed within the MOH in order to reduce complications and improve patient management and future outcomes.

National Diabetes Registry Components

The NDR contains information on patients with diabetes managed at participating MOH health clinics (*klินิก kesihatan* or KKS) and consists of two related components: (i) patient registry and (ii) clinical audit datasets.

As baseline information, the NDR collects basic socio-demographic information, clinical and outcome data of all patients with DM managed in MOH health clinics and selected hospitals in the patient registry. At the end of December 2019, the patient registry contained 1.61 million patient records.

The audit dataset is a subset of the patient registry. On an annual basis, T2DM patients from the registry are randomly selected for auditing for clinical variables. The clinical audit dataset has more complete information as it captures clinical variables, drug use and outcomes of care data for audited patients. The clinical audit is performed on active patients in the NDR since 2009.

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Methodology

Site selection criteria

All MOH KKs managing patients with diabetes from 2013 to 2019 were eligible for inclusion for this report. At the end of 2019, 830 KKs throughout Malaysia have provided data to the NDR.

Clinical Audit for Diabetes Patients

Annually, randomly sampled T2DM patients meeting the selection criteria are selected for clinical audit whereby a more detailed clinical data is collected. The sampled population comes from active patients with T2DM enrolled in the registry dataset.

The workflow for data collection for clinical audit is described in the first NDR Report.

Patient selection criteria

The NDR includes all forms of diabetes, except gestational diabetes. However, for clinical data analysis, only T2DM patients were reported.

Sample size estimation

The sample size is calculated to estimate the proportion of patients with T2DM-related complications managed at MOH health clinics. The sample of patients with T2DM required for the clinical audit from each district were based on the number of active patients registered in each district and the sample size calculation is described in the first NDR Report.

Data collection

The NDR is web-based application. The database contains information about patients with diabetes receiving care at participating KKs.

The following data is collected for all diabetes patients:

- Sociodemographic
- Type of Diabetes
- Date Diagnosed
- Diabetes Related Complications

Statistical Methods

Results below present descriptive statistical analysis as generated by the NDR web-based application, and are presented as categorical variables (n, %) or continuous variables (mean, 95% CI and/or median, IQR).

Results below were generated using data from the NDR extracted on 31st December 2019 for the years 2013 to 2019.

Clinical Setting

In the reporting period ending 2019, a total of 830 government health clinics (KKs) from all states in Malaysia submitted data to the NDR. The distribution of KKs providing data to the NDR by state is shown in Table 1 below.

Table 1
Distribution of KKs enrolled in the NDR registry by state, 2019

State	Number of KKs
Johor	94
Kedah	56
Kelantan	64
Melaka	29
Negeri Sembilan	49
Pahang	79
Perak	76
Perlis	10
Pulau Pinang	28
Sabah	69
Sarawak	141
Selangor	70
Terengganu	47
Wilayah Persekutuan Kuala Lumpur	13
Wilayah Persekutuan Labuan	1
Wilayah Persekutuan Putrajaya	4
Malaysia	830

8 Findings

Patient Population

At the end of the reporting year for 2019, there were a total of 1,614,363 patients enrolled in the registry and there were 897,421 active diabetes patients in the NDR. Nearly all the patients enrolled in the NDR were diagnosed with T2DM. At the end of 2019, patients diagnosed with Type 1 Diabetes Mellitus (T1DM) or other forms of DM comprised only 0.62% and 0.09% respectively.

The characteristics of patients are shown in **Table 2**. There were 42.9% men and 57.1% women respectively. The ethnic distribution was as follows: Malay 59.16%, Chinese 19.62%, Indian 13.17%, and others at 8.05%.

