THE DIRECT HEALTH-CARE COST OF NONCOMMUNICABLE DISEASES IN MALAYSIA

Ministry of Health Malaysia

World Health Organization
Malaysia, Brunei Darussalam and Singapore

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ABBREVIATIONS

ATC	anatomical therapeutic chemical
CI	confidence interval
CVD	cardiovascular disease
DALYs	disability-adjusted life years
DDD	defined daily dose
DRG	diagnosis-related group
GDP	gross domestic product
HCTM	Hospital Canselor Tuanku Muhriz
HUSM	Hospital University Science Malaysia
ICD-10	International Statistical Classification of Diseases and Related Health Problems, Tenth Revision
MNHA	Malaysian National Health Accounts
MoH	Ministry of Health
MoHE	Ministry of Higher Education
NCD	noncommunicable disease
NHMS	National Health and Morbidity Survey
PEN	WHO Package of Essential Noncommunicable Disease interventions
RM	Malaysian ringgit
T&CM	traditional and complementary medicine
UMMC	University of Malaya Medical Centre
WHO	World Health Organization

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EXECUTIVE SUMMARY

Noncommunicable diseases (NCDs) are the main cause of death and disability in Malaysia. Their growing prevalence is placing increased strain on the country's health system through a rising demand for health services. Given the country's ageing population, the health and economic burden of NCDs can be expected to worsen over time. This report estimates the direct health-care costs of selected NCDs – cardiovascular disease (CVD), diabetes and cancer – for the national population of Malaysia.

The research team worked with officers from the Office of the World Health Organization (WHO) Representative for Malaysia, Brunei Darussalam and Singapore and the Malaysian Ministry of Health (MoH) to obtain the best data available. The secured data were largely restricted to the public sector; extrapolations to the private sector were necessarily based on assumptions. All costs are expressed in Malaysian ringgit (RM) for the 2017 reference year.

The total direct health-care costs of the three selected NCD categories were estimated at RM 9.65 billion in 2017. This equates to a per capita cost for the national population of RM 301.37. For overall expenditure by NCD category, the estimated total health-care cost for diabetes was RM 4.38 billion (45.38% of total costs), followed by CVD with RM 3.93 billion (40.73%), and cancer with RM 1.34 billion (13.89%).

The higher costs of diabetes compared to CVD are largely accounted for by the high proportion of primary care and outpatient attendances that were attributable to diabetes. The other contributing factor is the inclusion of tests for heart disease being limited to routine diagnostic and monitoring tests (such as fasting blood glucose, total cholesterol) delivered in an outpatient setting to adults at risk of heart disease. It was assumed that more complex and costly tests such as echocardiogram, coronary angiogram, etc. were primarily performed in the inpatient setting and would be captured in the hospitalization costs.

Hospitalization costs totalled RM 1.58 billion, or 16.33% of total costs for the three NCD categories. Although the hospitalization costs for diabetes were low, it is likely that many patients admitted with a principal diagnosis of CVD would have diabetes as a comorbidity, as it is a common precursor to a cardiac event. Primary care consultations were associated with a cost of RM 4.20 billion, or 43.38% of total costs. Diabetes accounted for by far the largest proportion of these costs (70.56%), while cancer accounted for only 6.57%.

In 2017, RM 1.72 billion was expended on medications for the three selected NCD categories. Nearly half (46.00%) of this expenditure was incurred for drugs for patients with CVD, while the balance was distributed between drugs for diabetes (30.33%) and cancer (23.67%). Expenditures on medical tests for the three NCD categories totalled RM 1.67 billion in 2017. Tests for CVD patients accounted for the largest share of this expenditure (RM 899.83 million, or 53.77% of the total), followed by testing of diabetes patients RM 661.26 million or 39.52%.

While the cost estimates are based on the best available date, they no doubt underestimate the real cost of the direct health-care costs associated with NCDs in Malaysia.

Firstly, it must be kept in mind that the estimates only relate to the three largest categories of NCDs, and exclude others such as chronic respiratory diseases, mental health and osteoarthritis. Secondly, of the diseases included, some components of costs were not taken into consideration, given the lack of available data. Excluded costs are documented in the report and include categories such as rehabilitation, palliative and long-term care; medical consumables used in the management of, but not specific to, the three NCD categories; electrocardiograms in outpatient settings, and traditional and complementary medicine in private settings.

Despite the various limitations and challenges in data availability, this report constitutes the best estimates based on current data. The proportion of health spending attributed to these NCD categories was relatively small compared to the 26% of total health expenditure allocated for NCDs across 51 low- and middle-income countries. In interpreting the findings, several caveats apply, and these are elaborated within the report.

1. INTRODUCTION

Globally, the burden of noncommunicable diseases (NCDs) has been growing over past decades. In 2019, two out of the top three disease categories with the highest disability-adjusted life years (DALYs) were NCDs, whereas respiratory infections such as tuberculosis and maternal/child illness predominantly caused deaths and disabilities 20 years ago *(1).*

To reduce premature mortality due to NCDs, the World Health Organization (WHO) *Global Plan of Action for the Prevention and Control of Noncommunicable Diseases (2013–2020),* which is undergoing revision, was developed to build country capacity to strengthen evidence-based and cost-effective public health interventions, as well as health service delivery worldwide *(2).* Concurrently, the WHO Global Health Expenditure Database has been updated in line with the 2011 version of the System of Health Accounts, whereby country health spending is recorded by disease categories. This enables the tracking of health resource allocations by types of health conditions relative to demands for care.

Malaysia, like most other countries in the world, is being severely impacted by the global NCD crisis. NCDs are the main cause of death and are also the biggest contributor to the country's morbidity burden. The 2019 *National Health and Morbidity Survey* (NHMS) estimated that the population prevalence of raised blood glucose in Malaysia was 18.3%, raised blood pressure 30.0%, hypercholesterolemia 24.6% and overweight or obese 50.1%. These prevalences continue to increase compared to the previous NHMS *(3).* This growing prevalence of NCDs is placing increased strain on Malaysia's health system through a rising demand for health services.

The *National Strategic Plan for Noncommunicable Disease 2016–2025,* as well as other complementary strategies, are designed to place greater emphasis on prevention through the control of NCD risk factors and early screening services *(4).* However, the public health-care system is constrained by insufficient allocation of funds to address this rising burden of NCDs, especially in the context of the country's ageing population.

The Malaysian Ministry of Health (MoH) has designated the prevention and control of NCDs as a high priority *(4).* It has sought the support of the Office of the WHO Representative for Malaysia, Brunei Darussalam and Singapore, known as the WHO country office, to build a strong, evidence-informed advocacy case for investment in NCD prevention and control in Malaysia. In 2019, it embarked on a project to establish the economic burden associated with NCDs, and the Deakin Health Economics unit at Deakin University in Australia completed a project to monetize the productivity losses and burden of disease attributable to selected NCDs in Malaysia *(5).*

MOH HAS DESIGNATED THE PREVENTION AND CONTROL OF NCDs AS A HIGH PRIORITY.

To complete the picture of both the direct and indirect costs of NCDs in Malaysia, in September 2020, MoH commissioned a second project to estimate the direct health-care costs associated with managing NCDs. MoH seeks the cost estimates so that it can advocate for an appropriate level of investment in and a whole-of-government approach to the task of preventing and controlling NCDs. This report outlines the economic analysis to estimate direct health-care costs for the prevention, control and management of NCDs in Malaysia.

1.1 Country context and health systems architecture

Malaysia is an upper-middle-income country according to the World Bank's income classification, comprising 13 states and three federal territories, covering Peninsular Malaysia and East Malaysia on the island of Borneo. The value of gross domestic product (GDP) at current prices was 1353.4 billion Malaysian ringgit (RM) in 2017 *(6)*. More than half of the country's economic output is derived from the service sector, followed by the manufacturing and agriculture sectors. Malaysia's population in 2017 was estimated at 32 million *(7)*.

Malaysia is a multi-ethnic society, of which the largest ethnic group is Bumiputra (Malay and indigenous groups), followed by Chinese and Indian groups.

The Malaysian health-care system comprises both public and private sectors offering universal coverage of essential and affordable care through the public health system coupled with a fee-for-service private health system. Public health services are financed by general taxation and are delivered by three ministries, namely MoH, the Ministry of Defence and the Ministry of Higher Education (MoHE). In 2017, MoH operated inpatient services through 135 government hospitals and nine special medical institutions (comprising some 42 220 beds) and primary care through 994 health clinics and 1798 community clinics throughout the country *(8)*. In addition, five university teaching hospitals are run by MoHE and five military hospitals by the Ministry of Defence *(9)*. Any Malaysian is eligible to seek a wide range of care at government health facilities by incurring minimal user fees, regulated under the Fees Act 1951 and associated regulations and orders.

On the other hand, private health services are predominantly financed through household out-of-pocket payments, followed by private insurers and employers. In 2019, 20.5% of Malaysia's population had private health insurance policies *(10)*. As of December 2017, there were 200 private hospitals and more than 7000 private medical clinics *(8,9)*. Private health-care facilities are concentrated in urban areas and generally are utilized by the wealthier population. The professional fees for seeking care at private facilities are regulated under the Private Healthcare Facilities and Services Act 1998. However, private providers preserve autonomy to set prices for other components of medical bills, such as ward charges or medications.

In 2017, the total health expenditure of Malaysia was equivalent to 4.24% of the country's GDP (RM 57.4 billion), with health expenditure per capita amounting to RM 1790 *(9)*. Malaysia National Health Accounts (MNHA) estimated that 51.2% of total health expenditure was derived from public health services, while the rest was from private health services. MoH was the most predominant financing source (43.1% of total health expenditure), followed by out-of-pocket spending (37.6%) and private insurers (7.1%). Currently, the MNHA 1.0 framework does not allow the calculation of health spending by disease categories, but the framework is being enhanced.

1.2 Project scope

The study aims to estimate the direct health-care costs of selected NCDs for the national population of Malaysia in 2017. A 2017 reference year is employed in order to align with that of the previous report prepared in 2020 on the indirect costs of NCDs in Malaysia *(5)*. At the request of WHO and MoH, costs are confined to three NCD categories, namely cardiovascular disease (CVD), diabetes and cancer. Complications of these three disease categories and their impacts on other diseases have been taken into account, wherever practical. Costs relating to other categories of NCDs such as chronic respiratory disease, osteoarthritis and mental health are excluded unless they are shown to be a direct complication of one of the three specified NCD categories.

To the extent that data are obtainable, the cost estimates cover both costs to the public and private health-care system. The direct health-care costs include hospitalizations, primary care and outpatient attendances, medications, medical consumables, medical tests, traditional and complementary medicine, and health promotion programmes. Patient out-of-pocket costs are generally not included. The extent to which all of these cost categories are included and able to be measured with a reasonable degree of accuracy is dependent on the availability of data and the ease with which such data can be remotely accessed in a timely manner.

1.3 Project methods

Given international travel restrictions at the time, the project was conducted remotely, without any opportunities for in-country data collection by the research team. Regular videoconference meetings were held with the working group comprising representatives of WHO and MoH; additional MoH staff were invited to specific meetings, as appropriate. Acknowledgement is made of the contributions of members of the working group and all MoH staff who made data available. Particular thanks are extended to Dr Arunah Chandran who worked tirelessly to support the research team in their pursuit of the best data available.

At the outset, the research team conducted a literature review to understand the Malaysian health system and the pathways for the management of NCDs. In addition to academic journal articles, the review covered both the grey literature (reports of the Government and its agencies) identified through searches of publicly available materials on websites such as those of WHO and MoH, and searches of reference lists, as well as other documents identified and provided by the project team.

The second data collection phase aimed to identify, measure and value all direct health-care costs associated with each of the selected NCD categories in Malaysia in 2017. These resources relate to costs of prevention, diagnosis, treatment and management of disease and associated complications. The cost estimates were estimated separately for each of the cost categories (hospitalizations, primary care and outpatient attendances, medications, medical tests, medical consumables, traditional and complementary medicine, and health promotion), and the results are reported separately by each NCD category, where possible. Given that the costing methodology varies for each cost category, detailed methods are specified in each of the cost category chapters. Table 1 details the data sources used for the estimates in each chapter of the report. The overall method combined both top-down and bottom-up approaches to costing. Any assumptions required were based on the best evidence available and are clearly specified in the report.

The cost estimates were calculated from a limited societal perspective. This assumes that all costs will be taken into account irrespective of whom they were incurred by. However, given that it was not always possible to determine costs to patients or the private sector, the primary focus is a government and private health insurance perspective. All costs are expressed in the 2017 Malaysian ringgit. Where unit costs were only available for earlier or later years, they were adjusted to the reference year based on the MNHA-derived GDP deflator *(11)*. All unit costs in foreign currency were converted to 2017 Malaysian ringgit using the World Bank purchasing power parities *(12)*.

As undertaken for our previous project on the indirect costs of NCDs in Malaysia, a tool was developed in Microsoft Excel to facilitate the estimation of the direct costs. It provides clear step-by-step instructions and is intended to be a user-friendly, simple-to-use and easy-to-understand interactive tool for professionals with no modelling or advanced Microsoft Excel skills. It allows users to see the calculations involved in the estimates and provides more detailed tables than in the report. It also allows the user to revise and update the tables as new data become available.

TABLE 1. **Data sources by cost item**

DATA SOURCE	COMMENTS	COSTS EXCLUDED
HOSPITALIZATIONS		
2018 data on number of hospital discharges, average length of stay and average cost per discharge obtained for relevant categories of the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (ICD-10) obtained from Casemix data, Executive Information System Malaysian DRG 2.0. Number of inpatient admissions 2017, University of Malaya Medical Centre (UMMC), UMMC Annual Report 2018 (13). Number of inpatient admissions, 2018, Hospital Canselor Tuanku Muhriz UKM (HCTM), HCTM website. Number of inpatient admissions, Hospital University Science Malaysia (HUSM), HUSM website.	Data obtained covered 40% MoH hospital discharges. Inpatient admissions for the three university teaching hospitals were assigned to disease categories in the same proportions as for the MoH admission. Data were extrapolated to all MoH hospitals and private hospitals.	Admissions to two university teaching hospitals, under the MoHE, and all military hospitals under the Ministry of Defence. Admissions to rehabilitation and long-term care facilities.
OUTPATIENT AND PRIMARY CARE ATTENDANCES		
Hospital outpatient clinic visits, MoH hospitals, 2017, disaggregated by relevant ICD-10 codes. Hospital outpatient visits at Emergency Departments, MoH hospitals, 2017, disaggregated by ICD-10 codes. Specialist clinic visits, MoH hospitals, 2017, disaggregated by ICD-10 codes. Primary care visits (primary care clinics), 2017, disaggregated by ICD-10 codes. Outpatient attendances at National Cancer Hospital 2017. Dietetic attendances. Dialysis patients by type of dialysis and centre.	Data confined to first-time visits in public sector facilities. Data were factored up to account for subsequent visits and to estimate attendance at private facilities. Cancer data cover both new cases, follow-up cases, and radiotherapy, brachytherapy and chemotherapy sessions.	Day-care/ambulatory centres (excluding overnight stays). Rehabilitation services, all allied health services (except for dietetics). Outpatient dialysis cases.
MEDICATIONS		
Expenditure by individual drug by facility type and sector obtained from Pharmacy Research and Development Branch of MoH.	List of locally registered medicines used for management of the three NCDs identified from National Essential Medicines, 5th ed. 2019 and Malaysian Statistics on Medicines 2015–2016.	Antibiotics, painkillers, etc. to treat complications of NCDs, but not specific to NCDs.

TABLE 1. Data sources by cost item *(continued)*

DATA SOURCE	COMMENTS	COSTS EXCLUDED
MEDICAL TESTS		
Commonly administered tests to diabetes patients obtained from the National Diabetes Registry, plus proportion of patients receiving such. Numbers receiving cancer screening obtained from various MoH reports.	Assumed same tests as for diabetes patients would be received by CVD patients. Frequency of tests based on the WHO *Package of Essential Noncommunicable (PEN) Disease Interventions for Primary Care* guidelines. Assumed distribution of medical tests between public and private facilities the same as distribution of primary care and outpatient attendances between sectors.	Electrocardiograms in outpatient settings, liver function tests and blood investigations for tumour markers, such as a prostate-specific antigen blood test. No data by sector (i.e. medical tests ordered in hospitals compared to outpatient clinics, etc. is not available).
MEDICAL CONSUMABLES		
Three-year contract for provision of blood glucose strips and glucometers listed in MoH Annual Report 2017.		All other medical consumables (e.g. needles, sterile blood lines, dressings, etc.).
TRADITIONAL AND COMPLEMENTARY MEDICINE		
2018 Encounter data by type of therapy and targeted disease/condition obtained from Traditional and Complementary Medicine (T&CM) Division of MoH. Unit costs by therapy types sourced from market survey on pricing strategy for T&CM 2018.	Number of encounters and unit costs were adjusted to 2017 reference year, and then mean unit costs for each therapy type were applied to calculate total expenditure.	Traditional and complementary medicine encounters in private facilities.
HEALTH PROMOTION		
Total budget allocation to MoH's Health Education Division 2019. List of health promotion relevant to NCDs, supplied by MoH.	No budget breakdown by disease or programme.	
OTHER COSTS		
MoH funds to National Heart Institute, Malaysia sourced from MoH Annual Report 2017. Ambulance transfers.	Assumed ambulance transfers to hospitals are included in hospitalization costs.	Cost of treating private patients at the National Heart Institute who are not subsidized by MoH. Ambulance transfers to private hospitals and for non-admitted patients. Home care, institutional care (including nursing homes).

2. HOSPITALIZATIONS

Costs of hospitalization refers to the costs incurred when patients are admitted to a hospital and treated as inpatients. The cost of inpatient stays covers all costs incurred during the patient's period of admission, including medical treatment, pathology, nursing, procedures and investigations, emergency care, hotel costs (cleaning and catering) and ward supplies.

2.1 Methods

Casemix data, from the Executive Information System Malaysian diagnosis-related group (DRG) 2.0 and compiled by the MoH Hospital Management Services Unit, was sourced. Inpatients are classified by the principal diagnosis at the time of discharge. The data include people who died while in hospital. Data were obtained for the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (ICD-10) categories relevant to the three NCD conditions, namely I00–I79 and I95–I99 for CVD, E10–E14 for diabetes, and C00–C97 and D00–D48 for cancer. In addition, data were obtained for a number of diabetes complications, which fell outside these broad groupings. The latter included amputations of the lower leg; based on expert opinion, 80% of such amputations were assigned as a consequence of diabetes. Encounters for care involving renal dialysis (ICD-10 code Z49) were also included, with 69.2% of new dialysis cases being attributable to diabetes and 20.6% to hypertension in accordance with data from the 26th Report of the Malaysian Dialysis and Transplant Registry 2018 *(14)*.

The data comprised the number of hospital discharges, average length of stay and average cost per discharge by diagnostic-related groups or ICD-10 codes *(15)*. Costs for each component item (for example, nursing and pathology) were not obtainable from the Casemix costing database. Casemix data were representative of all MoH hospitals, including the five regional cancer hospitals and the National Cancer Hospital.

Adjustments to the MoH data were required given that they were neither complete nor for the correct reference year. Detailed spreadsheets tabulating all data adjustments by DRG code are available in the Excel document. The data obtained were for 2018 as the equivalent data for the reference year 2017 were considered by MoH staff to be less reliable. Discharge numbers for 2018 were adjusted to the 2017 reference year, based on the relative population size in the two years. As a validation measure, adjustment in terms of the difference in DALYs for the two years for each of the three NCD categories obtained from the Global Burden of Disease data were undertaken *(16)*.

As the Casemix data covered only 40% of MoH hospitals, the discharges were then factored up to 100% by multiplying by 2.5. They were further adjusted to reflect the fact that data were received from only 98.44% of the expected number of hospitals *(17)*. The Casemix data were confined to MoH hospitals that were considered generally representative of all public hospitals, covering both larger and smaller facilities. Mean, lower and upper values of discharges in public hospitals were calculated for each DRG category based on the split in utilization rates for inpatient services between public health-care facilities (75.3%; 95% confidence interval

[CI] = 69.60, 80.31) and private facilities (25.5%; 95% CI = 20.46, 31.24) obtained from the National Health and Morbidity Survey 2019, Table 4.20 *(10)*.

Total hospital admissions in 2017 for the three largest MoHE teaching hospitals — University of Malaya Medical Centre (UMMC), Hospital Canselor Tuanku Muhriz UKM (HCTM) and Hospital University Science Malaysia (HUSM) — were included *(13)*, and were assigned to disease categories in the same proportions as applied to MoH discharges.

To calculate these proportions, the percentage of total admissions for each NCD group for MoH hospitals – 8.01% for CVD and 4.62% for neoplasms *(17)* – were then applied to total admissions in the three university teaching hospitals. These were then apportioned between each of the ICD-10 codes in the disease group in line with the apportionment for MoH hospitals. Diabetes admissions as a proportion of total admissions were not available from the *Health Facts* report. This was calculated based on the proportions of other CVD ICD-10 codes to diabetes ICD-10 codes from the MoH Casemix data. No data were available for the other two university teaching hospitals run by MoHE or military hospitals run by the Ministry of Defence, and they are excluded from the calculations.

Casemix data were not available for the 25.5% of discharges that occurred in private hospitals. As for public hospitals, utilization rates for inpatient services in private health-care facilities (25.5%) (NHMS 2019, Table 4.20) were used to calculate mean, low and high numbers of discharges by the DRG code *(10)*.

It should be noted that the Casemix data used were limited to discharges by primary diagnosis. Discharges by secondary diagnosis were not included because of potential issues of double counting; this means that hospitalization costs of the three diseases will be underestimated.

To quantify the cost of hospitalizations, the 2018 average cost of discharges for each DRG category was deflated to 2017 values using MNHA-derived GDP deflation multiplier of 0.97 *(11)*. These 2017 average costs were then applied to all public hospital discharges to obtain expenditure on hospitalizations for the 2017 reference year. Expert opinion indicated that while the number of discharges is split between public and private hospitals in a 75:25 ratio, the cost of hospitalizations is apportioned more evenly (50:50) between the two sectors; this was used to adjust the unit cost of private hospital discharges for each of the NCDs *(10)*. Private hospital unit costs were adjusted upwards by a factor of 3.01. Average cost of discharges in public and private hospitals by disease condition are shown in Annex 1.

2.2 Results

There were an estimated 350 789 hospital discharges in 2017 for the three selected NCD categories. CVD accounted for 188 775, or 53.81%, of these discharges, followed by cancer 138 396, or 39.45% (Table 2).

Total hospitalization costs amounted to RM 2.12 billion, the bulk of which was attributable to CVD discharges (47.77%), or cancer (46.18%). Diabetes accounted for only a very small proportion of both discharges and costs (6.73% and 6.05%, respectively). However, it is likely that many of the patients admitted with a principal diagnosis of CVD are very likely to have diabetes as a comorbidity, as it is a common precursor to a cardiovascular event.

Table 3 provides the range of estimates for discharges and hospitalization costs, both for public (MoH and university teaching hospitals, listed separately) and private hospitals.

TABLE 2. Costs of hospitalizations by selected NCD category, Malaysia 2017

NCD category	Discharge		Hospital costs (RM)	
	Total discharges	Percentage (%)	Mean total cost	Percentage (%)
Cardiovascular disease	188 775	53.81	1 014 451 254	47.77
Diabetes	23 617	6.73	128 567 296	6.05
Cancer	138 396	39.45	980 767 474	46.18
TOTAL selected NCD categories	**350 788**	**100.00**	**2 123 786 024**	**100.00**

RM: Malaysian ringgit

Source: Estimated from Casemix data, Executive Information System Malaysian DRG 2.0.

TABLE 3. Cost of hospitalizations by sector, by selected NCD category, Malaysia 2017

	DISCHARGES			
NCD category	MoH hospitals	University teaching hospitals	Private hospitals	All hospitals
Cardiovascular disease	134 867	9 668	44 239	188 774
Diabetes	16 976	1 072	5 568	23 617
Cancer	100 049	5 529	32 818	138 396
TOTAL selected NCD categories	**251 892**	**16 269**	**82 625**	**350 789**

	COST OF DISCHARGES (RM)			
NCD category	MoH hospitals	University teaching hospitals	Private hospitals	All hospitals
Cardiovascular disease	492 577 871	35 330 626	486 542 757	1 014 451 254
Diabetes	62 687 778	3 959 797	61 919 721	128 567 296
Cancer	480 060 517	26 528 192	474 178 766	980 767 474
TOTAL selected NCD categories	**1 035 326 166**	**65 818 615**	**1 022 641 244**	**2 123 786 024**

RM: Malaysian ringgit

Source: Estimated from Casemix data, Executive Information System Malaysian DRG 2.0.

2.2.1 Cardiovascular disease

Table 4 tabulates the discharges and expenditure on hospitalizations with a primary diagnosis of CVD by broad categories. While the 188 775 hospital discharges for CVD in 2017 are spread across 77 different cardiovascular conditions, five conditions account for nearly two thirds of the discharges. Ischaemic heart disease accounted for 38.91% of discharges (the main conditions being angina pectoris and acute myocardial infarction), followed by cerebrovascular disease (stroke) 22.87%. Other individual conditions that account for significant numbers of discharges are heart failure and essential primary hypertension.

Hospitalization costs for CVD totalled RM 1.01 billion in 2017. The same small number of conditions dominated, accounting for only a slightly smaller share of the expenditure. The average cost per hospital episode of CVD was RM 5374.

IN 2017, THE AVERAGE COST PER HOSPITAL EPISODE OF CVD WAS RM 5374.

It should be noted that while some would classify acute rheumatic fever as an infectious disease, it is classed as an NCD within the ICD-10 system due to the long-term sequelae of the condition.

TABLE 4. Cost of hospitalizations by condition, cardiovascular disease, Malaysia 2017

ICD-10	NCD category	Discharges		Hospital costs	
		Mean	Percentage (%)	Cost (RM)	Percentage (%)
I00–I02	Acute rheumatic fever	341	0.18	2077 532	0.20
I05–I09	Chronic rheumatic heart diseases	850	0.45	5 722 333	0.56
I10–I15	Hypertensive diseases	22 948	12.16	84 353 923	8.32
I20–I25	Ischaemic heart diseases	73 450	38.91	389 123 258	38.36
I26–I28	Pulmonary heart disease and diseases of pulmonary circulation	836	0.44	8 782 276	0.87
I30–I52	Other forms of heart diseases	40 594	21.50	246 917 106	24.34
I60–I69	Cerebrovascular diseases	43 169	22.87	234 869 539	23.15
I70–I79	Diseases of arteries, arterioles and capillaries	2 491	1.32	16 180 583	1.60
I95–I99	Other and unspecified disorders of the circulatory system	1 680	0.89	12 794 621	1.26
Z49.0	Encounters for care involving renal dialysis	2 416	1.28	13 630 083	1.34
	TOTAL cardiovascular diseases*	**188 775**	**100.00**	**1 014 451 254**	**100.00**

RM: Malaysian ringgit

* I80–I89: Diseases of veins, lymphatic vessels and lymph nodes, not elsewhere classified, have been excluded.

Source: Estimated from Casemix data, Executive Information System Malaysian DRG 2.0.

2.2.2 Diabetes

IN 2017, THE TOTAL HOSPITAL COSTS FOR DIABETES WAS RM 128.6 MILLION.

There were only 23 617 hospital discharges where diabetes was listed as the principal reason for the hospital episode. As already mentioned, there are likely to be many additional patients with diabetes among the CVD discharges. It also reflects the fact that management of diabetes is usually at the primary care level.

Table 5 specifies hospital discharges and associated costs for diabetes. Of the discharges for diabetes, 6.94% related to type 1 diabetes and 51.95% to type 2 diabetes, while 32.99% were due to renal dialysis that was directly attributable to diabetes. The total hospital expenditure on diabetes was RM 128.60 million. Its apportionment generally reflected that of discharges. Some 34.64% of the hospitalization expenditure on diabetes relates to those patients with diabetes receiving dialysis. The average cost per hospital episode for diabetes was RM 5444.

TABLE 5. Cost of hospitalizations by condition, diabetes, Malaysia 2017

ICD-10	NCD category	Discharges		Hospital costs	
		Number	Percentage (%)	Cost (RM)	Percentage (%)
E10	Type 1 diabetes mellitus*	1 639	6.94	8 681 254	6.75
E11–E14	Type 2 diabetes mellitus**	12 270	51.95	65 403 171	50.87
N08.3	Diabetes with renal complications	461	1.95	2 635 821	2.05
H28, 36	Diabetes with ophthalmic complications	902	3.82	3 286 102	2.56
G59, 63.2, 73, 99	Diabetes with neurological complications	210	0.89	995 513	0.77
I79.2, M14.2, 14.6	Diabetes with periphery circulatory complications	84	0.36	475 459	0.37
S88–S89	Amputations	259	1.10	2 554 254	1.99
Z49.0	Encounters for care involving renal dialysis	7 792	32.99	44 535 722	34.64
	TOTAL diabetes	**23 617**	**100.00**	**128 567 296**	**100.00**

* Type 1 diabetes without complications

** Type 2 diabetes without complications

RM: Malaysian ringgit

Source: Estimated from Casemix data, Executive Information System Malaysian DRG 2.0.

2.2.3 Cancer

Table 6 specifies hospital discharges and associated costs for cancers by broad categories of cancers. The 138 396 hospital discharges in 2017 for cancer were spread across 137 different classes of neoplasms, the vast majority being forms of malignant neoplasms (Table 6). More than half of discharges (53.24%) related to six categories of malignant neoplasms, namely of the female genitalia (12.75%), breast (9.94%), nasopharynx (8.91%), rectum (8.15%), colon (7.96%), and bronchus and lung (5.53%).

These six neoplasm categories accounted for a slightly higher proportion of hospitalization expenditures on cancer (56.27%) driven by the longer length of stays associated with malignant neoplasms of the nasopharynx and breast. Hospital expenditures on cancers totalled RM 980.77 million. The average cost of a hospital episode for cancer was RM 7087, which is considerably higher than for the other two NCD categories.

IN 2017, THE AVERAGE COST OF A HOSPITAL EPISODE FOR CANCER WAS RM 7087.