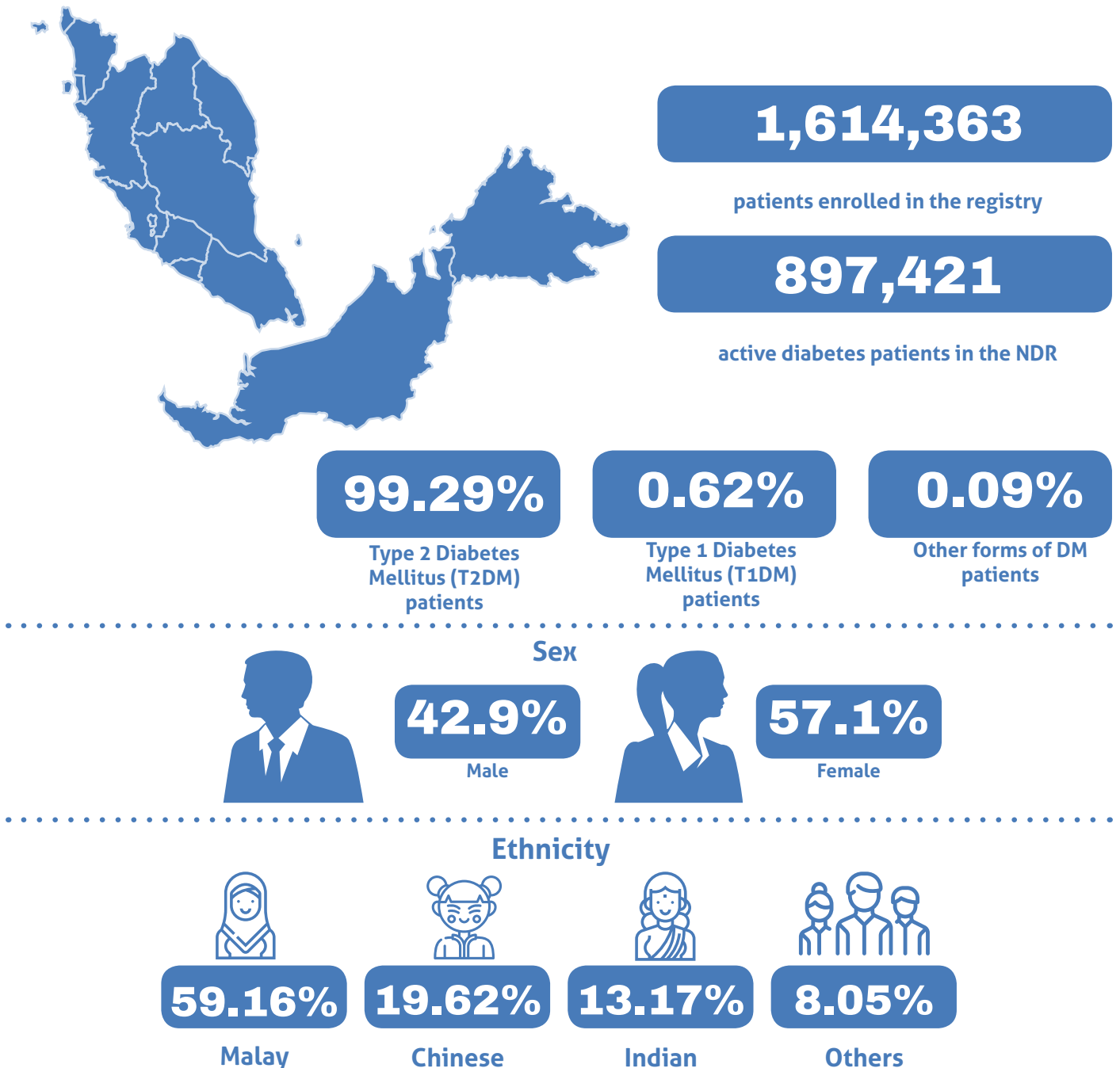


Table 2
 Characteristics of Patients enrolled in National Diabetes Registry, 2019 [Registry Dataset]

Variable	n	%
Sex		
Male	692,595	42.90
Female	921,768	57.10
Total	1,614,363	100.00
Ethnicity		
Malay	954,938	59.15
Chinese	316,758	19.62
Indian	212,681	13.17
Others	129,986	8.05
Total	1,614,363	100.00
Age Group (at Enrollment, years)		
<18	5,030	0.31
18-19	2,524	0.16
20-24	10,402	0.64
25-29	26,923	1.67
30-34	56,439	3.50
35-39	99,400	6.16
40-44	162,277	10.05
45-49	227,109	14.07
50-54	277,844	17.21
55-59	267,850	16.59
60-64	205,301	12.72
65-69	137,012	8.49
70-74	79,966	4.96
75-79	38,448	2.38
>80	17,838	1.11
Total	1,614,363	100.00
Type of Diabetes		
Type 2	1,602,882	99.29
Type 1	10,086	0.62
Others/Unknown	1,395	0.09
Total	1,614,363	100.00

The age at diagnosis of patients with diabetes is reported below (**Table 3**). The mean age of diagnosis of T2DM patients registered in the NDR was 53 years.

Table 3
Age at Diagnosis of Type 2 Diabetes Patients (in years) [Registry Dataset]

	Age at Diagnosis
Mean age (95% CI)	53 (53.2-53.3)
Median	53
Inter-Quartile range	15.0

As shown in **Figure 2** below, most of the patients in the NDR were diagnosed between the age of 50-54 (17.2%) years old, followed by the 55-59 (16.6%) years and the 45-49 (14.1%) years age group.

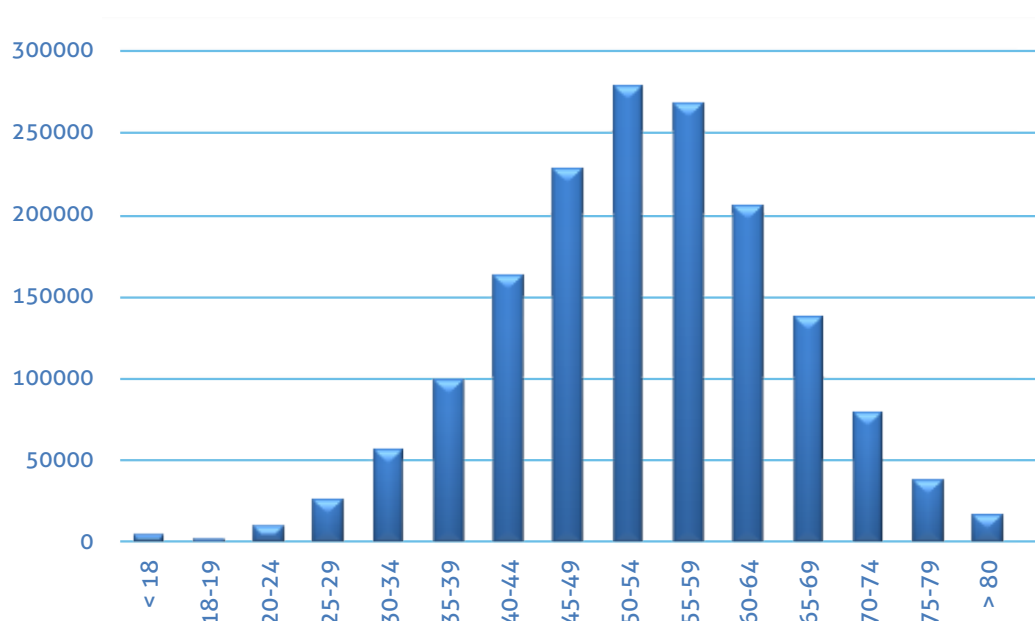


Figure 2
Distribution of T2DM patients according to age at diagnosis [Registry Dataset]

The characteristics of patients according to states are shown in **Table 4**. In all states except WP Putrajaya and Negeri Sembilan, there were more females than males with diabetes who were registered in the NDR. The mean age ranged between 57 to 64 years.