TABLE 6. Cost of hospitalizations by condition, cancer, Malaysia 2017

ICD-10	NCD category	Discharges		Hospital costs	
		Number	Percentage (%)	Cost (RM)	Percentage (%)
MALIGNANT NEOPLASMS					
C00–14	Cancers of lip, oral cavity and pharynx	12 333	8.91	153 317 115	15.63
C15	Cancer of oesophagus	1 164	0.84	7 668 559	0.78
C16	Cancer of stomach	2 084	1.51	13 734 733	1.40
C17	Cancer of small intestine	281	0.20	1 854 189	0.19
C18	Cancer of colon	11 023	7.96	72 633 845	7.41
C19–21	Cancers of rectum and anal canal	11 277	8.15	74 304 904	7.58
C22	Cancer of liver and intrahepatic bile ducts	2 237	1.62	14 333 892	1.46
C23–24	Cancers of gallbladder and biliary tract	848	0.61	5 430 854	0.55
C25–26	Cancers of pancreas and other digestive organs	1 487	1.07	9 541 459	0.97
C30–31	Cancers of nasal cavity, middle ear and sinuses	438	0.32	5 441 678	0.55
C32	Cancer of larynx	976	0.71	12 135 805	1.24
C33	Cancer of trachea	14	0.01	98 598	0.01
C34–39	Cancers of trachea, bronchus and lung	7 660	5.53	54 381 088	5.54
C40–41	Cancers of bone and articular cartilage	2 039	1.47	14 042 622	1.43
C43–44	Cancers of skin	587	0.42	2 924 113	0.30
C45–49	Cancers of mesothelial and soft tissue	2 189	1.58	14 665 250	1.50

Table 6. Cost of hospitalizations by condition, cancer, Malaysia 2017 *(continued)*

ICD-10	NCD category	Discharges		Hospital costs	
		Number	Percentage (%)	Cost (RM)	Percentage (%)
MALIGNANT NEOPLASMS *(continued)*					
C50	Cancer of breast	13 760	9.94	99 843 098	10.18
C60–C63	Cancers of male genital organs (including prostate)	2 876	2.08	24 390 421	2.49
C69–C72	Cancers of eye, brain and other parts of central nervous system	3 196	2.31	22 553 413	2.30
C73–C75	Cancers of thyroid and other endocrine glands	3 109	2.25	22 469 746	2.29
C76–C97	Other malignant cancers	22 060	15.94	159 543 481	16.27
OTHER NEOPLASMS (IN SITU AND BENIGN)					
D00–D48	Other neoplasms (in situ and benign)	15 636	11.30	79 034 253	8.06
	TOTAL cancer	**138 396**	**100.00**	**980 767 474**	**100.00**

RM: Malaysian ringgit

Source: Estimated from Casemix data, Executive Information System Malaysian DRG 2.0.

3. OUTPATIENT AND PRIMARY CARE ATTENDANCES

This chapter relates to all medical attendances occurring outside of the hospital inpatient system, within both primary care and hospital outpatient settings. In the public sector, such services are provided through public hospital emergency departments, hospital specialist clinics, hospital outpatient clinics and government health clinics (also called primary care clinics), with MoH being the main provider of such services.

The key practitioners involved are clinical specialists (including family medicine specialists), medical officers and assistant medical officers, and other allied health-care practitioners. In the private sector, the key settings are private hospital specialist clinics, hospital outpatient clinics and general practitioner clinics, with the key practitioners being clinical specialists, general practitioners and allied health-care practitioners.

3.1 Methods

National data on public sector attendances were available for 2017 separately for hospital outpatient clinics, hospital accident and emergency departments, primary care clinics, and specialist clinics, disaggregated by ICD-10 codes. Given that these data related to first consultations only, they were factored up by multiplying by the reported average number of visits to public outpatient facilities per year (1.76) to calculate total MoH consultations *(10)*.

Only the total number of outpatient admissions were available for three of the university teaching hospitals (namely UMMC, HCTM UKM and HUSM). These were apportioned to ICD-10 categories in the same proportions as MoH outpatient admissions.

In the absence of outpatient and primary care attendance data for the private sector, the numbers of private sector attendances were calculated based on the knowledge that 64.6% of the total outpatient attendances occurred in the public sector and the remaining 36.3% in the private sector *(10)*.

For the purposes of costing the attendances, mean unit costs were calculated as the average of the low and high fees for different consultation types as specified by the Amended Thirteenth Fee Schedule *(18)* or the Seventh Fee Schedule *(19)*, and they were inflated to the reference year. These unit costs for the private sector were then scaled down (using the same factor of 0.33 as used for hospitalizations) to obtain unit costs for public sector attendances.

In the absence of itemized outpatient attendance data for patients with diabetes complications, it was assumed that 20% of cataract procedures were attributable to diabetic complications *(20)*. Also 20% of the outpatient attendances coded in the "Remainder of diseases of the eye and adnexa" ICD-10 codes group were presumed to be attributable to retinopathy procedures. No data on outpatient attendances for dialysis were available and have been excluded.

In addition to the above estimates of outpatient attendances, data were obtained for NCD-related attendances for dietetic services and

for cancer outpatient treatment services. In terms of allied health, only dietetic services were able to estimate their encounters for NCDs, as most allied health services do not split their service by disease. MoH estimated that all 80 649 dietetic encounters in health centres would be related to the three NCDs of interest; they were apportioned equally between CVD and diabetes.

Separate data on the number of new cases, follow-up visits, and radiotherapy and chemotherapy outpatient sessions at Malaysia's National Cancer Institute were obtained from the MoH Oncology Centre Statistics 2015–2019 (unpublished data). No double counting was involved as National Cancer Hospital attendances were not included in the MoH outpatient attendances above. No additional private sector cases of radiotherapy, chemotherapy, etc. were assumed.

Data on the number of dialysis patients by type and centre for 2016 were obtained from the 26th report of the Malaysian Dialysis and Transplant Registry 2018 *(14)*. The numbers were adjusted to the 2017 reference year based on population. Numbers of patients at MoH facilities and at military and university teaching hospitals were aggregated to determine public sector totals, while numbers at nongovernmental centres and private facilities made up the private sector.

In accordance with data in the Registry report, some 69.2% of dialysis cases were caused by diabetes mellitus and 20.6% by hypertension and were assigned to diabetes and CVD accordingly. Annual cost per patient per year were drawn from the report and assigned to patients depending on the type of dialysis, whether prevalence or incidence cases, and whether the donor for renal replacement was living or dead.

3.2 Results

Table 7 shows the number of outpatient attendances and the associated cost for each of the three NCD categories. These comprise attendances at both public and private hospitals, including the National Cancer Institute.

The total of 3 356 719 outpatient and primary care attendances were associated with a total cost of RM 4.25 billion. CVD accounted for by far the largest number of attendances (2 017 021, or 60.09%), but only 24.25% of total costs (RM 1.03 billion). While only 31.74% of all attendances were by diabetes patients, they accounted for 73.77% of costs.

Outpatient attendances at the National Cancer Institute are shown separately in Table 8. Of the total of 139 866 attendances, the biggest share was for multiple follow-up visits accounting for 73.5% (RM 59.87 million) of the total costs of RM 81.46 million.

Cancer only accounted for 8.17% of attendances and a smaller share of the total costs (2.06%). The private sector accounted for RM 3.49 billion or 83.57% of the total costs (Table 9).

3.2.1 Cardiovascular disease

Of primary care and outpatient attendance expenditures for CVD patients, the majority was expended on dialysis (RM 951.4 million, or 92.23%, primarily due to the number of dialysis patients caused by hypertension) (Table 9).

3.2.2 Diabetes

Of the RM 3.13 billion expended on primary care and outpatient attendances for diabetes, the vast majority (98.74%) was expended on renal dialysis directly resulting from diabetes mellitus (Table 9).

3.2.3 Cancer

Malignant neoplasms accounted for the largest share (37.24%) of the cost of primary and outpatient attendances for cancer (Table 9).

TABLE 7. Primary care and outpatient attendances and costs by NCD category, Malaysia 2017

NCD category	Outpatient attendances*		Outpatient costs (RM)*	
	Number	Percentage (%)	Number	Percentage (%)
Cardiovascular disease	2 017 021	60.09	1 031 583 370	24.25
Diabetes	1 065 584	31.74	3 148 906 744	73.77
Cancer	274 114	8.17	88 098 934	2.06
TOTAL	**3 356 719**	**100.00**	**4 268 589 048**	**100.00**

* This table incorporates data from both Tables 8 and 9.

RM: Malaysian ringgit

TABLE 8. Outpatient attendances at National Cancer Institute

Reason for attendance	Attendances	Cost of outpatient attendances (RM)
New cases	6 252	3 923 237
Follow-up visits	95 400	59 865 137
Radiotherapy	11 464	418 918
Chemotherapy	26 750	17 250 000
TOTAL	**139 866**	**81 457 292**

RM: Malaysian ringgit

Source: MoH Oncology Centre Statistics 2015–2019 (unpublished data).

TABLE 9. **Cost of primary care and outpatient attendances by sector by NCD category, Malaysia 2017**

ICD-10	Disease category	Cost of primary care and outpatient attendances (RM)*			Percentage (%)
		Sector			
		Public	Private	All	
CARDIOVASCULAR DISEASE					
I05–I09	Chronic rheumatic heart disease	762 912	668 491	1 431 404	0.14
I10–I15	Hypertensive disease	17 652 075	19 364 828	3 016 903	3.59
I20–I25	Ischaemic heart disease	8 134 948	8 247 429	16 382 377	1.59
I60–I69	Cerebrovascular disease	3 878 001	4 062 499	7 940 500	0.77
I00–I99	Other diseases of circulatory system	7 427 830	6 487 650	13 915 480	1.35
	Dietetic services	2 247 813	1 246 158	3 493 971	0.34
	Dialysis and renal transplantation	156 810 019	794 592 717	951 402 736	92.23
	TOTAL cardiovascular disease	**196 913 598**	**834 669 772**	**1 031 583 370**	**100.00**
DIABETES					
E10–E14	Diabetes	14 241 697	15 019 876	29 261 573	0.93
H28.0	Diabetic cataract	1 240 452	753 694	1 994 146	0.06
H36.0	Diabetic retinopathy	2 895 518	1 988 557	4 884 075	0.16
	Dietetic services	2 247 813	1 246 158	3 493 971	0.11
	Dialysis and renal transplantation	464 461 522	2 630 811 457	3 095 272 979	98.74
	TOTAL diabetes	**485 087 002**	**2 649 819 742**	**3 134 906 744**	**100.00**
CANCER					
C00–C97	Malignant neoplasms	1 347 628	1 125 505	2 473 133	37.24
D00–D09	Other neoplasms	904 174	743 866	1 648 040	24.81
D10–D36	Benign neoplasms	1 060 189	786 497	1 846 686	27.80
D37–D48	Neoplasms of uncertain or unknown behaviour	352 539	321 244	673 783	10.14
	TOTAL cancer	**3 664 530**	**2 977 112**	**6 641 642**	**100.00**
	TOTAL outpatient visits	**685 665 130**	**3 487 466 626**	**4 173 131 756**	

* Excludes outpatient attendances at the National Cancer Institute

RM: Malaysian ringgit

Sources: Report of morbidity for outpatient attendances at emergency, GOPD and satellite clinics, public health facilities, and specialist clinics 2017 (unpublished data); University of Malaya Medical Centre Annual report 2018; Hospital Canselor Tuanku Muhriz website 2018; Hospital University Science Malaysia website 2018; Ministry of Health data regarding dietetic encounters in health centres (unpublished data); MoH Oncology Centre Statistics 2015–2019 (unpublished data); Malaysian Dialysis and Transplant Registry 2018; Amended Thirteenth Fee Schedule and the Seventh Fee Schedule.

4. MEDICATIONS

This chapter estimates the cost of all medications used in the prevention and treatment of the three selected NCD categories in Malaysia in 2017. Medicines procurement in the public sector is mainly through volume-based national tenders and medicines are supplied free to patients. Prices in the private sector are determined by market forces.

Overall, the total estimated medicines utilization in Malaysia in 2016 was reported at 632.32 defined daily dose (DDD)/1000 persons/day, with the public sector accounting for 63.8% and the private sector 36.2% *(21)*. The total cost of medicines procured in 2017 for all MoH hospitals, institutions and health clinics was RM 1.72 billion. The number of prescriptions received at public health facilities was 58.8 million, of which 38 million were received in health clinics and 20.8 million in hospitals *(8)*.

Table 10 shows drugs in therapeutic groups by the Anatomical Therapeutic Chemical (ATC) classification relating to the three NCD categories that featured in the top 50 utilized therapeutic groups in 2016 *(21)*. In terms of utilization, drugs used in diabetes were the most utilized therapeutic group in 2016, followed by drugs used in CVD (calcium channel blockers, agents acting on the renin-angiotensin system and lipid modifying agents).

IN 2017, THE TOTAL COST OF MEDICINES PROCURED FOR ALL MoH HOSPITALS WAS RM 1.72 BILLION.

TABLE 10. Therapeutic groups relevant to NCDs in top 50 utilized therapeutic groups, Malaysia, 2016

RANK	ATC Code	Therapeutic group	Utilization in DDD/1000 inhabitants/day		
			Public	Private	TOTAL
1	A10	Drugs used in diabetes	61.96	11.31	73.27
2	C08	Calcium channel blockers	61.51	7.53	69.04
3	C09	Agents acting on the renin-angiotensin system	39.40	11.28	50.68
4	C10	Lipid modifying agents	27.70	8.90	36.60
7	C07	Beta blocking agents	14.22	3.50	17.72
9	C03	Diuretics	14.92	1.96	16.88
22	C01	Cardiac therapy	3.40	1.33	4.73
30	C02	Antihypertensives	2.37	0.26	2.63
45	L04	Immunosuppressants	0.47	0.17	0.64

ATC: Anatomical Therapeutic Chemical code – DDD: defined daily dose

Source: Adapted from Malaysian Statistics on Medicine 2015–2016, Table 2.2.

4.1 Methods

Drugs used in the prevention and treatment of the three NCD categories were initially identified from the National Essential Medicines List, 5th edition, 2019 *(22)* and the Malaysian Statistics on Medicines 2015–2016 *(21)*, which provides a listing of locally registered medicines used for the management of different disease conditions. The MoH Pharmacy Research and Development Branch then provided for each individual drug, expenditure by facility (for example, hospitals, pharmacies, etc.) by sector for 2017. Expenditures were then grouped by broad categories of drugs for each of the NCD categories.

It should be noted that medications listed under the hospital setting (both public and private) include medications prescribed to both admitted patients and to outpatients receiving follow-up treatment at hospitals or hospital specialist clinics. Pharmacies refer to private pharmacies operating in the community, while clinics refer to government health clinics and specialist clinics in the private sector. The Pharmacy Research and Development Branch obtained the data from the pharmacy unit of each facility in the Government. In the private sector, most of the data were obtained from pharmaceutical distributors that supply medications to private hospitals, clinics and community pharmacies. Other private sector data were obtained from participating facilities.

The cost of drugs administered to inpatients are included in the Casemix data used to estimate hospitalization costs in Chapter 2; they have been subtracted when totalling disease costs (Chapter 9) to avoid double counting. An estimated 15.8% of hospitalization costs (based on expert advice) was deducted to avoid double counting of medication costs.

4.2 Results

Table 11 shows expenditure on medications by the three NCD categories by sector and facility type. In 2017, RM 1.7 billion was expended on medications for the three selected NCD categories. Nearly half (46.00%) of this expenditure was incurred on drugs for patients with CVD, while the balance was reasonably evenly distributed between drugs for diabetes (30.33%) and cancer (23.67%).

Some 61.27% of the drugs were distributed through the private sector; this proportion was greatest for cardiovascular drugs (70.51%) and lowest for diabetes drugs (52.58%). The private sector accounted for RM 1.06 billion on drugs, the largest proportion being distributed through pharmacies, followed by private hospitals and private clinics. The public sector accounted for RM 667.67 million on medications for the three NCD categories or 38.73% of expenditure, with public hospitals accounting for the biggest proportion (Table 11).

Annexes 1, 2 and 3 indicate total expenditure by sector and facility type for each individual medication. In addition, the cost per DDD for each medication by sector provides a good indication of the variation in the cost of medications between the public and private sector. The markup in prices in the private sector ranges from modest increases over public sector prices to as much as four times higher.