Table 4
Characteristics of Diabetes Patients enrolled in National Diabetes Registry, 2019, by state

State	No. of patients, n (%)	Male, n (%)	Mean age (95%CI)	Ethnicity				Foreigners/Unknown
				Malay	Chinese	Indian	Other Malaysian	
Johor	228,166 (14.13)	99,117 (43.44)	63 (63.0-63.1)	144,054 (63.13)	54,993 (24.10)	27,438 (12.03)	859 (0.38)	822 (0.36)
Kedah	150,087 (9.29)	62,313 (41.51)	61 (61.3-61.4)	116,260 (77.46)	15,425 (10.27)	16,526 (11.01)	52 (0.03)	1,824 (1.22)
Kelantan	63,622 (3.94)	24,168 (37.98)	63 (63.0-63.2)	60,231 (94.67)	2,499 (3.93)	317 (0.49)	16 (0.03)	559 (0.87)
Melaka	88,226 (5.46)	39,102 (44.32)	64 (63.8-64.0)	60,421 (68.48)	18,266 (20.70)	8,860 (10.04)	122 (0.14)	557 (0.63)
Negeri Sembilan	110,591 (6.85)	49,271 (51.85)	64 (63.9-64.0)	65,483 (59.21)	19,930 (18.02)	24,407 (22.07)	371 (0.34)	400 (0.36)
Pahang	95,008 (5.88)	41,429 (43.60)	63 (62.5-62.7)	71,816 (75.58)	14,531 (15.29)	7,710 (8.11)	490 (0.52)	461 (0.48)
Perak	175,762 (10.88)	77,538 (44.11)	64 (64.0-64.1)	96,808 (55.07)	41,138 (23.41)	36,383 (20.70)	601 (0.34)	832 (0.47)
Pertis	30,114 (1.86)	12,426 (41.26)	62 (62.1-62.4)	25,967 (86.22)	2,694 (8.95)	650 (2.16)	30 (0.09)	773 (2.56)
Pulau Pinang	88,272 (5.5)	39,558 (44.81)	64 (64.3-64.5)	38,903 (44.07)	32,579 (36.90)	16,279 (1.84)	53 (0.06)	458 (0.52)
Sabah	48,915 (3.03)	21,432 (43.81)	61 (60.8-61.0)	2,296 (4.69)	10,276 (21.01)	398 (0.81)	30,444 (62.23)	5,501 (11.24)
Sarawak	160,587 (9.95)	64,840 (40.37)	62 (61.5-61.7)	41,512 (25.85)	39,260 (24.44)	648 (0.40)	77,515 (48.26)	1,652 (1.03)
Selangor	232,054 (14.37)	101,282 (43.64)	62 (62.0-62.1)	128,799 (55.50)	41,576 (17.92)	58,552 (25.23)	732 (0.32)	2,395 (1.03)
Terengganu	63,593 (3.93)	24,669 (38.79)	61 (61.1-61.2)	62,120 (97.68)	1,257 (1.97)	75 (0.12)	17 (0.03)	124 (0.19)
WP Kuala Lumpur	67,328 (4.17)	29,684 (44.08)	64 (64.3-64.5)	30,901 (45.89)	21,533 (31.98)	14,046 (20.86)	147 (0.22)	701 (1.04)
WP Labuan	3,836 (0.23)	1,592 (41.50)	58 (57.9-58.7)	1,828 (47.65)	559 (14.57)	41 (1.07)	1,174 (30.60)	234 (6.10)
WP Putrajaya	8,202 (0.50)	4,174 (50.89)	57 (57.1-57.6)	7,539 (91.91)	242 (2.95)	351 (4.28)	38 (0.46)	32 (0.39)
Malaysia	1,614,363 (100)	692,595 (42.90)	63 (62.7-62.8)	954,938 (59.15)	316,758 (19.62)	212,681 (13.17)	112,661 (6.97)	17,325 (1.07)

Comorbidities and Complications

Table 5 below shows the presence of comorbidities and complications among diabetes patients in the clinical audit dataset.

The prevalence of hypertension among T2DM patients has steadily increased from 72.9% in 2013 to 80.4% in 2019. Similarly, the prevalence of dyslipidaemia has also increased from 59.8% in 2013 to 74.3% in 2019.

Retinopathy among diabetes patients has increased from 7.2% in 2013 to 10.6% in 2019. Similarly, nephropathy has increased from 8.8% in 2013 to 14.6% in 2019. The prevalence of erectile dysfunction among the men screened increased steadily from 8.3% in 2013 to 14.5% in 2019. The proportion of patients with diabetic foot ulcers remained static at 1.2 to 1.3% over the six years, similarly for the proportion of patients with amputations (0.6 to 0.7%). The proportion of patients with IHD had increased slightly from 5.4% in 2013 to 5.9% in 2019. The prevalence of cerebrovascular disease similarly increased slightly from 1.3% in 2013 to 1.8% in 2019.

The accuracy of data on diabetes-related complications in the NDR has improved from the previous report, whereby the proportion of 'unknown' complications have reduced over the years. In 2019, the proportion of unknown for each of the conditions only ranged between 1.6 to 2.3%.

The accuracy of data on diabetes-related complications in the NDR still needs further work. In particular, the prevalence of diabetic foot ulcer is unexpectedly low in the dataset. Considering that this is a microvascular complication, it should at least match or exceed the prevalence of retinopathy and nephropathy. This could be explained by the high proportion of patients with "unknown" complications status in **Table 4**, i.e. the rates of unknown complications in 2012 were 12.3% for nephropathy, 15.2% for retinopathy, 12.8% for IHD, 12.5% for cerebrovascular disease, 11.1% for diabetic foot ulcer and 11.0% for amputation.

Table 5
Complications and comorbidities in 2013 to 2019 [Audit Dataset]