To avoid double counting, when summing total costs for the selected NCDs (Chapter 9), in-hospital pharmacy costs of RM 333.48 million were deducted from the hospitalization costs, as they are already included in total medication costs. It should be noted that not all of the in-hospital pharmacy costs for drugs for the three NCD categories are specifically related to admissions for these conditions. The balance will be used by patients who have one or more of these conditions, but who were admitted to hospital for quite different reasons.

As an example, a person with diabetes admitted to hospital for a hip replacement will still require their Metformin while in hospital. Equally well, it will also account for medications that were related to NCD admissions but are not listed as an NCD (for example, drugs used in surgery).

4.2.1 Cardiovascular disease

IN 2017, CVD DRUGS ACCOUNTED FOR 46.00% OF DRUG COSTS FOR THE 3 NCD CATEGORIES.

Drugs used in the management of CVD incur the highest expenditure of the three NCD categories, in part due to the rising prevalence of CVD risk factors and improved access for CVD patients to health-care facilities.

Expenditures on cardiovascular drugs amounted to RM 792.88 million in 2017, or 46.00% of drug expenditures for the three NCD categories. Two thirds of this expenditure was in the private sector (RM 559.09 million), with more than half of this being expended through pharmacies, followed by private clinics and then private hospitals (Table 12). Clinics in the private and public sector were responsible for roughly similar expenditures on cardiovascular drugs, while public hospitals accounted for more expenditures than private hospitals.

The two largest categories of cardiovascular drugs were those classified as agents acting on the renin-angiotensin system, which accounted for 15.34% of expenditures followed by lipid-modifying drugs (14.73%) (Table 12). While there were some 109 different cardiovascular drugs purchased, nearly half (40.62%) of the expenditures were on nine of the drugs. Drugs with the highest expenditures were atorvastatin, rosuvastatin and simvastatin (all lipid-modifying agents), and amlodipine and perindopril (agents acting on the renin-angiotensin system).

Annex 2 shows that while the majority of the expenditures on cardiovascular medications occurred in the private sector, they were much more a reflection of the higher cost of medicines in that sector rather than higher volume.

4.2.2 Diabetes

Expenditure on diabetes drugs amounted to RM 522.85 million, which equated to 30.33% of the expenditures on medications for the three NCD categories. Some 52.58% of these expenditures on diabetes drugs occurred in the private sector, and in particular, through private pharmacies (23.96%). Public sector clinics were responsible for a similar proportion (32.74%) of the expenditures (Table 11).

Annex 3 shows the expenditure by individual diabetes medications. While expenditure was incurred on some 32 different drugs, more than half (56.83%) of the diabetes drug costs stemmed from three drugs, namely metformin, gliclazide, and metformin and sitagliptin combined. Different forms of insulins used in diabetes accounted for expenditure of RM 143.31 million or 27.42% of the total expenditures on diabetes medications. Again, the cost per DDD provided a good indicator of the higher cost of diabetes medications in the private sector.

4.2.3 Cancer

Expenditures on cancer drugs totalled RM 408.10 million in 2017; this accounted for 23.67% of the medication expenditures on all three categories of NCDs. The distribution between sectors was more even than for the other two disease areas, with the private sector accounting for 54.43% and the public sector 45.57% (Table 11). Within the private sector, pharmacies were the main distributors of cancer drugs.

Annex 4 shows expenditures by individual cancer medications. Data on the DDD were not available for many of these medications.

TABLE 11. **Medication costs by NCD category by sector and facility type, Malaysia 2017**

NCD category	Cost (RM)							
	PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS		
	Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL
Cardiovascular disease	113 273 390	120 517 250	105 468 940	149 968 250	303 648 020	233 790 640	559 085 210	792 875 850
Diabetes	76 739 990	171 169 560	58 536 300	91 119 980	125 281 450	247 909 550	274 937 730	522 847 280
Cancer	183 345 840	2 626 500	153 291 570	26 533 560	42 301 560	185 972 340	222 126 690	408 099 030
TOTAL medication costs for selected NCDs	**373 359 220**	**294 313 310**	**317 296 810**	**267 621 790**	**471 231 030**	**667 672 530**	**1 056 149 630**	**1 723 822 160**

NCD category	Percentage of total by disease (%)							
	PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS		
	Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL
Cardiovascular disease	14.29	15.20	13.30	18.91	38.30	29.49	70.51	46.00
Diabetes	14.68	32.74	11.20	17.43	23.96	47.42	52.58	30.33
Cancer	44.93	0.64	37.56	6.50	10.37	45.57	54.43	23.67
Percentage of total medication costs provided by each facility and sector	**21.66**	**17.07**	**18.41**	**15.52**	**27.34**	**38.73**	**61.27**	**100.00**

RM: Malaysian ringgit

Source: Pharmacy Research and Development Branch, MoH.

TABLE 12. Medication costs by category of drug, by NCD category, Malaysia 2017

ATC Code	NCD category	Cost (RM)								
		PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS			
		Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	% of total
CARDIOVASCULAR DRUG										
C01	Cardiac therapy	28 009 340	3 580 390	12 831 190	3 549 720	12 407 040	31 589 730	28 787 950	60 377 680	3.50
C02	Antihypertensives	6 540 610	7 446 630	1 882 020	934 670	4 298 480	13 987 240	7 115 170	21 102 410	1.22
C03	Diuretics	5 197 410	7 443 810	2 770 780	1 878 160	4 021 640	12 641 220	8 670 580	21 311 800	1.24
C04	Peripheral vasodilators	287 430	53 280	258 160	52 330	343 600	340 710	654 090	994 800	0.06
C07	Beta-blocking agents	15 727 020	27 392 810	7 766 780	9 186 130	22 868 720	43 119 830	39 821 630	82 941 460	4.81
C08	Calcium channel blockers	9 600 310	15 012 620	8 134 660	15 813 630	39 154 230	24 612 930	63 102 520	87 715 450	5.09
C09	Agents acting on the renin-angiotensin system	18 965 990	36 660 880	25 021 650	69 655 260	114 201 830	55 626 870	208 878 740	264 505 610	15.34
C10	Lipid modifying agents	28 945 280	22 926 830	46 803 700	48 898 350	106 352 480	51 872 110	202 054 530	253 926 640	14.73
TOTAL cardiovascular drugs		113 273 390	120 517 250	105 468 940	149 968 250	303 648 020	233 790 640	559 085 210	792 875 850	46.00
DIABETES DRUG										
A10	Diabetes	76 739 990	171 169 560	58 536 300	91 119 980	125 281 450	247 909 550	274 937 730	522 847 280	30.33
TOTAL diabetes drugs		76 739 990	171 169 560	58 536 300	91 119 980	125 281 450	247 909 550	274 937 730	522 847 280	30.33
CANCER DRUG										
L01	Antineoplastic agents	99 190 480	2 131 160	105 460 910	10 006 930	20 029 670	101 321 640	135 497 510	236 819 150	13.74
L02	Endocrine therapy	10 923 970	156 440	18 466 530	6 333 590	8 594 200	11 080 410	33 394 320	44 474 730	2.58
L03	Immunostimulants	13 065 320	49 110	7 160 250	856 690	492 350	13 114 430	8 509 290	21 623 720	1.25
L04	Immunosuppressants	60 166 070	289 790	22 203 880	9 336 350	13 185 340	60 455 860	44 725 570	105 181 430	6.10
TOTAL cancer drugs		183 345 840	2 626 500	153 291 570	26 533 560	42 301 560	185 972 340	222 126 690	408 099 030	23.67

ATC: anatomical therapeutic chemical – RM: Malaysian ringgit

Source: Pharmacy Research and Development Branch, MoH.

5. MEDICAL TESTS

The medical tests costed in this chapter refer to any diagnostic and monitoring tests performed on patients other than those in hospitals. Medical tests performed on patients admitted to hospital are excluded here and have been incorporated under the hospitalization costs.

5.1 Methods

5.1.1 Cardiovascular disease

The only tests included here are the routine tests (such as fasting blood glucose and total cholesterol) delivered in an outpatient setting to adults at risk of heart disease. More complex tests such as echocardiogram, coronary angiogram, etc. have not been included as it was assumed that they are performed as an inpatient and are therefore captured in the hospitalization costs.

The eligible population was calculated by subtracting from the adult population aged 40–74 years the number who had a diagnosis of diabetes. Routine testing of populations at risk of CVD are recommended and age is a key risk factor for CVD. We assumed that all adults aged between 40 and 74 years are eligible for routine testing. We assumed that the proportion of this population that does not have diabetes are eligible for CVD tests. However, it is unlikely that all those who are eligible get the recommended tests. In the absence of any other available data, the same proportions of this population were assumed to receive the same medical tests as the diabetes population, and at the same frequency (Table 13).

Having estimated the eligible population, the total expenditure on these tests for CVD patients was calculated by applying unit costs for the different tests sourced from published literature *(23,24)* or an average of the fees recommended in the Seventh Fee Schedule *(19)* and the Thirteenth Fee Schedule *(18)*. The public sector costs of electrocardiograms were factored down by the same adjustment as used for hospitalizations, as well as primary care and outpatient attendances. No cost was applied for blood pressure testing as it is assumed to be routinely done during consultations with general practitioners, which have already been costed in Chapter 3 (primary care attendances).

5.1.2 Diabetes

A list of tests commonly administered to people with diabetes was compiled from the *National Diabetes Registry Report 2013–2019 (25)*. It was assumed that these tests were conducted in the primary care and outpatient setting. The prevalence of diabetes was reported as 3 057 162 in 2019, or 9.4% (8.66% to 10.20%) of the population. The percentage of the population with diabetes receiving each of the tests was sourced from the *National Diabetes Registry Report 2013–2019 (25)*. After adjusting back to the 2017 population, expenditures on specific tests were obtained by multiplying the eligible 2017 population by the unit prices for each test – sourced from published literature and the Amended Thirteen Fee Schedule *(18,23)* and the frequency of testing (based on published literature *(23)* (Table 13). It is acknowledged that some of these tests may be done together, and that the unit costs may be lower than the sum of each test's unit cost. In that case, these cost estimates would be overstated.

TABLE 13. Eligible population, frequency and unit costs of diabetes tests

TEST	Proportion of people with diabetes who had test[a] (%)	Number of tests per year	Unit cost of test[b] (RM)	
			Public sector	Private sector
Haemoglobin A1c	85.3	2	15.59	46.93
Fasting blood glucose	57.7	4	2.80	8.44
Random blood glucose	59.8	4	2.80	8.44
Two-hour postprandial glucose	2.9	4	2.80	8.44
Creatinine	81.7	4	2.80	8.44
Total cholesterol	81.7	1	13.98	42.08
Low-density lipoprotein	65.6	1	13.98	42.08
High-density lipoprotein	66.2	1	13.98	42.08
Triglycerides	80.5	1	13.98	42.08
Urine protein	67.2	1	2.06	6.20
Urine microalbumin	51.1	1	7.32	22.03
Foot examination	75.7	1	14.81	44.59
Fundus examination	50.9	1	17.22	51.84
Electrocardiogram	58.9	1	21.87	65.86

RM: Malaysian ringgit

a: Sourced from National Diabetes Registry Report 2013–2019 *(23)*.

b: Sourced from Amended Thirteenth Fee Schedule *(16)* and published literature *(21,22)*.

5.1.3 Cancer

The medical tests for cancer were limited to screening tests for breast, cervical and colorectal cancer. It was assumed that any other diagnostic testing would occur as inpatients within the hospital system.

BREAST CANCER – The aims of Malaysia's Breast Health Awareness Programme is to promote breast self-examination to all women, to perform annual clinical breast examinations on women aged 40 years and older, and mammograms to women above 50 years. Primary care serves as the entry point for high-risk women before being referred for a mammogram examination at a government hospital. Mammograms are offered to women over the age of 40 years every two years, and for high-risk women yearly. The proportion of eligible women reporting having a mammogram in the past 12 months was 7.00% (6.00–7.67%) *(3)*. The resultant number of mammograms was then multiplied by the unit cost to obtain the total expenditure on mammograms *(18)*.

CERVICAL CANCER – The National Pap Smear Screening Programme offers opportunistic cervical cancer screening to all sexually active women aged 30–65 years. Pap smear screening is offered every three years following two initial consecutive negative smears one year apart. In 2017, the national pap smear coverage was 26.3% or 532 127 cases *(8)*.

COLORECTAL CANCER – Colorectal cancer screening was implemented in 2014 with the aim of detecting pre-lesion and colorectal malignancy at the earliest stage possible among the asymptomatic population aged 50–70 years. The screening is carried out using immunological faecal occult blood test (unit cost RM 2.79) followed by colonoscopy. In 2017, a total of 32 464 individuals were screened *(26)*.

When summing total costs for selected NCDs (Chapter 9), 10% (based on assumptions) of these routine medical test costs were deducted from hospitalization costs to avoid double counting of those routine medical tests performed on admitted patients.

5.2 Results

Table 14 shows expenditures on medical tests for the three NCD categories totalled RM 1.67 billion in 2017. Tests for CVD patients accounted for the largest share of this expenditure (RM 899.83 million, or 53.77% of the total), followed by testing of diabetes patients (RM 661.26 million, or 39.52% of the total), and then cancer screening (RM 112.33 million, or 6.71% of the total).

5.2.1 Cardiovascular disease

NEARLY RM 900 MILLION WERE SPENT ON TESTING FOR CVD RISK.

Of the mean total of RM 899.83 million expended on testing for CVD risk, the largest component (RM 181.94 million, or 20.22%) was spent on electrocardiograms, followed by total cholesterol tests (RM 161.26 million, or 17.92%), renal function tests (RM 129.41 million, or 14.38%) and fundus examinations (RM 123.77 million, or 13.75%).

5.2.2 Diabetes

Tests delivered to patients diagnosed with diabetes are designed to either monitor their diabetes or cholesterol readings, detect complications arising from the disease (such as diabetic foot or diabetic retinopathy) or to check for cardiovascular comorbidities. Of the 11 tests fitting into the first category, haemoglobin A1c comprise the largest component of expenditure (RM 137.02 million, or 20.72%) followed by total cholesterol (8.9%) and triglycerides (8.77%). Foot and eye examinations accounted for some RM 102.93 million, or 15.57%, of all diabetes expenditures. However, the second-largest proportion of expenditure was a result of electrocardiograms (RM 66.39 million, or 10.04%). As diabetes is a risk factor for heart disease, patients with diabetes are regularly tested for CVD symptoms.

5.2.3 Cancer

Of the total of RM 112.33 million expended on cancer screening, breast screening accounted for the largest proportion (RM 94.39 million, or 84.02%) followed by cervical cancer screening (RM 17.79 million, or 15.84%).