Comorbidities	2013	2014	2015	2016	2017	2018	2019
	n (%)						
No. of patients audited	120,518	113,071	152,528	161,778	167,313	157,787	181,634
Hypertension							
Yes	87,944 (72.9)	83,535 (73.9)	113 121 (74.2)	122 769 (75.9)	129 948 (77.7)	123 904 (78.5)	146,032 (80.4)
No	26,656 (22.1)	25,353 (22.4)	35 142 (23.0)	36 252 (22.4)	35 534 (21.2)	32 576 (20.6)	34,721 (19.1)
Unknown	5,918 (4.9)	4,183 (3.7)	4 265 (2.8)	2 757 (1.7)	1 831 (1.1)	1 307 (0.8)	881 (0.5)
Dyslipidaemia							
Yes	72,031 (59.8)	70,468 (62.3)	97,954 (64.2)	109,357 (67.6)	118,115 (70.6)	112,348 (71.2)	135,015 (74.3)
No	39,966 (33.2)	36,371 (32.2)	48,504 (31.8)	48,756 (30.1)	46,611 (27.9)	43,580 (27.6)	45,308 (24.9)
Unknown	8,521 (7.1)	6,232 (5.5)	6,070 (3.9)	3,665 (2.3)	2,587 (1.5)	1,859 (1.2)	1,311 (0.7)
Complications							
Complications	2013	2014	2015	2016	2017	2018	2019
	n (%)						
Nephropathy							
Present	10,658 (8.8)	10,278 (9.1)	14,875 (9.7)	16,898 (10.4)	18,862 (11.3)	18,846 (11.9)	26,434 (14.6)
Absent	94,761 (78.6)	91,662 (81.1)	127,487 (83.6)	138,112 (85.4)	143,398 (85.7)	135,111 (85.6)	152,245 (83.8)
Unknown	15,099 (12.5)	11,131 (9.8)	10,166 (6.7)	6,768 (4.2)	5,053 (3.0)	3,830 (2.4)	2,955 (1.6)
Retinopathy							
Present	8,687 (7.2)	8,743 (7.7)	12,837 (8.4)	14,836 (9.2)	16,046 (9.6)	15,397 (9.8)	19,246 (10.6)
Absent	93,122 (77.3)	89,752 (79.4)	125,598 (82.3)	137,294 (84.8)	144,104 (86.1)	137,285 (87.0)	158,200 (87.0)
Unknown	18,709 (15.5)	14,576 (12.9)	14,093 (9.2)	9,648 (6.0)	7,163 (4.3)	5,105 (3.2)	4,188 (2.3)

Table 5
Complications and comorbidities in 2013 to 2019, *continued* [Audit Dataset]

Ischaemic Heart Disease							
Present	6,463 (5.4)	5,480 (4.8)	7,926 (5.2)	8,387 (5.2)	8,782 (5.2)	8,235 (5.2)	10,660 (5.9)
Absent	98,353 (81.6)	95,851 (84.8)	133,502 (87.5)	145,995 (90.2)	153,163 (91.5)	145,606 (92.3)	167,790 (92.3)
Unknown	15,702 (13.0)	11,740 (10.4)	11,100 (7.3)	7,396 (4.6)	5,368 (3.2)	3,946 (2.5)	3,184 (1.8)
Cerebrovascular Disease							
Present	1,614 (1.3)	1,506 (1.3)	2,096 (1.4)	2,346 (1.5)	2,690 (1.6)	2,596 (1.6)	3,248 (1.8)
Absent	103,683 (86.0)	100,043 (88.5)	139,699 (91.6)	152,447 (94.2)	159,457 (95.3)	151,285 (95.9)	175,207 (96.5)
Unknown	15,221 (12.6)	11,522 (10.2)	10,733 (7.0)	6,985 (4.3)	5,166 (3.1)	3,906 (2.5)	3,179 (1.8)
Diabetic Foot Ulcer							
Present	1,520 (1.3)	1,400 (1.2)	2,052 (1.3)	2,154 (1.3)	2,181 (1.3)	2,010 (1.3)	2,230 (1.2)
Absent	105,440 (87.4)	101,701 (89.9)	141,465 (92.7)	153,769 (95.0)	160,665 (96.0)	152,313 (96.5)	176,578 (97.2)
Unknown	13,558 (11.3)	9,970 (8.8)	9,011 (5.9)	5,855 (3.6)	4,467 (2.7)	3,464 (2.2)	2,826 (1.6)
Amputation							
Present	752 (0.6)	738 (0.7)	947 (0.6)	1,081 (0.7)	1,158 (0.7)	1,104 (0.7)	1,230 (0.7)
Absent	106,303 (88.2)	102,520 (90.6)	142,601 (93.5)	154,888 (95.7)	161,850 (96.7)	153,208 (97.1)	177,554 (97.7)
Unknown	13,463 (11.2)	9,813 (8.7)	8,980 (5.9)	5,809 (3.6)	4,305 (2.6)	3,475 (2.2)	2,850 (1.6)
Erectile Dysfunction							
Abnormal	1,348 (8.3)	1,470 (8.4)	1,375 (7.1)	2,066 (9.7)	2,132 (9.8)	2,369 (10.9)	3,651 (14.5)
Normal	14,949 (91.7)	16,014 (91.6)	18,079 (92.9)	19,127 (90.3)	19,536 (90.2)	19,300 (89.1)	21,457 (85.5)
Total male tested / Total male audited	16,297/ 47,251	17,484/ 44,033	19,454/ 59,003	21,193/ 62,391	21,668/ 63,954	21,669/ 60,160	25,108/ 69,586

Clinical Investigations

Table 6 shows the proportion of patients who had routine clinical tests performed. Overall, the proportions of patients receiving clinical investigations have improved from 2013 to 2019.

Annually, the proportion of patients whose blood pressure (BP) was recorded increased from 92.7% in 2013 to 95.9% in 2019. The proportion of patients who had at least one HbA1c test done annually also increased from 77.4% in 2013 to 91.4% in 2019. Other parameters related to blood glucose are as shown in **Table 6**.

Blood creatinine examination for diabetes patients increased from 78.1% in 2013 to 86.9% in 2019. Patients tested for total cholesterol has also increased from 78.6% in 2013 to 86.9% in 2019. Similarly, for other blood cholesterol, the proportion has steadily increased.

The proportion of patients tested for urine protein has increased from 67.5% in 2013 to 73.2% in 2019. In 2013, 73.8% of patients had a foot examination and this proportion increased to 78.5% in 2019. In 2013, only 48.4% of patients had fundus examination and this proportion increased to 58.7% in 2019. In 2012, 56.5% of patients had an electrocardiogram (ECG) performed as compared to 61.2% in 2019.

Despite urine dipstick being easily available, inexpensive and yields quick results, the testing rates remains sub-optimal. Similarly, for foot examination, defined in the NDR as visual inspection of the feet, the screening rates remain sub-optimal. The increase in fundus examination is however, reassuring.