TABLE 14. **Medical tests by NCD category, Malaysia 2017**

MEDICAL TEST	Costs (RM)			Percentage of total (%)
	MEAN	LOWER	UPPER	
CARDIOVASCULAR DISEASE				
Full blood count	84 444 616	83 698 969	85 134 341	9.38
Total cholesterol	161 255 930	159 832 036	162 573 031	17.92
Fasting or random blood glucose	93 057 373	92 235 675	93 817 445	10.34
Renal function tests (creatinine, eGFR, serum electrolytes)	129 409 147	128 266 462	130 466 131	14.38
Uric acid	73 151 482	72 505 553	73 748 967	8.13
Urinalysis – dip stick: microalbuminuria and microscopic haematuria	52 800 778	52 334 546	52 232 043	5.87
Electrocardiogram	181 939 553	180 333 022	183 425 593	20.22
Fundus examination	123 769 400	122 676 514	124 780 320	13.75
TOTAL cardiovascular disease tests	**899 828 279**	**891 882 777**	**906 177 871**	**100.00**

TABLE 14. Medical tests by NCD category, Malaysia 2017 *(continued)*

MEDICAL TEST	Costs (RM)			Percentage of total (%)
	MEAN	LOWER	UPPER	
DIABETES				
Haemoglobin A1c	137 017 036	126 230 588	148 678 060	20.72
Fasting blood glucose	33 347 740	30 722 493	36 185 846	5.04
Random blood glucose	34 561 436	31 840 642	37 502 835	5.23
Two-hour postprandial glucose	1 676 056	1 544 111	1 818 699	0.25
Creatinine	47 218 551	43 501 346	51 237 151	7.14
Total cholesterol	58 838 741	54 206 755	63 846 293	8.90
Low-density lipoprotein	47 243 836	43 524 640	51 264 588	7.14
High-density lipoprotein	47 675 944	43 922 732	51 733 472	7.21
Triglycerides	57 974 524	53 410 573	62 908 527	8.77
Urine protein	7 130 464	6 569 129	7 737 311	1.08
Urine microalbumin	19 265 842	17 749 170	20 905 489	2.91
Foot examination	57 764 792	53 217 351	62 680 944	8.74
Fundus examination	45 160 731	41 605 525	49 004 198	6.83
Electrocardiogram	66 385 740	61 159 629	72 035 590	10.04
TOTAL diabetes tests	**661 261 433**	**609 204 684**	**717 539 003**	**100.00**
CANCER				
Mammogram screening (breast cancer)	94 388 220	80 904 189	103 377 575	84.02
Pap smears (cervical cancer)	17 790 842	—	—	15.84
Immunological faecal occult blood tests (colorectal cancer)	155 061	—	—	0.14
TOTAL cancer tests	**112 334 123**	**80 904 189**	**103 377 575**	**100.00**
TOTAL TESTS	**1 673 423 835**	**1 581 991 650**	**1 727 094 249**	
PERCENTAGE OF TOTAL TESTS FOR SELECTED NCDs (in %)				
Cardiovascular disease	53.77	56.38	52.47	
Diabetes	39.52	38.51	41.55	
Cancer	6.71	5.11	5.99	
TOTAL TESTS	**100.00**	**100.00**	**100.00**	

RM: Malaysian ringgit

Sources: WHO Risk-based CVD management: https://apps.who.int/iris/bitstream/handle/10665/333221/9789240001367-eng.pdf; National Diabetes Registry Report 2013–2019; Institute for Public Health (IPH), National Institute of Health, Ministry of Health Malaysia; National Health and Morbidity Survey (NHMS) 2019: Vol. I: NCDs – Non-Communicable Diseases: Risk Factors and other Health Problems; Ministry of Health Malaysia. Annual Report Ministry of Health Malaysia 2017; Overview of colorectal cancer screening programme in Malaysia. Medical Journal of Malaysia, 2020; Amended Thirteenth Fee Schedule and the Seventh Fee Schedule.

6. MEDICAL CONSUMABLES

Most medical consumable items, such as needles, sterile blood lines and dressings, are commonly used across all health-care patients. For example, dressings are used for a variety of conditions, most commonly trauma and post-operative wound care, as well as for NCD patients. In the absence of any reliable information as to the distribution of such consumables among different types of patients, no attempt has been made to apportion a share of consumable costs to the three NCD categories.

The exception is medical consumables that are unique to a particular disease. In 2017, MoH entered a three-year contract for the provision of blood glucose strips and glucometers that are exclusively used in the management of diabetes patients *(8)*.

The total value of this contract (RM 23 509 275) was apportioned over three years, resulting in an annual cost for 2017 of RM 7 836 425.

7. COST FOR TRADITIONAL AND COMPLEMENTARY MEDICINE

AS OF 2017, A TOTAL OF 15 HOSPITALS OFFERED T&CM SERVICES.

In Malaysia, the practice of traditional and complementary medicine (T&CM) can be defined as a form of health-related practice designed to prevent, treat or manage any ailment or illness or preserve the mental and physical well-being of an individual. Although T&CM practices have begun to be incorporated into the national health-care system in selected public hospitals and clinics in Malaysia, the bulk of T&CM practice lies in the private sector. While the Traditional and Complementary Medicine Act 2016 (Act 775) provides for the establishment of the T&CM Council to regulate the T&CM services, there is little information available regarding T&CM practice outside of MoH services.

A study on the use of T&CM by the Malaysian population in 2015 reported 29.25% of the national population had used T&CM at some stage in their lifetime, while 21.51% reported using it within the last 12 months *(27)*. Given the high demand for T&CM, the Government has made conscious efforts over the past two decades to integrate it into the national health-care system. Under the Traditional and Complementary Medicine Act 2016, there are seven recognized practice areas, namely traditional Malay medicine, traditional Chinese medicine, traditional Indian medicine, homeopathy, chiropractic, osteopathy and Islamic medical practice. As of 2017, a total of 15 government hospitals offered T&CM services.

7.1 Methods

The MoH Traditional and Complementary Medicine Division provided encounter data for 2018 by type of therapy and broad categories of the disease or symptoms targeted. The data only relate to T&CM encounters that are provided at government facilities; no data were obtained for therapy provided in private facilities. Malay massage and Chinese acupuncture encounters, specifically used by stroke patients, were separately itemized. The same two therapies were used for chronic pain management; it was assumed that 30% of these encounters were used by cancer patients. Of the Indian traditional and complementary medicine encounters, none of the Basti Luaran and Varman therapy encounters were assigned to the three NCD categories; these therapies are more relevant to musculoskeletal conditions. Of the encounters for Shirodhara, a therapy commonly used for stress relief, an arbitrary 30% were assigned equally across the three NCD categories.

After adjusting the number of encounters back to the 2017 reference year, mean unit costs for each of the therapy types obtained from a 2018 market survey *(28)* were inflated from 2015 to 2017 values and then applied to calculate total expenditure.

7.2 Results

Overall expenditure on T&CM for the three NCD categories was estimated at RM 2.31 million in 2017 (Table 15). Of this total, the largest component of expenditure was for cancer RM 1.84 million, or 79.74% of total expenditures. CVDs accounted for a further RM 470 000, or 20.14%.

The largest component of expenditure on T&CM was expended on traditional Indian therapies and, in particular, for patients with cancer.

TABLE 15. Traditional and complementary medicine by NCD condition, Malaysia 2017

NCD condition	Encounters 2017	Unit cost per encounter	Total cost (RM)	Percentage of total cost (%)
CARDIOVASCULAR DISEASE				
Malay massage – stroke patients	3 051.72	68.58	20 280	9.05
Chinese acupuncture – stroke patients	4 808.98	52.75	253 685	10.97
Indian Shirodhara therapy	18.57	149.49	2 776	0.12
TOTAL cardiovascular disease	**7 879.27**	—	**465 741**	**20.14**
DIABETES				
Indian Shirodhara therapy	18.57	149.49	2776	0.12
TOTAL diabetes	**18.57**	—	**2776**	**0.12**
CANCER				
Malay massage – chronic pain management	4 299.90	68.58	294 879	12.75
Chinese acupuncture – chronic pain management	8 228.97	52.75	434 097	18.77
Chinese acupuncture – curb nausea and vomiting associated with chemotherapy	34.61	52.75	1 826	0.08
Complementary Indian therapy for cancer patients	7 426.58	149.49	1 110 01	48.01
Indian Shirodhara therapy	18.57	149.49	2776	0.12
TOTAL cancer	**20 008.63**	—	**1 843 590**	**79.74**
TOTAL	**27 906.48**	—	**2 312 107**	**100.00**

RM: Malaysian ringgit

Sources: The MoH Traditional and Complementary Medicine Division 2018; Traditional and Complementary Division, Ministry of Health Malaysia, Market survey on pricing strategy for traditional and complementary medicine services in Malaysia, 2018.

8. OTHER COSTS

8.1 Health promotion

In 2019, the budget allocation of the MoH Health Education Division was RM 8.57 million. This figure was deflated to the 2017 reference year (RM 8.01 million). No detailed breakdown of this expenditure by programme was available, which would enable estimation of expenditure on programmes targeting NCDs or specific diseases. MoH estimated that 75% of this budget was allocated to healthy living and NCD prevention.

Examples of such programmes include the anti-smoking campaign, physical activity (10 000 Steps) campaign, weight management programmes and disease-based awareness campaigns (CVD, diabetes and cancers). As a crude estimate, it was assumed that this amount (RM 6.01 million) was assigned evenly across each of the three selected NCD categories (RM 2 million each).

8.2 Ambulance transfers

The cost of ambulance transfers for patients admitted to hospital are included in the Casemix data used in Chapter 2. This component would cover a large proportion of ambulance usage, given that ambulances typically prioritize acute patients. However, the Casemix data do not cover ambulance transfers for patients requiring care outside the hospital system. No data are available on the usage of, or expenditure on, ambulances for non-admitted patients or for ambulance transport to private hospitals.

8.3 Payments to the National Heart Institute of Malaysia

The Institut Jantung Negara, or the National Heart Institute of Malaysia, was established in 1992 as a specialized institution committed to delivering advanced standards in cardiovascular and thoracic treatments for adult and paediatric patients with heart diseases. MoH provides subsidies for Malaysian citizens who are entitled (that is, the poor and less fortunate, civil servants and retired civil servants) to receive treatment at the Institute. The subsidy covered 232 237 patients and amounted to RM 465.08 million in 2017 *(8)*. The cost of treating private patients, those not subsidized by MoH, was not included due to the lack of available data.

9. COST BY NCD CATEGORY

Table 16 brings together all cost components and reports them by each of the NCD categories for 2017.

It should be noted that in this summary table, deductions were made to hospitalization costs to avoid double counting. As mentioned previously in sections 4.1 and 5.1, 15.8% and 10% of hospitalization costs were deducted to account for medications and medical tests administered to admitted patients, respectively. For the same reason, some RM 58 165 805 expended on renal dialysis for admitted patients (recorded under hospitalizations) was deducted from primary and outpatient attendances in the final summing of costs.

THE TOTAL COSTS FOR THE 3 NCD CATEGORIES ACCOUNTED FOR 16.8% OF THE TOTAL HEALTH EXPENSES.

The total of direct health-care costs for the three NCD categories in 2017 was an estimated RM 9.65 billion, accounting for 16.8% of total health expenditures. The largest components of the total costs were primary care and outpatient attendances, which accounted for RM 4.20 billion, or 43.48% of the total, and medications RM 1.72 billion, or 17.86% of total costs, followed closely by medical tests RM 1.67 billion, or 17.34%.

The total costs equated to a cost per head of the 2017 Malaysian population of RM 301.37. Primary care and outpatient attendances accounted for a cost of RM 131.05 per capita, followed by medications RM 53.83 and medical tests RM 52.26.

The distribution of costs by different cost components varies markedly between the three NCD categories. This is discussed for each of the three NCD categories in the following sections.

9.1 Cardiovascular disease

The estimated total health-care cost of CVD in 2017 was RM 3.93 billion, which equated to 40.73% of the total costs. Primary care and outpatient attendances accounted for 25.90% of this expenditure, followed by medical tests 22.89% and medications 20.17%.

9.2 Diabetes

The estimated total health-care cost of diabetes in 2017 was RM 4.38 billion, which amounted to 45.38% of the total costs of all three NCD categories. However, the distribution of total diabetes costs varied markedly to the other two NCD categories. Nearly all of the cost was attributed to primary care and outpatient attendances (70.56%).

Hospitalizations for diabetes are very low, accounting for only 2.18% of total hospitalizations. Many of the admissions for cardiovascular events are likely to be a consequence of patients' underlying diabetes, but they are classified on the basis of their principal diagnosis at time of discharge. It is not uncommon for diabetes to be under-represented in hospitalization data.

As an illustration, the Australian Institute of Health and Welfare reported that in 2017–2018, there were 1.2 million hospital admissions in Australia associated with diabetes. However, only 5% of them had a principal diagnosis of

diabetes, while 95% recorded diabetes as a co-existing condition that would affect their management during hospitalization *(29)*. Other studies, including one in Australia, have also reported the low proportion of hospitalizations recording diabetes as the principal diagnosis *(30,31)*.

9.1 Cancer

The estimated total health-care cost for cancer in 2017 was RM 1.34 billion, which was equal to 13.89% of total costs for the three NCD categories. The fact that the bulk of care for cancer patients occurs within the hospital system is reflected in the high hospitalization expenditure (RM 727.73 million, or 54.30% of total cancer costs). Medications accounted for the second largest component of costs (RM 408.10 million, or 30.45%).

TABLE 16. Total costs of selected NCD categories by cost category, Malaysia 2017

NCD category	Hospitalizations (less inpatient medication costs)[a]	Primary care consultations	Medications	Medical tests	Medical consumables	Traditional and complementary medicine	Others[b]	TOTAL (RM)	Percentage of total (%)
RM									
Cardiovascular disease	752 722 830	1 017 953 288	792 875 850	899 828 279	—	465 741	467 083 150	3 930 929 140	40.73
Diabetes	95 396 934	3 090 371 022	522 847 280	661 261 433	7 836 425	2776	2 003 150	4 379 719 021	45.38
Cancer	727 729 466	88 098 934	408 099 030	112 334 123	—	1 843 590	2 003 150	1 340 108 293	13.89
TOTAL costs (RM)	**1 575 849 230**	**4 196 423 244**	**1 723 822 160**	**1 673 423 835**	**7 836 425**	**2 312 107**	**471 089 450**	**9 650 756 454**	**100.00**
PERCENTAGE (%)									
Cardiovascular disease	19.15	25.90	20.17	22.89	0.00	0.01	11.88	100.00	
Diabetes	2.18	70.56	11.94	15.10	0.18	0.00	0.05	100.00	
Cancer	54.30	6.57	30.45	8.38	0.00	0.14	0.15	100.00	
Percentage of total (%)	**16.33**	**43.48**	**17.86**	**17.34**	**0.08**	**0.02**	**4.88**	**100.00**	
Cost per capita[c] (RM)	**49.21**	**131.05**	**53.83**	**52.26**	**0.24**	**0.07**	**14.71**	**301.37**	

RM: Malaysian ringgit

a. 15.8% of hospitalization costs attributable to inpatient medication costs have been deducted as they are already counted under "Medications". A further 10% of hospitalization costs have been deducted to account for routine medical tests performed in hospitals. RM 58 165 805 have been deducted from primary care to account for renal dialysis provided to admitted patients.

b. Others include health promotion and payments to National Heart Institute of Malaysia.

c. Cost per head of 2017 Malaysian population.

Source: Data for this table was was compiled from Tables 2, 7, 11, 14 and 15.

10. CONCLUSIONS

This report quantifies the direct health-care costs that stem from the three largest categories of NCDs in Malaysia, namely CVD, diabetes and cancer. The costs are those that arise from hospitalizations, primary care and outpatient attendances, as well as medications, medical tests, medical consumables, traditional and complementary medicine (T&CM), and health promotion.

The cost estimates were compiled using a variety of methods. In several instances, MoH was able to provide complete records for a cost component, such as Casemix data itemizing inpatient costs, and expenditure totals for specific drugs. In other cases, cost estimates had to be built using a from-the-ground-up approach; such was the case for the costing of medical tests. In most instances, data were only available for MoH facilities (or a proportion of them), which were extrapolated to estimate expenditure in private facilities. Estimated unit costs in the public sector were calculated using the two private sector fee schedules as a starting point. Any assumptions made were based on the best evidence available.