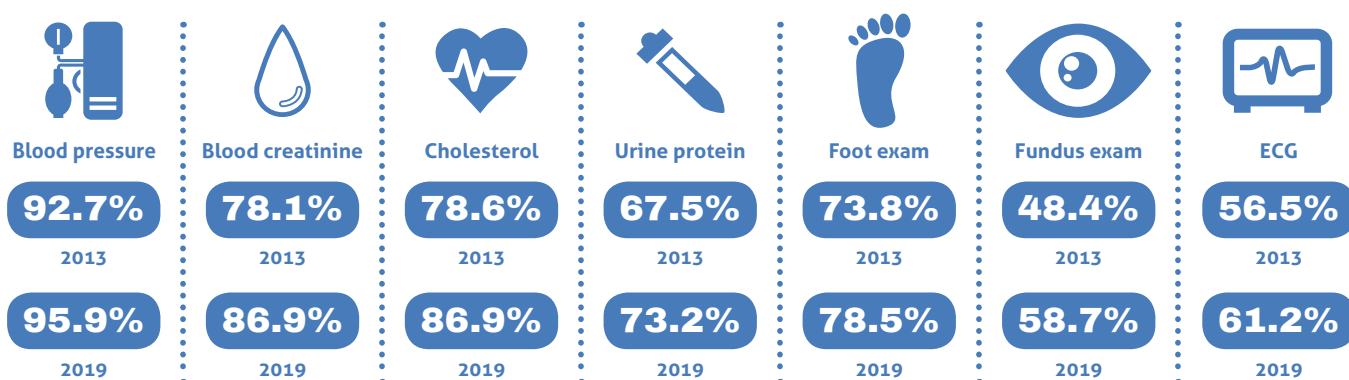


Table 6
Proportion of patients receiving clinical investigations in 2013 to 2019 [Audit Dataset]

Investigation	n (%)						
	2013	2014	2015	2016	2017	2018	2019
BP	111,679 (92.7)	105,446 (93.3)	136,997 (89.8)	148,098 (91.5)	156,624 (93.6)	149,924 (95.0)	174,340 (95.9)
HbA1c	93,257 (77.4)	89,773 (79.4)	118,488 (77.7)	134,267 (82.9)	142,644 (85.3)	141,007 (89.4)	165,962 (91.4)
FBG	74,723 (62.0)	72,628 (64.2)	88,248 (57.9)	93,887 (58.0)	96,501 (57.7)	94,059 (59.6)	109,887 (60.5)
RBG	69,500 (57.7)	63,178 (55.9)	86,388 (56.6)	95,679 (59.1)	100,069 (59.8)	95,134 (60.3)	109,689 (60.3)
2HPP	5,029 (4.2)	4,996 (4.4)	6,880 (4.5)	5,680 (3.5)	4,921 (2.9)	3,588 (2.3)	3,763 (2.1)
Creatinine	94,072 (78.1)	90,405 (79.9)	116,945 (76.7)	129,241 (79.9)	136,670 (81.7)	132,961 (84.3)	157,925 (86.9)
Total Cholesterol	94,734 (78.6)	91,026 (80.5)	117,690 (77.2)	129,628 (80.1)	136,656 (81.7)	131,601 (83.4)	157,807 (86.9)
LDL	68,621 (56.9)	68,920 (60.9)	95,606 (62.7)	105,883 (65.4)	109,823 (65.6)	98,897 (62.7)	121,867 (67.1)
HDL	69,243 (57.5)	69,297 (61.3)	96,350 (63.2)	106,864 (66.1)	110,690 (66.2)	100,448 (63.7)	122,686 (67.5)
TG	94,284 (78.2)	90,500 (80.0)	116,682 (76.5)	129,080 (79.8)	134,667 (80.5)	128,777 (81.6)	155,220 (85.5)
Urine protein	81,352 (67.5)	79,600 (70.4)	100,826 (66.1)	109,611 (67.8)	112,450 (67.2)	109,282 (69.3)	133,010 (73.2)
Urine Microalbumin	70,187 (58.2)	67,183 (59.4)	80,715 (52.9)	83,513 (51.6)	85,573 (51.1)	80,111 (50.8)	95,064 (52.3)
Foot examination	88,899 (73.8)	87,128 (77.1)	110,442 (72.4)	121,919 (75.4)	126,673 (75.7)	123,173 (78.1)	142,648 (78.5)
Fundus examination	58,305 (48.4)	59,858 (52.9)	70,582 (46.3)	80,208 (49.6)	85,222 (50.9)	86,540 (54.8)	106,712 (58.7)
EKG	68,043 (56.5)	69,522 (61.5)	86,468 (56.7)	95,463 (59.0)	98,545 (58.9)	93,340 (59.2)	111,113 (61.2)
No. of patients audited	120,518	113,071	152,528	161,778	167,313	157,787	181,634



Clinical Target Achievement

Table 7 shows the mean HbA1c and the percentage of patients reaching clinical targets for HbA1c. Mean HbA1c showed improvement by which it has decreased slightly over the years, from 8.1% in 2013 to 7.9% in 2019. The proportion of patients achieving glycaemic control with HbA1c $\leq 6.5\%$ ranged between 29.62% to 32.41% over the 6 years. Whereas, the proportion of HbA1c $\geq 10.0\%$ has been on a decreasing trend ranging from 19.69 to 17.05%. **Table 8** shows that the achievement of HbA1c treatment target ($\leq 6.5\%$) varied across the states.

However, we should take note that the analysis of target achievement excludes patients who did not undergo HbA1c testing, or have no HbA1c results documented in their case notes. If we were to assume that patients who were not tested are more likely among those with poor glycaemic control, then the percentage achieving glycaemic target would be much lower. The variation between states over the years in terms of HbA1c achievement must be interpreted with caution since the coverage of HbA1c testing also greatly differs between states (data not shown in this report). However, since the allocation of resources to each individual state is proportion to its disease burden, we would need to explore why such discrepancies are occurring. Despite this caveat, the dataset is still useful for each individual state to monitor the changing trends of HbA1c achievements over time.

Table 9 and **Table 10** reports the mean clinical test values and proportions of audited patients achieving treatment targets. Among audited patients, the proportion of those who tested negative for urine protein and urine microalbumin declined from 2013 to 2019.

For blood pressure parameters, the proportion of the audited patients achieving treatment target for systolic and diastolic blood pressure were mixed. The proportions of patients achieving treatment targets for triglyceride (TG) and low density lipoprotein (LDL) cholesterol also improved. For Body Mass Index (BMI) and Waist Circumference, the proportions of those who achieved treatment target unfortunately declined over the years.

Table 7
Mean HbA1c and patients achieving glycaemic targets*, 2013 to 2019
[Audit Dataset]

HbA1c	2013	2014	2015	2016	2017	2018	2019
Mean HbA1c, %	8.1	8.0	8.1	8.1	8.0	8.0	7.9
Distribution, n(%)							
≤6.5%	28,316 (30.35%)	29,669 (33.09%)	35,050 (29.62%)	41,041 (30.60%)	45,196 (30.56%)	44,310 (31.42%)	53,797 (32.41%)
≤7.0%	36,267 (38.87%)	37,148 (41.43%)	45,048 (38.07%)	52,246 (38.96%)	58,216 (39.36%)	56,440 (40.02%)	68,484 (41.26%)
≤8.0%	54,001 (57.87%)	53,857 (60.06%)	67,370 (56.93%)	77,197 (57.56%)	86,063 (58.19%)	83,259 (59.04%)	100,257 (60.40%)
≥10.0%	18,058 (19.35%)	16,269 (18.14%)	23,306 (19.69%)	25,984 (19.38%)	27,559 (18.63%)	25,571 (18.13%)	28,292 (17.05%)
No. of patients with HbA1c test results	93,312	89,672	11,8339	13,4110	147,905	141,012	165,978

Note:

*The denominator for the percentage achieving target was the number of patients with HbA1c test results. Good glycaemic control as defined by the Malaysian CPG on T2DM (2009)

Table 8
Proportion of patients achieving HbA1c treatment target (HbA1c \leq 6.5%) and mean HbA1c by state, 2013 to 2019
[Audit Dataset]

State	2013			2014			2015			2016		
	% achieved target	Mean HbA1c (95%CI)	% achieved target	Mean HbA1c (95%CI)	% achieved target	Mean HbA1c (95%CI)	% achieved target	Mean HbA1c (95%CI)	% achieved target	Mean HbA1c (95%CI)		
Johor	24.6	8.3 (8.2-8.3)	26.0	8.2 (8.1-8.2)	23.4	8.3 (8.3-8.4)	25.2	8.2 (8.2-8.3)				
Kedah	26.5	8.3 (8.3-8.4)	33.9	8.1 (8.0-8.1)	29.9	8.2 (8.2-8.2)	24.4	8.4 (8.4-8.5)				
Kelantan	22.4	8.7 (8.6-8.7)	22.8	8.7 (8.6-8.7)	23.2	8.5 (8.5-8.5)	26.2	8.4 (8.4-8.4)				
Melaka	34.3	7.8 (7.7-7.8)	40.5	7.6 (7.5-7.6)	29.9	8.0 (7.9-8.0)	29.7	8.0 (7.9-8.0)				
Negeri Sembilan	30.7	8.0 (8.0-8.0)	33.0	7.9 (7.9-7.9)	32.6	7.9 (7.9-7.9)	35.8	7.8 (7.8-7.9)				
Pahang	24.6	8.4 (8.3-8.4)	26.5	8.3 (8.3-8.4)	23.0	8.4 (8.4-8.4)	27.3	8.2 (8.2-8.3)				
Perak	35.0	8.0 (7.9-8.0)	36.9	8.0 (7.9-8.0)	32.1	8.2 (8.1-8.2)	35.1	8.0 (8.0-8.1)				
Pertis	34.3	7.9 (7.7-8.0)	38.8	7.7 (7.6-7.8)	36.5	7.9 (7.8-7.9)	39.2	7.8 (7.7-7.9)				
P.Pinang	25.1	8.1 (8.0-8.1)	31.7	7.9 (7.8-8.0)	24.8	8.2 (8.1-8.3)	28.6	8.0 (8.0-8.1)				
Sabah	48.0	7.3 (7.2-7.3)	48.8	7.2 (7.2-7.3)	44.7	7.3 (7.3-7.4)	43.0	7.4 (7.4-7.5)				
Sarawak	37.5	7.5 (7.4-7.6)	42.4	7.3 (7.2-7.4)	45.7	7.3 (7.2-7.3)	42.3	7.4 (7.3-7.4)				
Selangor	28.5	8.2 (8.2-8.3)	28.8	8.2 (8.1-8.2)	29.4	8.2 (8.1-8.2)	30.8	8.1 (8.1-8.2)				
Terengganu	25.5	8.6 (8.6-8.7)	29.1	8.4 (8.4-8.5)	24.8	8.6 (8.5-8.6)	25.7	8.6 (8.5-8.6)				
WP. Kuala Lumpur	38.1	7.7 (7.7-7.7)	38.4	7.6 (7.6-7.7)	29.0	7.9 (7.9-8.0)	29.0	7.8 (7.8-7.9)				
WP. Labuan	44.2	7.4 (7.2-7.5)	51.6	7.2 (7.0-7.3)	40.9	7.4 (7.2-7.6)	37.3	7.6 (7.4-7.8)				
WP. Putrajaya	42.9	7.7 (7.5-7.8)	36.2	7.7 (7.6-7.9)	29.7	7.9 (7.7-8.0)	20.85	8.2 (8.1-8.4)				
Malaysia	30.35	8.1 (8.1-8.1)	33.09	8.0 (8.0-8.0)	29.62	8.1 (8.1-8.1)	30.60	8.1 (8.1-8.1)				

Table 8
Proportion of patients achieving HbA1c treatment target (HbA1c ≤6.5%) and mean HbA1c by state, 2013 to 2019 , continued
[Audit Dataset]