Great reliance was placed on the ongoing support of officers from MoH and the WHO country office, who comprised the working group. Given that the project was being conducted remotely without any opportunity for in-country data collection, the research team conducted regular videoconference calls with the working group to discuss each cost component, to source the best available data and to ensure that they (the research team) correctly understood and interpreted that data. Despite the best efforts of the research team and the working group, there are still a number of significant items that have been excluded from the costing because of the lack of readily accessible data. The most notable of these are hospitalizations in two university teaching hospitals and all military hospitals; admissions to rehabilitation and long-term care facilities; day care and ambulatory care; outpatient rehabilitation services and allied health services; antibiotics, painkillers to treat complications of NCDs, but not specific to NCDs; electrocardiograms in outpatient settings; liver function tests and blood investigations for tumour markers; medical consumables; and T&CM encounters in private facilities.

The total estimated direct health-care costs totalled RM 9.65 billion accounted for 16.8% of total health expenditures in 2017. This equates to a per capita cost for the national population of RM 301.37.

The proportion of health spending attributed to these NCD categories was relatively small compared to 26% of total health expenditures, which were on average allocated for NCDs across 51 low- and middle-income countries *(32)*. However, this comparison should be interpreted with caution since the cost estimates are intended to reflect actual expenditures on the three selected NCDs in 2017. Also, the estimates only cover the diagnosed and treated population. They do not cover patients with one or more of the three NCDs who are either undiagnosed or diagnosed but not being treated. For example, application of the WHO CVD risk charts *(33)* and the WHO *Package of Essential Noncommunicable (PEN) Disease Interventions for Primary Care (34)* to the Malaysia population suggests that there are large numbers of the population with NCD risk factors who are not receiving appropriate treatment or management.

This study constitutes a cost-of-illness study. It set out to establish the magnitude of the burden imposed by the three NCD categories.

A limitation of such a study is that it does not provide any indication of the specific interventions required to lessen the prevalence or burden of NCDs. The latter would require economic evaluations of multiple potential interventions to determine their cost-effectiveness credentials within the Malaysian setting.

When these estimated direct health-care costs are coupled with the lost productivity costs of RM 12.88 billion estimated in our previous report in 2020 *(5),* the combined cost burden of the three NCD categories is RM 22.53 billion to the Malaysian economy. This is the equivalent of 1.56% of Malaysia's 2017 GDP *(6).* This proportion is small, which in part is due to the fact that not all NCDs are being costed in our study. It also is likely to reflect the insufficient resources being invested in the prevention and early diagnosis of NCDs. As a result, many people with NCD risk factors remain undiagnosed and untreated. The picture is the same for many countries in South-East Asia where government health expenditures as a percentage of GDP are generally very low *(35).* Any future investment in prevention and early diagnosis is likely to provide a positive return on investment from reduced hospitalization and productivity costs.

Given Malaysia's ageing population, the health and economic burden of NCDs can be expected to worsen over time. NCDs will continue to consume an increasing share of national health expenditure. The country's broader economy will continue to be impacted through loss of production due to disability or death of working age people. Financial hardship will be increasingly experienced at the individual household level through loss of income, and carer and support roles. The recent coronavirus pandemic has also accentuated concern about the prevalence of CVD and diabetes in particular, given that people with these comorbidities are more likely to experience worse coronavirus outcomes *(36,37).*

Yet NCDs are largely preventable and avoidable and arise through behavioural risk factors such as physical inactivity, tobacco smoking, excess alcohol consumption and poor diet. As recommended by a recent panel from countries of the Association of Southeast Asian Nations *(35),* Malaysia – like other countries in the region – needs to place greater focus on gaps in policy, particularly around inadequate surveillance of NCDs and their risk factors, lack of trained health-care personnel and limited primary care capacity. Greater investment is required in prevention, including health promotion around healthy lifestyles, and the capacity of the primary care system to provide essential preventive interventions for NCDs, through comprehensive implementation of the WHO PEN package.

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ANNEXES

ANNEX 1. Average cost of hospitalizations by sector and by disease condition, Malaysia 2017

ICD-10 codes		DISEASE	Average length of stay (in days)	Average cost of hospitalization (RM)	
				PUBLIC	PRIVATE
CARDIOVASCULAR DISEASE					
I00–102	I00	Acute rheumatic fever	7.12	3 956.74	11 914.65
	I01		8.71	4 556.67	13 721.20
	I02		8.00	4 556.67	13 721.20
I05–I09	I05	Chronic rheumatic heart diseases	4.53	4 596.71	13 841.74
	I06		3.54	4 596.71	13 841.74
	I07		5.80	4 596.71	13 841.74
	I08		3.70	4 596.71	13 841.74
	I09		6.46	4 556.67	13 721.20
I10–I15	I10	Hypertensive diseases	2.58	2 491.99	7 503.06
	I11		2.76	2 491.99	7 503.96
	I12		3.62	3 113.74	9 376.20
	I13		5.31	3 876.83	11 674.04
	I15		3.03	2 491.99	7 503.96
I20–I25	I20	Ischaemic heart diseases	2.63	3 376.96	10 168.82
	I21		4.42	3 376.96	10 168.82
	I22		3.71	4 556.67	13 721.20
	I23		3.54	5 312.02	15 995.73
	I24		2.68	3 190.24	9 606.55
	I25		4.66	5 805.43	17 481.49
I26–I28	I26	Pulmonary heart disease and diseases of pulmonary circulation	10.45	7 830.37	23 579.06
	I27		5.30	5 220.92	15 721.40
	I28		1.80	4 556.67	13 721.20
I30–I52	I30	Other forms of heart disease	3.00	3 903.53	11 754.42
	I31		4.02	3 903.53	11 754.42
	I33		25.12	25 602.36	77 094.64
	I34		5.09	4 596.71	13 841.74
	I35		4.02	5 438.24	16 375.79
	I36		3.00	5 438.24	16 375.79
	I37		1.75	4 596.71	13 841.74
	I38		7.70	4 596.71	13 841.74
	I40		6.71	4 717.95	14 206.83

ICD-10 codes		DISEASE	Average length of stay (in days)	Average cost of hospitalization (RM)	
				PUBLIC	PRIVATE
CARDIOVASCULAR DISEASE *(continued)*					
I30–I52	Other forms of heart disease *(continued)*				
	I41		1.50	4 717.95	14 206.83
	I42		5.18	4 717.95	14 206.83
	I44		4.24	3 335.23	10 043.13
	I45		4.53	3 130.80	9 427.57
	I46		7.77	6 685.79	20 132.45
	I47		2.70	3 130.80	9 427.57
	I48		3.31	3 335.23	10 043.13
	I49		3.01	3 130.80	9 427.57
	I50		4.20	4 038.18	12 159.90
	I51		4.48	5 312.02	15 995.73
I60–I69	I60	Cerebrovascular diseases	4.99	3 691.03	11 114.54
	I61		7.08	4 326.64	13 028.51
	I62		5.33	3 691.03	11 114.54
	I63		4.35	4 326.64	13 028.51
	I64		4.02	3 028.98	9 120.95
	I65		3.92	3 028.98	9 120.95
	I66		5.12	3 028.98	9 120.95
	I67		5.02	4 326.64	13 028.51
	I68		27.33	4 326.64	13 028.51
	I69		4.01	4 326.64	13 028.51
I70–I79	I70	Diseases of arteries, arterioles and capillaries	5.88	4 822.55	14 521.82
	I71		4.53	4 822.55	14 521.82
	I72		4.77	3 972.67	11 962.62
	I73		4.93	3 972.69	11 962.62
	I74		4.88	3 972.69	11 962.62
	I77		5.30	4 822.55	14 521.82
	I78		2.50	3 972.67	11 962.62
I95–I99	I95	Other and unspecified disorders of the circulatory system	3.49	5 312.02	15 995.73
	I97		3.25	5 312.02	15 995.73
	I98		18.00	11 690.60	35 203.10
	I99		5.70	4 556.67	13 721.20

ICD-10 codes		DISEASE	Average length of stay (in days)	Average cost of hospitalization (RM)	
				PUBLIC	PRIVATE
DIABETES					
E10	E10	Type 1 diabetes mellitus	4.66	3 593.72	10 821.53
E11–E14	E11	Type 2 diabetes mellitus	4.20	3 706.17	11 160.13
	E12		4.00	3 706.17	11 160.13
	E13		6.86	3 593.72	10 821.53
	E14		4.16	3 593.72	10 821.53
N08.3		Diabetic nephropathy	5.24	3 876.83	11 674.04
H28.0		Diabetic cataract	2.01	2 397.29	7 218.81
H36.0		Diabetic retinopathy	2.37	2 500.42	7 529.35
G73.0		Diabetes amyotrophy	6.50	3 593.72	10 821.53
G99.0		Diabetes autonomic neuropathy	4.25	3 178.07	9 569.89
G59.0		Diabetic mononeuropathy	3.82	3 178.07	9 569.89
G63.2		Diabetic polyneuropathy	4.00	3 261.99	9 822.62
I79.2		Diabetic peripheral angiopathy	9.50	5 836.85	17 576.11
M14.2		Diabetic arthropathy	5.38	3 593.72	10 821.53
M14.6		Neuropathic diabetic arthropathy	9.07	3 706.17	11 160.13
S88		Traumatic amputation of lower leg	8.63	5 836.85	17 576.11
S89		Other and unspecified injuries of lower leg	9.69	6 923.27	20 847.58
Z49.0		Encounters for care involving renal dialysis	4.10	3 876.83	11 674.04
CANCER					
— MALIGNANT NEOPLASMS					
C00–C14	C00	Cancers of lip, oral cavity and pharynx	3.50	8 417.34	25 346.56
	C01		10.10	8 417.34	25 346.56
	C02		8.57	8 417.34	25 346.56
	C03		4.15	8 417.34	25 346.56
	C04		6.08	8 417.34	25 346.56
	C05		9.38	8 417.34	25 346.56
	C06		6.72	8 417.34	25 346.56
	C07		5.53	8 417.34	25 346.56
	C08		15.33	8 417.34	25 346.56
	C09		7.04	8 417.34	25 346.56
	C10		8.23	8 417.34	25 346.56
	C11		7.63	8 417.34	25 346.56
	C12		6.33	8 417.34	25 346.56

ICD-10 codes		DISEASE	Average length of stay (in days)	Average cost of hospitalization (RM)	
				PUBLIC	PRIVATE
— MALIGNANT NEOPLASMS *(continued)*					
C00–C14	C13		7.69	8 417.34	25 346.56
	C14		4.90	8 417.34	25 346.56
C15	C15	Cancer of oesophagus	5.88	4 461.51	13 434.63
C16	C16	Cancer of stomach	5.88	4 461.51	13 434.63
C17	C17	Cancer of small intestine	4.80	4 461.51	13 434.63
C18	C18	Cancer of colon	3.41	4 461.51	13 434.63
C19–C21	C19	Cancers of rectum and anal canal	4.06	4 461.51	13 434.63
	C20		4.89	4 461.51	13 434.63
	C21		4.41	4 461.51	13 434.63
C22	C22	Cancers of liver and intrahepatic bile ducts	4.72	4 338.01	13 062.76
C23–C24	C23	Cancers of gallbladder and biliary tract	4.74	4 338.01	13 062.76
	C24		5.60	4 338.01	13 062.76
C25–C26	C25	Cancers of pancreas and other digestive organs	4.79	4 338.01	13 062.76
	C26		4.25	4 461.51	13 434.63
C30–C31	C30	Cancers of nasal cavity, middle ear and sinuses	6.63	8 417.34	25 346.56
	C31		7.26	8 417.34	25 346.56
C32	C32	Cancer of larynx	7.93	8 417.34	25 346.56
C33	C33	Cancer of trachea	4.50	4 804.21	14 466.58
C34–C39	C34	Cancers of trachea, bronchus and lung	4.51	4 804.21	14 466.58
	C37		5.29	4 774.67	14 377.65
	C38		5.96	4 804.21	14 466.58
	C39		3.25	6 459.91	19 452.29
C40–C41	C40	Cancer of bone	4.10	4 662.54	14 039.99
	C41		4.87	4 662.54	14 039.99
C43–C44	C43	Cancer of skin	5.37	5 280.65	14 039.99
	C44		6.29	2 592.99	7 808.09
C45–C49	C45	Cancers of mesothelial and soft tissue	1.75	4 461.51	13 434.63
	C46		5.35	2 592.99	7 808.09
	C47		3.64	4 662.54	14 039.99
	C48		2.95	4 461.51	13 434.63
	C49		5.53	4 662.54	14 039.99
C50	C50	Cancer of breast	4.16	4 912.76	14 793.47

ICD-10 codes		DISEASE	Average length of stay (in days)	Average cost of hospitalization (RM)	
				PUBLIC	PRIVATE
— MALIGNANT NEOPLASMS *(continued)*					
C51–C58	C51	Cancers of female genital organs (including cancer of cervix)	5.70	3 736.50	11 251.47
	C52		6.66	3 736.50	11 251.47
	C53		6.21	3 736.50	11 251.47
	C54		3.93	3 736.50	11 251.47
	C55		4.18	3 736.50	11 251.47
	C56		2.82	3 736.50	11 251.47
	C57		2.56	3 736.50	11 251.47
	C58		3.38	3 736.50	11 251.47
C60–C63	C60	Cancers of male genital organs (including cancer of prostate)	4.75	5 741.19	17 288.04
	C61		5.89	5 741.19	17 288.04
	C62		4.86	5 741.19	17 288.04
	C63		5.83	5 741.19	17 288.04
C64–C68	C64	Cancers of urinary tract	4.10	3 709.70	11 170.76
	C65		4.75	3 709.70	11 170.76
	C66		5.59	3 709.70	11 170.76
	C67		4.37	3 709.70	11 170.76
	C68		7.29	3 709.70	11 170.76
C69–C72	C69	Cancers of eye, brain and other parts of central nervous system	2.38	3 412.98	10 277.27
	C70		2.64	5 063.08	15 246.11
	C71		5.97	5 063.08	15 246.11
	C72		4.69	5 063.08	15 246.11
C73–C75	C73	Cancers of thyroid and other endocrine glands	3.83	4 880.49	14 696.29
	C74		4.22	4 880.49	14 696.29
	C75		5.40	5 063.08	15 246.11
C76–C80	C76	Cancers of ill-defined, secondary and unspecified sites	5.31	8 417.34	25 346.56
	C77		3.63	4 774.67	14 377.65
	C78		3.65	4 461.51	13 434.63
	C79		6.22	4 774.67	14 377.65
	C80		5.42	4 774.67	14 377.65
C81–C97	C81	Cancers of lymphoid, haematopoietic and related tissue	4.30	4 362.16	13 135.46

ICD-10 codes		DISEASE	Average length of stay (in days)	Average cost of hospitalization (RM)	
				PUBLIC	PRIVATE
— MALIGNANT NEOPLASMS *(continued)*					
C81–C97	C82		3.11	4 362.16	13 135.46
	C83		6.27	4 362.16	13 135.46
	C84		6.31	4 362.16	13 135.46
	C85		6.49	4 362.16	13 135.46
	C86		6.46	4 362.16	13 135.46
	C88		5.69	4 362.16	13 135.46
	C90		5.60	4 362.16	13 135.46
	C91		6.17	5 428.16	16 345.46
	C92		10.02	5 428.16	16 345.46
	C93		2.50	4 362.16	13 135.46
	C94		6.83	4 774.67	14 377.65
	C95		5.55	5 428.16	16 345.46
	C96		3.90	4 774.67	14 377.65
	C97		3.71	6 085.54	18 324.98
— OTHER NEOPLASMS (IN SITU AND BENIGN)					
D00–D48	D00	In situ and benign neoplasms of uncertain or unknown behaviour	3.43	4 461.51	13 434.63
	D01		2.88	4 461.51	13 434.63
	D02		1.00	8 417.34	25 346.56
	D03		1.38	2 592.99	7 808.09
	D04		4.83	2 592.99	7 808.09
	D05		3.22	4 912.76	14 793.47
	D06		2.86	3 736.50	11 251.47
	D07		3.03	3 736.50	11 251.47
	D09		2.96	4 774.67	14 377.65
	D10		2.00	2 478.09	7 462.12
	D11		4.58	5 084.23	15 309.78
	D12		3.62	2 589.37	7 797.18
	D13		4.43	3 485.49	10 495.63
	D14		3.35	2 478.09	7 462.12
	D15		3.44	3 849.05	11 590.37
	D16		4.90	2 351.14	7 079.82
	D17		2.05	2 592.99	7 808.09
	D18		4.45	4 556.67	13 721.20

ICD-10 codes		DISEASE	Average length of stay (in days)	Average cost of hospitalization (RM)	
				PUBLIC	PRIVATE
— OTHER NEOPLASMS *(continued)*					
	D18		4.45	4 556.67	13 721.20
	D19		1.00	4 774.67	14 377.65
	D20		3.67	2 589.37	7 797.18
	D21		3.60	2 778.37	8 366.31
	D22		1.44	2 592.99	7 809.09
	D23		2.30	2 592.99	7 809.09
	D24		1.66	2 592.99	7 809.09
	D25		2.60	2 205.63	6 641.66
	D26		2.18	2 205.63	6 641.66
	D27		3.10	2 205.63	6 641.66
	D28		3.00	2 205.63	6 641.66
	D29		3.43	2 179.08	6 561.71
	D30		3.87	3 709.70	11 170.76
	D31		2.20	3 412.98	10 277.27
	D32		6.88	5 449.60	16 409.99
	D33		5.06	5 449.60	16 409.99
	D34		3.62	4 259.48	12 826.28
	D35		4.47	4 880.49	14 696.29
	D36		1.99	4 774.67	14 377.65
	D37		5.60	2 589.37	7 797.18
	D38		2.94	4 804.21	14 466.58
	D39		3.60	3 736.50	11 251.47
	D40		3.86	2 179.08	6 561.71
	D41		3.36	3 709.70	11 170.76
	D42		8.57	5 449.60	16 409.99
	D43		4.33	5 449.60	16 409.99
	D44		4.93	4 880.49	14 696.99
	D45		1.64	2 678.26	8 064.85
	D46		4.87	4 774.67	14 377.65
	D47		4.25	2 678.26	8 064.85
	D48		3.79	2 778.37	8 366.31

ICD-10: International Statistical Classification of Diseases and Related Health Problems – RM: Malaysian ringgit

Source: International Statistical Classification of Diseases and Related Health Problems (ICD-10), Tenth Revision, Fifth ed. Geneva: World Health Organization; 2016. Available from: https://apps.who.int/iris/handle/10665/246208.

ANNEX 2. Pharmaceutical costs by drug type, cardiovascular disease, Malaysia 2017

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
1	C01AA05	Digoxin	369 310	204 640	130 610	50 070	369 290	573 950	549 970	**1 123 920**	0.20	0.41	**0.27**
2	C01BB01	Lidocaine	466 150	10 240	820 620	64 430	54 420	476 390	939 470	**1 415 860**	27.16	55.30	**41.00**
3	C01BC03	Propafenone	0	0	13 950	9 530	74 650	0	98 130	**98 130**	—	2.85	**2.85**
4	C01BC04	Flecainide	99 660	25 870	255 330	71 090	663 170	125 530	989 590	**1 115 120**	9.00	10.49	**10.30**
5	C01BD01	Amiodarone	584 500	153 410	733 970	542 310	94 150	737910	1 370 430	**2 108 340**	2.66	1.90	**2.11**
6	C01BD07	Dronedarone	0	0	80 660	28 230	170 110	0	279 000	**279 000**	—	11.91	**11.91**
7	C01CA02	Isoprenaline	33 370	5 810	0	0	0	39 180	0	**39 180**	8 258.41	—	**8 258.41**
8	C01CA03	Norepinephrine	5 474 620	56 990	1 447 110	3 870	104 170	5 531 610	1 555 150	**7 086 760**	5.81	44.79	**7.18**
9	C01CA04	Dopamine	367 900	6 230	254 500	5 390	69 360	374 130	329 250	**703 380**	6.81	19.48	**9.79**
10	C01CA06	Phenylephrine	140 020	1 810	12 490	0	0	141 830	12 490	**154 320**	5.48	3.95	**5.31**
11	C01CA07	Dobutamine	1 290 190	12 170	415 780	860	45 100	1 302 360	461 740	**1 764 100**	17.95	83.80	**22.60**
12	C01CA24	Epinephrine	2 039 570	42 080	416 650	50 650	82 210	2 081 650	549 510	**2 631 160**	0.72	1.26	**0.79**
13	C01CA26	Ephedrine	110 600	230	114 360	15 750	4 970	110 830	135 080	**245 910**	1.26	2.92	**1.83**
14	C01CE02	Milrinone	98 550	23 650	69 640	0	0	122 200	69 640	**191 840**	484.89	570.83	**512.92**
15	C01DA02	Glyceryl trinitrate	1 492 010	415 410	625 960	46 020	325 720	1 907 420	997 700	**2 905 120**	0.62	1.58	**0.78**
16	C01DA08	Isosorbide dinitrate	523 150	345 730	358 970	43 030	45 010	868 880	447 010	**1 315 890**	0.13	2.93	**0.20**
17	C01DA14	Isosorbide mononitrate	460 590	516 190	307 080	173 970	879 820	976 780	1 360 870	**2 337 650**	0.32	0.73	**0.47**

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
18	C01EA01	Alprostadil	2 707 560	0	72 040	0	9 020	2 707 560	81 060	**2 788 620**	1 775.45	1 801.43	**1 776.19**
19	C01EB10	Adenosine	517 620	192 640	441 580	31 560	29 290	710 260	502 430	**1 212 690**	115.60	190.66	**138.13**
20	C01EB15	Trimetazidine	4 373 370	1 468 250	3 224 500	1 679 580	5 590 770	5 841 620	10 494 850	**16 336 470**	0.22	1.20	**0.46**
21	C01EB17	Ivabradine	6 860 600	99 040	2 621 060	612 080	3 548 250	6 959 640	6 781 390	**13 741 030**	3.48	5.16	**4.15**
22	C01EB18	Ranolazine	0	0	414 330	121 300	247 560	0	783 190	**783 190**	—	10.76	**10.76**
23	C02AB01	Methyldopa (levorotatory)	560 330	960 260	62 650	20 390	66 010	1 520 590	149 050	**1 669 640**	0.91	1.16	**0.93**
24	C02AC05	Moxonidine	150	0	844 220	339 740	1 147 620	150	2 331 580	**2 331 730**	1.32	2.12	**2.12**
25	C02CA01	Prazosin	4 047 390	6 398 430	160 410	36 640	410 850	10 445 820	607 900	**11 053 720**	0.46	1.93	**0.48**
26	C02CA04	Doxazosin	1 737 140	26 860	770 780	430 860	2 492 630	1 764 000	3 694 270	**5 458 270**	0.29	2.16	**0.69**
27	C02DB02	Hydralazine	114 930	52 020	9 730	0	0	166 950	9 730	**176 680**	15.01	16.09	**15.07**
28	C02DC01	Minoxidil	43 730	9 060	0	0	7 120	52 790	7 120	**59 910**	3.85	4.45	**3.92**
29	C02KX01	Bosentan	36 940	0	34 230	107 040	69 000	36 940	210 270	**247 210**	307.79	350.44	**343.34**
30	C02KX05	Riociguat	0	0	0	0	105 250	0	105 250	**105 250**	—	214.80	**214.80**
DIURETICS													
31	C03AA03	Hydro-chlorothiazide	955 330	5 812 050	6 280	190 720	259 010	6 767 380	456 010	**7 223 390**	0.05	0.08	**0.06**
32	C03BA08	Metolazone	291 850	0	0	0	0	291 850	0	**291 850**	0.25	—	**0.25**
33	C03BA11	Indapamide	140	0	148 230	1 251 030	1 487 360	140	2 886 620	**2 886 760**	1.94	0.63	**0.63**
34	C03BD01	Theobromine	0	0	420	380	64 150	0	64 950	**64 950**	—	5.82	**5.82**

ANNEX 2. Pharmaceutical costs by drug type, cardiovascular disease, Malaysia 2017 *(continued)*

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
35	C03CA01	Furosemide	2 636 860	783 490	1 503 190	181 690	1 145 400	3 420 350	2 830 280	**6 250 630**	0.06	0.47	**0.10**
36	C03CA02	Bumetanide	210 880	14 990	535 370	29 120	169 600	225 870	734 090	**959 960**	2.52	1.59	**1.74**
37	C03DA01	Spironolactone	1 020 680	344 570	426 250	139 080	642 560	1 365 250	1 207 890	**2 573 140**	0.38	0.82	**0.51**
38	C03DA04	Eplerenone	24 450	0	134 330	11 400	170 570	24 450	316 300	**340 750**	4.91	5.12	**5.11**
39	C03EA01	Hydro-chlorothiazide & potassium-sparing agents	57 220	488 710	16 710	74 740	82 990	545 930	174 440	**720 370**	0.09	0.14	**0.10**
40	C04AD03	Pentoxifylline	282 520	46 550	258 160	52 330	343 600	329 070	654 090	**983 160**	1.39	4.69	**2.62**
41	C04AE01	Ergoloid mesylates	4 910	6 730	0	0	0	11 640	0	**11 640**	0.84	—	**0.84**
BETA BLOCKING AGENTS													
42	C07AA05	Propranolol	728 950	657 330	361 710	101 140	694 640	1 386 280	1 157 490	**2 543 770**	0.52	1.03	**0.67**
43	C07AA07	Sotalol	81 790	0	109 300	0	21 130	81 790	130 430	**212 220**	1.36	1.04	**1.14**
44	C07AB02	Metoprolol	6 831 690	16 391 450	383 710	148 590	1 128 060	23 223 140	1 660 360	**24 883 500**	0.28	0.47	**0.29**
45	C07AB03	Atenolol	1 137 540	6 708 050	507 920	1 573 780	4 221 430	7 845 590	6 303 130	**14 148 720**	0.11	0.35	**0.16**
46	C07AB05	Betaxolol	0	0	10 700	105 830	284 120	0	400 650	**400 650**	—	1.33	**1.33**
47	C07AB07	Bisoprolol	2 673 340	2 777 370	4 329 830	4 494 850	12 775 680	5 450 710	21 600 360	**27 051 070**	0.26	2.56	**0.92**
48	C07AB09	Esmolol	88 640	10 540	5 020	0	0	99 180	5 020	**104 200**	1 137.86	1 063.57	**1 134.04**
49	C07AB12	Nebivolol	0	0	882 310	1 531 740	1 186 840	0	3 600 890	**3 600 890**	—	1.30	**1.30**

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
50	C07AG01	Labetalol	3 984 210	690 330	576 090	57 940	176 140	4 674 540	810 170	**5 484 710**	6.12	5.92	**6.09**
51	C07AG02	Carvedilol	200 860	157 740	532 040	199 550	1 322 170	358 600	2 053 760	**2 412 360**	0.43	2.36	**1.42**
52	C07BB07	Bisoprolol and thiazides	0	0	55 960	348 170	296 560	0	700 690	**700 690**	—	1.26	**1.26**
53	C07CB03	Atenolol, other diuretics	0	0	12 190	624 540	761 950	0	1 398 680	**1 398 680**	—	0.51	**0.51**
CALCIUM CHANNEL BLOCKERS													
54	C08CA01	Amlodipine	3 223 170	10 790 540	4 947 230	13 775 860	30 842 400	14 013 710	49 565 490	**63 579 200**	0.02	0.59	**0.09**
55	C08CA02	Felodipine	3 859 630	2 061 750	611 700	478 090	2 631 260	5 921 380	3 721 050	**9 642 430**	0.14	1.11	**0.21**
56	C08CA05	Nifedipine	232 290	780 680	813 910	687 480	2 926 850	1 012 970	4 428 240	**5 441 210**	0.07	1.10	**0.28**
57	C08CA06	Nimodipine	131 100	9 290	92 350	3 050	20 450	140 390	115 850	**256 240**	26.25	54.43	**34.27**
58	C08CA09	Lacidipine	0	0	910	18 400	259 010	0	40 090	**40 090**	—	1.81	**1.81**
59	C08CA13	Lercanidipine	0	0	505 530	318 410	0	0	2 138 100	**2 138 100**	—	1.35	**1.35**
60	C08DA01	Verapamil	393 320	130 910	296 990	36 080	1 487 360	524 230	809 410	**1 333 640**	1.13	3.01	**1.82**
61	C08DB01	Diltiazem	1 760 800	1 239 450	738 460	161 480	64 150	3 000 250	1 704 120	**4 704 370**	1.19	2.07	**1.41**
62	C08GA02	Amlodipine and diuretics	0	0	127 580	334 780	1 145 400	0	580 170	**580 170**	—	1.58	**1.58**
AGENTS ACTING ON THE RENIN-ANGIOTENSIN SYSTEM													
63	C09AA01	Captopril	154 110	448 200	4 380	16 130	31 490	602 310	52 000	**654 310**	0.07	0.81	**0.08**
64	C09AA02	Enalapril	697 270	3 126 310	106 460	884 160	1 200 580	3 823 580	2 191 200	**6 014 780**	0.07	0.46	**0.10**
65	C09AA03	Lisinopril	0	0	90 750	531 050	1 329 390	0	1 951 190	**1 951 190**	—	0.73	**0.73**

ANNEX 2. Pharmaceutical costs by drug type, cardiovascular disease, Malaysia 2017 *(continued)*

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
66	C09AA04	Perindopril	5 807 750	17 753 770	1 642 990	3 320 880	7 595 950	23 561 520	12 559 820	**36 121 340**	0.07	0.66	**0.10**
67	C09AA05	Ramipril	324 970	129 680	208 410	235 110	778 900	454 650	1 222 420	**1 677 070**	0.32	0.62	**0.50**
68	C09AA16	Imidapril	0	0	0	0	65 880	0	65 880	**65 880**	—	1.54	**1.54**
69	C09BA04	Perindopril and diuretics	310 330	632 230	231 360	1 039 810	1 506 880	942 560	2 778 050	**3 720 610**	0.37	1.46	**0.83**
70	C09BB04	Perindopril and Amlodipine	0	0	2 129 340	4 791 390	7 413 180	0	14 333 910	**14 333 910**	—	2.27	**2.27**
71	C09BX01	Perindopril, Amlodipine and Indapamide	0	0	253 270	811 490	229 580	0	1 294 340	**1 294 340**	—	2.59	**2.59**
72	C09CA01	Losartan	1 107 870	1 506 020	2 440 110	4 387 400	8 568 480	2 613 890	15 395 990	**18 009 880**	0.09	1.15	**0.41**
73	C09CA03	Valsartan	3 121 790	2 020 770	985 810	2 103 750	5 161 950	5 142 560	8 251 510	**13 394 070**	0.71	1.33	**1.00**
74	C09CA04	Irbesartan	1 448 160	4 399 670	935 760	1 656 150	6 632 170	5 847 830	9 224 080	**15 071 910**	0.61	1.34	**0.91**
75	C09CA06	Candesartan	0	0	411 840	902 230	3 929 390	0	5 243 460	**5 243 460**		1.11	**1.11**
76	C09CA07	Telmisartan	2 550 730	2 919 400	2 088 410	5 692 180	10 210 940	5 470 130	17 991 530	**23 461 660**	0.43	1.49	**0.95**
77	C09CA08	Olmesartan Medoxomil	0	0	436 010	1 031 660	2 684 500	0	4 152 170	**4 152 170**	—	1.33	**1.33**
78	C09DA01	Losartan and diuretics	340 180	224 740	922 520	4 419 950	6 618 000	564 920	11 960 470	**12 525 390**	0.28	1.66	**1.36**
79	C09DA03	Valsartan and diuretics	443 790	454 500	506 880	2 436 990	6 015 220	898 290	8 959 090	**9 857 380**	0.96	1.90	**1.74**