State	2017		2018		2019	
	% achieved target	Mean HbA1c (95%CI)	% achieved target	Mean HbA1c (95%CI)	% achieved target	Mean HbA1c (95%CI)
Johor	22.8	8.4 (8.3-8.4)	24.4	8.3 (8.2-8.3)	25.4	8.2 (8.2-8.2)
Kedah	24.5	8.4 (8.3-8.4)	24.9	8.5 (8.4-8.5)	28.8	8.2 (8.1-8.3)
Kelantan	28.0	8.3 (8.3-8.3)	30.0	8.3 (8.3-8.4)	29.8	8.3 (8.3-8.3)
Melaka	31.0	7.9 (7.9-8.0)	29.8	7.9 (7.9-7.9)	31.7	7.8 (7.7-7.8)
Negeri Sembilan	33.1	7.9 (7.9-7.9)	34.0	7.9 (7.8-7.9)	34.1	7.9 (7.8-7.9)
Pahang	28.6	8.2 (8.1-8.2)	28.1	8.2 (8.2-8.2)	35.1	7.9 (7.8-7.9)
Perak	34.5	8.0 (7.9-8.0)	35.3	8.0 (8.0-8.1)	35.6	7.9 (7.9-8.0)
Pertlis	30.6	7.9 (7.8-8.0)	28.3	8.2 (8.0-8.4)	30.1	8.0 (7.8-8.1)
P.Pinang	30.5	7.9 (7.8-7.9)	32.4	7.8 (7.7-7.8)	34.3	7.7 (7.7-7.8)
Sabah	40.4	7.6 (7.5-7.6)	38.7	7.6 (7.6-7.7)	42.2	7.5 (7.5-7.5)
Sarawak	43.0	7.4 (7.3-7.4)	39.9	7.5 (7.4-7.5)	40.7	7.5 (7.4-7.5)
Selangor	27.1	8.1 (8.1-8.2)	26.3	8.1 (8.1-8.2)	30.6	7.9 (7.9-8.0)
Terengganu	26.6	8.4 (8.3-8.4)	28.9	8.3 (8.2-8.3)	28.8	8.2 (8.2-8.2)
WP. Kuala Lumpur	28.6	7.8 (7.8-7.9)	32.9	7.6 (7.6-7.7)	32.9	7.6 (7.6-7.7)
WP. Labuan	28.2	7.8 (7.7-7.9)	49.7	7.3 (7.2-7.5)	43.0	7.3 (7.2-7.3)
WP. Putrajaya	30.3	7.7 (7.6-7.8)	36.0	7.4 (7.3-7.5)	42.6	7.3 (7.2-7.3)
Malaysia	30.56	8.0 (8.0-8.0)	31.42	8.0 (8.0-8.0)	32.41	7.9 (7.9-7.9)

Table 9

Target achievement based on clinical investigations, 2013 to 2019 [Audit Dataset]

Clinical Test	Treatment Target	Percentage (%)						
		2013	2014	2015	2016	2017	2018	2019
Urine Protein	Negative	76.7	76.9	73.7	71.2	71.8	68.8	66.5
Urine microalbumin	Negative	71.9	74.2	73.6	71.7	69.8	69.6	65.6
Blood pressure: Systolic	≤135 mmHg	55.3	55.4	54.0	53.3	51.9	52.6	52.2
Blood pressure: Diastolic	≤75 mmHg	39.0	40.6	42.2	42.8	42.2	43.0	44.5
Blood pressure	≤135/75 mmHg	27.4	28.3	28.9	29.2	28.3	28.9	29.3
Total cholesterol	<4.5 mmol/l	29.0	30.6	32.7	34.8	35.4	37.2	38.9
TG	≤1.7 mmol/l	61.5	62.1	62.8	62.6	63.5	64.3	65.9
HDL	>1.2 mmol/l (Male)	36.2	37.8	38.1	37.2	39	39.6	36.4
	>1.0 mmol/l (Female)	80.1	81	82.4	82.1	83.9	84.7	83.2
LDL	≤2.6 mmol/l	37.3	39.2	40.5	42.7	43.2	44.9	45.1
BMI	<23 kg/m ²	16.5	16.1	16.9	16.6	16.2	15.9	15.97
Waist circumference	<90 cm (Male)	33.7	33.7	33.5	33.5	32.5	30.7	30.3
	<80 cm (Female)	14.4	14.4	14.2	14.4	13.1	12.5	12.2

Table 10

Target achievements (Mean Values) based on clinical investigations [Audit Dataset]

Clinical Test	2013	2014	2015	2016	2017	2018	2019
Blood pressure: Systolic (mmHg)	135.1	134.8	135.4	135.4	135.8	135.4	135.4
Blood pressure: Diastolic (mmHg)	77.7	77.4	77.1	77.1	77.3	77.1	76.9
Total cholesterol (mmol/l)	5.1	5.1	5.1	5.0	5.0	5.0	4.9
TG (mmol/l)	1.8	1.8	1.8	1.8	1.7	1.7	1.7
HDL (Male) (mmol/l)	1.2	1.2	1.2	1.2	1.2	1.2	1.2
HDL (Female) (mmol/l)	1.3	1.4	1.4	1.4	1.4	1.4	1.4
LDL (mmol/l)	3.1	3.0	3.0	3.0	3.0	2.9	2.9
BMI (kg/m ²)	27.4	27.5	27.5	27.5	27.6	27.7	27.8
Waist circumference (Male) (cm)	94.0	94.1	94.1	94.2	94.5	95.1	95.2
Waist circumference (Female) (cm)	90.7	91.0	90.8	90.8	91.5	91.8	92.1

Drug Treatment

The use of anti-diabetic drugs is shown in **Table 11** below. In 2019, 28.9% of patients were on monotherapy compared to 27.7% in 2013, while those on 2 or more OADs were 35.1% compared to 42.1% in 2013. The changes are reflected in patients who were on insulin-OAD combination treatment which increased from 17.5% in 2013 to 23.7% in 2019. The proportion of patients on diet management only also ranged from 5.6% to 9.6%, and this is still high.

Among the OADs, metformin was the most commonly prescribed followed by are the sulphonylureas. These are followed alpha-glucosidase and glitazones. On the other hand, the use of insulin has increased over the last 7 years, from 23.11% of patients in 2013, increasing to 30.3% in 2019.

Table 11
Anti-diabetic drugs used (%), 2013 to 2019 [Audit Dataset]

Therapy	2013	2014	2015	2016	2017	2018	2019
Monotherapy (OAD)	27.7	28.1	28.1	29.1	29.1	28.9	28.9
≥2 OAD	42.1	40.1	35.9	34.6	34.7	34.6	35.1
OAD + Insulin	17.5	19.3	19.7	20.9	21.8	23.2	23.7
Diet only	7.1	6.3	9.6	8.6	7.5	6.5	5.6
Type of anti-diabetic drug							
Metformin	80.6	80.8	76.6	77.4	79.7	81.5	83.0
Sulphonylureas	52.5	49.9	45.7	44.2	44.4	44.4	44.3
a-Glucosidase Inhibitors	4.4	3.5	3.5	3.1	2.4	2.2	1.4
Meglitinides	0.1	0.1	0.1	0.2	0.1	0.1	0.1
Glitazones	1.0	1.1	1.0	0.8	1.1	0.6	0.8
Other OADs	1.1	1.6	1.9	2.4	2.1	1.6	1.7
Insulin	23.1	25.4	26.3	27.6	28.6	29.9	30.3

The use of insulin as a mode of treatment from 2013 to 2019 by state is shown in **Table 12**. Generally, there was a steady growth in percentage of patient receiving insulin treatment in all states over the years. The highest percentage of T2DM patients receiving insulin in 2019 is from Kelantan.

Table 12
Use of insulin by state (%), 2013 to 2019 [Audit Dataset]

State	2013	2014	2015	2016	2017	2018	2019
Johor	19.7	23.7	25.4	27.1	29.9	30.2	31.7
Kedah	17.7	18.4	21.1	22.4	26.5	29.1	31.6
Kelantan	24.3	30.7	31.9	36.2	37.7	38.6	39.5
Melaka	22.7	23.8	26.7	26.9	29.7	27.8	27.3
Negeri Sembilan	28.7	29.9	30.0	29.8	29.6	30.9	31.6
Pahang	22.5	26.0	27.1	28.2	28.5	31.3	31.5
Perak	17.7	20.6	20.6	21.7	22.9	24.9	25.2
Perlis	22.3	27.5	30.1	32.4	32.3	29.9	30.8
P.Pinang	21.4	22.7	24.3	23.8	24.7	24.4	24.5
Sabah	19.3	21.7	20.9	22.1	22.8	22.2	22.6
Sarawak	17.9	17.8	18.3	18.6	18.7	19.7	21.3
Selangor	26.3	30.3	31.2	31.9	33.7	34.1	33.2
Terengganu	25.9	29.8	29.9	33.2	34.8	37.3	37.0
WP. Kuala Lumpur	28.5	30.8	33.7	36.1	35.2	32.1	32.3
WP. Labuan	3.6	10.3	18.7	17.3	17.9	16.8	17.6
WP. Putrajaya	24.4	26.3	28.1	29.5	26.6	25.5	26.6
Malaysia	23.1	25.4	26.3	27.7	28.7	29.9	30.4

The use of other concomitant drugs is shown in **Table 13**. From 2013 to 2019, among the anti-hypertensives, ACE inhibitors and calcium channel blockers were the commonly used medication, followed by beta blockers. Of note, the use of calcium channel blockers have been increasing steadily. Aspirin was the most commonly used anti-platelet and statins were the most commonly used anti-lipids.

Table 13
Use of concomitant drugs (%), 2013 to 2019 [Audit Dataset]

Drug	2013	2014	2015	2016	2017	2018	2019
Anti-Hypertensives							
ACE inhibitors	49.3	49.8	48.6	49.2	49.5	51.7	51.8
Angiotensin receptor blockers	4.8	5.3	5.5	5.9	6.6	7.3	7.8
Beta blockers	23.9	23.8	22.1	22.7	23.3	24.3	25.0
Calcium channel blockers	41.6	45.4	45.0	48.2	51.6	54.9	57.7
Diuretics	20.1	20.3	19.5	19.3	20.1	20.4	20.3
Alpha blockers	3.6	3.4	3.2	3.1	3.3	3.6	4.1
Central-acting agents	0.2	0.3	0.3	0.3	0.1	0.2	0.1
Others	0.4	0.4	0.6	0.7	0.7	0.6	0.5
Anti-Platelet							
Acetyl Salicylic Acid	25.1	24.3	21.1	20.4	19.6	19.1	19.2
Ticlopidine	1.1	1.0	1.0	0.9	0.7	0.6	0.6
Others	0.8	1.0	0.9	1.2	1.4	1.6	1.8
Anti-Lipid							
Statins	64.8	68.4	68.8	71.5	74.1	76.9	79.7
Fibrates	3.4	3.4	2.7	2.5	2.6	2.2	1.8
Others	0.1	0.1	0.2	0.4	0.3	0.2	0.2

9

Coverage and Quality of Registration in NDR

There are several key features that we wish to highlight in this report. We discussed findings from the NDR data, and additionally, some comparisons are made against results of the NHMS since the survey reports prevalence of Malaysians with diabetes. Statistical testing of differences was not performed.

Based on the NHMS 2019 results, it was estimated that approximately 1,999,450 are known diabetes and 74.3% of patients with known diabetes are on follow-up at MOH KFs. Therefore, approximately 1,485,591 patients seek care at MOH KFs. In the NDR, there are 849,691 active diabetes patients, which means only 57% of diagnosed patients who claim to seek treatment at MOH primary care facilities are registered.

Since the methodology of the Diabetes Clinical Audit is heavily dependent on the quality of documentation of the patients' case notes, more emphasis should be placed on continually improving documentation by all healthcare providers providing care to patients with diabetes, regardless of level of care. The dataset also does not contain information about hospital admissions.

Klinik Kesihatan Gemencheh
Source: MOH/Ihsan Tahir



10 Conclusions

Despite some limitations in the dataset, the NDR dataset is a useful tool for monitoring quality of care for people living with Diabetes in MOH health clinics. Quality of reporting for the NDR has improved over the years with relatively lower with 'unknown' variables. The rate of screening for complications has also improved over the years. However, the data shows the outcomes of care, such as glycaemic control and proportions of patients with complications has not improved much. It is hoped that with the publication of this information, further exploration into these questions can be pursued.



Blood Sugar Testing
Source: World Health Organization (WHO)

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