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
80	C09DA04	Irbesartan and diuretics	726 730	764 570	476 720	1 941 990	5 151 260	1 491 300	7 569 970	**9 061 270**	1.00	2.15	**1.81**
81	C09DA06	Candesartan and diuretics	0	0	127 580	579 350	2 307 030	0	3 013 960	**3 013 960**	—	2.01	**2.01**
82	C09DA07	Telmisartan and diuretics	507 750	432 100	604 260	1 989 940	4 036 310	939 850	6 630 510	**7 570 360**	1.05	1.98	**1.78**
83	C09DA08	Olmesartan Medoxomil and diuretics	0	0	99 040	363 130	630 810	0	1 092 980	**1 092 980**	—	2.01	**2.01**
84	C09DB01	Valsartan and Amlodipine	495 320	287 620	2 872 190	8 879 740	17 256 090	782 940	29 008 020	**29 790 960**	1.00	2.31	**2.23**
85	C09DB02	Olmesartan Medoxomil and Amlodipine	0	0	720 720	1 798 870	2 704 470	0	5 224 060	**5 224 060**	—	2.01	**2.01**
86	C09DB04	Telmisartan and Amlodipine	836 190	1 140 240	2 348 570	10 065 240	6 278 130	1 976 430	18 691 940	**20 668 370**	1.15	2.16	**2.00**
87	C09DB06	Losartan and Amlodipine	30 120	7 970	1 578 580	6 363 130	415 870	38 090	8 357 580	**8 395 670**	0.90	2.69	**2.66**
88	C09DX01	Valsartan, Amlodipine and Hydro-chlorothiazide	55 730	413 090	729 850	2 770 440	4 172 350	468 820	7 672 640	**8 141 460**	1.00	2.42	**2.24**
89	C09DX04	Valsartan and Sacubitril	0	0	2 052 610	584 630	1 191 730	0	3 828 970	**3 828 970**	—	14.01	**14.01**
90	C09XA02	Aliskiren	7 200	0	17 230	58 470	85 300	7 200	161 000	**168 200**	1.29	2.37	**2.28**

ANNEX 2. Pharmaceutical costs by drug type, cardiovascular disease, Malaysia 2017 *(continued)*

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
LIPID MODIFYING AGENTS													
91	C10AA01	Simvastatin	6 608 920	15 777 840	2 209 400	3 822 280	7 986 230	22 386 760	14 017 910	**36 404 670**	0.09	0.51	**0.12**
92	C10AA02	Lovastatin	0	0	15 470	182 370	273 740	0	471 580	**471 580**	—	0.73	**0.73**
93	C10AA03	Pravastatin	181 930	55 170	33 510	50 610	80 980	237 100	165 100	**402 200**	0.35	0.79	**0.45**
94	C10AA04	Fluvastatin	0	0	21 470	16 580	140 900	0	178 950	**178 950**	—	1.97	**1.97**
95	C10AA05	Atorvastatin	7 645 060	1 899 390	19 331 140	16 358 140	36 648 520	9 544 450	72 337 800	**81 882 250**	0.10	1.68	**0.61**
96	C10AA07	Rosuvastatin	597 270	13 410	13 323 960	14 936 630	36 848 870	610 680	65 109 460	**65 720 140**	0.57	2.34	**2.28**
97	C10AB04	Gemfibrozil	1 880 020	3 827 040	0	79 790	129 920	5 707 060	209 710	**5 916 770**	0.80	1.72	**0.81**
98	C10AB05	Fenofibrate	1 471 690	504 100	2 451 100	4 959 690	7 886 420	1 975 790	15 297 210	**17 273 000**	1.38	2.66	**2.41**
99	C10AB08	Ciprofibrate	0	0	12 760	83 910	212 000	0	308 670	**308 670**	—	2.33	**2.33**
100	C10AC01	Colestyramine	24 590	3 430	0	0	0	28 020	0	**28 020**	1.79	—	**1.79**
101	C10BA02	Simvastatin and Ezetimibe	3 209 570	230 270	3 832 650	4 908 370	6 829 380	3 439 840	15 570 400	**19 010 240**	3.58	4.55	**4.33**
102	C10BA03	Pravastatin and Fenofibrate	0	0	3 240	14 880	14 860	0	32 980	**32 980**	—	2.78	**2.78**
103	C10BX03	Atorvastatin and Amlodipine	0	0	2 616 900	1 206 540	5 816 200	0	9 639 640	**9 639 640**	—	4.52	**4.52**
104	C01CA17	Midodrine	2 050	0	0	0	0	2 050	0	**2 050**	15.39	—	**15.39**
105	C01CX08	Levosimendan	113 660	0	0	0	0	113 660	0	**113 660**	1 887.18	—	**1 887.18**

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
106	C02KX04	Macitentan	0	0	259 350	0	0	0	259 350	**259 350**	—	411.67	**411.67**
107	C04AX02	Phenoxy-benzamine	26 880	0	0	0	0	26 880	0	**26 880**	7.61	—	**7.61**
108	C10AX09	Ezetimibe	7 183 640	616 180	1 571 890	1 234 020	3 480 640	7 799 820	6 286 550	**14 086 370**	3.13	3.48	**3.28**
109	C10BA05	Atorvastatin and Ezetimibe	0	0	1 120 860	1 044 540	3 820	0	2 169 220	**2 169 220**	—	4.68	**4.68**
TOTAL CARDIOVASCULAR PHARMACEUTICAL DRUG COSTS													
			113 273 390	**120 517 250**	**105 468 940**	**149 968 250**	**303 648 020**	**233 790 640**	**559 085 210**	**792 875 850**			

RM: Malaysian ringgit

Source: MoH Pharmacy Research and Development Branch.

ANNEX 3. Pharmaceutical costs by drug type, diabetes, Malaysia 2017

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
1	A10BA02	Metformin	16 403 900	59 960 850	3 268 370	7 972 280	14 818 810	76 364 750	26 059 460	**102 424 210**	0.36	0.95	**0.43**
2	A10BB01	Glibenclamide	191 850	1 749 090	31 030	237 370	580 250	1 940 940	848 650	**2 789 590**	0.11	0.13	**0.11**
3	A10BB07	Glipizide	0	0	31 930	26 970	303 740	0	362 640	**362 640**	—	1.03	**1.03**
4	A10BB09	Gliclazide	10 771 400	39 967 300	6 197 660	13 038 240	20 656 440	50 738 700	39 892 340	**90 631 040**	0.12	0.93	**0.19**
5	A10BB12	Glimepiride	0	0	319 560	664 800	2 422 760	0	3 407 120	**3 407 120**	—	1.23	**1.23**
6	A10BD02	Metformin and sulfonylureas	545 980	650 690	563 480	4 608 270	6 835 290	1 196 670	12 007 040	**13 203 710**	0.10	1.09	**0.59**
7	A10BD07	Metformin and Sitagliptin	631 070	20 050	10 756 150	13 791 030	25 712 820	651 120	50 260 000	**50 911 120**	2.47	5.12	**5.05**
8	A10BD08	Metformin and Vildagliptin	979 760	11 490	1 886 600	5 091 570	8 373 790	991 250	15 351 960	**16 343 210**	2.04	3.43	**3.29**
9	A10BD10	Metformin and Saxagliptin	51 990	0	1 472 680	2 111 130	3 746 370	51 990	7 330 180	**7 382 170**	1.34	2.75	**2.73**
10	A10BD11	Metformin and Linagliptin	0	0	1 410 950	7 413 010	1 663 620	0	10 487 580	**10 487 580**	—	3.02	**3.02**
11	A10BD15	Metformin and Dapagliflozin	0	0	1 888 370	2 389 470	1 474 250	0	5 752 090	**5 752 090**	—	3.33	**3.33**
12	A10BF01	Acarbose	904 150	1 353 720	242 460	225 410	946 050	2 257 870	1 413 920	**3 671 790**	0.66	2.61	**0.93**
13	A10BG03	Pioglitazone	510	0	242 960	756 840	158 100	510	1 157 900	**1 158 410**	8.51	3.87	**3.87**
14	A10BH01	Sitagliptin	3 404 090	77 550	1 677 440	1 843 890	5 485 140	3 481 640	9 006 470	**12 488 110**	2.45	3.85	**3.32**

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
15	A10BH02	Vildagliptin	882 670	23 060	298 740	540 100	1 060 750	905 730	1 899 590	**2 805 320**	2.54	3.69	**3.22**
16	A10BH03	Saxagliptin	531 010	1 749 550	185 100	248 270	638 930	2 280 560	1 072 300	**3 352 860**	1.37	3.78	**1.72**
17	A10BH05	Linagliptin	213 180	3 240	1 681 590	5 048 830	1 826 460	216 420	8 556 880	**8 773 300**	2.00	3.08	**3.04**
18	A10BJ01	Exenatide	1 560	0	1 077 520	325 800	152 470	1 560	1 555 790	**1 557 350**	13.99	14.95	**14.95**
19	A10BJ02	Liraglutide	275 350	0	2 954 670	1 493 650	852 720	275 350	5 301 040	**5 576 390**	15.58	16.77	**16.71**
20	A10BK01	Dapagliflozin	31 650	0	3 210 480	4 713 360	6 671 950	31 650	14 595 790	**14 627 440**	4.23	4.71	**4.71**
21	A10BK02	Canagliflozin	0	0	337 860	271 250	412 170	0	1 021 280	**1 021 280**	—	3.15	**3.15**
22	A10BK03	Empagliflozin	19 900	0	5 709 760	11 213 110	3 550 620	19 900	20 473 490	**20 493 390**	1.99	3.45	**3.45**
23	A10BX02	Repaglinide	7 330	0	23 190	26 190	230 000	7 330	279 380	**286 710**	2.72	3.01	**3.00**
24	A10AB01	Insulin (human), fast-acting	11 278 120	17 460 510	155 110	4 680	107 100	28 738 630	266 890	**29 005 520**	0.81	2.57	**0.81**
25	A10AB04	Insulin Lispro, fast-acting	149 560	5 500	113 400	57 560	150 090	155 060	321 050	**476 110**	2.89	4.14	**3.63**
26	A10AB05	Insulin Aspart, fast-acting	2 063 820	79 820	2 380 960	506 750	2 145 310	2 143 640	5 033 020	**7 176 660**	3.05	4.58	**3.98**
27	A10AB06	Insulin Glulisine, fast-acting	79 310	16 760	178 570	82 570	123 620	96 070	384 760	**480 830**	2.52	3.66	**3.36**
28	A10AC01	Insulin (human), intermediate acting	6 802 340	15 069 210	34 720	10 210	119 450	21 871 550	164 380	**22 035 930**	0.81	2.62	**0.82**

ANNEX 3. Pharmaceutical costs by drug type, diabetes, Malaysia 2017 *(continued)*

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
29	A10AD01	Insulin (human), intermediate or long-acting combined with fast-acting	11 788 000	27 208 640	93 360	50 510	733 280	38 996 640	877 150	**39 873 790**	0.81	2.62	**0.82**
30	A10AD04	Insulin Lispro, intermediate- or long-acting combined with fast-acting	148 320	6 210	1 097 540	508 020	844 060	154 530	2 449 620	**2 604 150**	2.89	4.22	**4.11**
31	A10AD05	Insulin Aspart, intermediate- or long-acting combined with fast-acting	2 380 910	2 379 690	4 491 710	2 750 930	7 461 810	4 760 600	14 704 450	**19 465 050**	2.96	4.59	**4.04**
32	A10AE04	Insulin Glargine	5 602 090	3 155 100	2 994 510	2 233 770	3 473 340	8 757 190	8 701 620	**17 458 810**	4.77	6.51	**5.51**
33	A10AE05	Insulin Detemir	600 170	221 530	1 527 870	864 140	1 549 890	821 700	3 941 900	**4 763 600**	4.87	6.79	**6.36**

TOTAL DIABETES PHARMACEUTICAL DRUGS COST							
76 739 990	**171 169 560**	**58 536 300**	**91 119 980**	**125 281 450**	**247 909 550**	**274 937 730**	**522 847 280**

RM: Malaysian ringgit

Source: MoH Pharmacy Research and Development Branch.

ANNEX 4. Pharmaceutical costs by drug type, cancer, Malaysia, 2017

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
1	L01XC02	Rituximab	15 773 690	0	10 256 880	813 020	1 438 650	15 773 690	12 508 550	**28 282 240**	4 346.81	5 603.18	4 825.33
2	L01XC03	Trastuzumab	17 146 960	0	16 942 730	1 505 700	1 526 740	17 146 960	19 975 170	**37 122 130**	5 542.18	5 763.34	5 659.03
3	L01XC06	Cetuximab	891 500	0	2 116 200	50 490	803 630	891 500	2 970 320	**3 861 820**	6 185.60	7 030.34	6 815.47
4	L01XC07	Bevacizumab	21 030	0	9 645 130	1 691 300	1 539 110	21 030	12 875 540	**12 896 570**	5 257.20	5 014.49	5 014.87
5	L01XC08	Panitumumab	0	0	1 082 810	294 500	101 950	0	1 479 260	**1 479 260**	0.00	3 710.54	3 710.54
6	L01XC12	Brentuximab vedotin	170 310	0	1 028 300	56 930	85 660	170 310	1 170 890	**1 341 200**	NA	NA	NA
7	L01XC13	Pertuzumab	83 470	0	8 930 100	144 200	741 600	83 470	9 815 900	**9 899 370**	NA	NA	NA
8	L01XC14	Trastuzumab emtansine	0	0	2 589 000	171 000	352 500	0	3 112 500	**3 112 500**	—	NA	NA
9	L01XC15	Obinutuzumab	0	0	241 480	0	0	0	241 480	**241 480**	—	NA	NA
10	L01XC18	Pembrolizumab	0	0	14 977 940	873 720	1 273 740	0	17 125 400	**17 125 400**	—	NA	NA
11	L01XE01	Imatinib	19 319 550	1 906 700	2 516 500	317 360	788 750	21 226 250	3 622 610	**24 848 860**	7 769.09	7 909.00	7 789.17
12	L01XE02	Gefitinib	1 069 940	0	4 014 160	465 060	1 476 980	1 069 940	5 956 200	**7 026 140**	1 440.99	4 990.24	3 629.07
13	L01XE03	Erlotinib	2 122 410	0	1 741 640	448 870	1 136 740	2 122 410	3 327 250	**5 449 660**	3 202.77	2 860.83	2 984.95
14	L01XE04	Sunitinib	563 670	0	729 790	172 430	344 100	563 670	1 246 320	**1 809 990**	5 351.26	8 110.52	6 988.35
15	L01XE05	Sorafenib	142 360	0	1 606 800	218 400	686 400	142 360	2 511 600	**2 653 960**	14 762.84	14 560.00	14 570.74
16	L01XE07	Lapatinib	14 210	0	450 450	108 570	323 400	14 210	882 420	**896 630**	307.40	349.80	349.04
17	L01XE08	Nilotinib	23 766 000	0	1 169 410	0	152 200	23 766 000	1 321 610	**25 087 610**	6 812.92	27 061.66	7 092.49

ANNEX 4. Pharmaceutical costs by drug type, cancer, Malaysia, 2017 *(continued)*

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
18	L01XE09	Temsirolimus	0	0	123 020	33 940	0	0	156 960	**156 960**	0.00	7 070.00	7 070.00
19	L01XE10	Everolimus	0	0	806 430	127 980	553 800	0	1 488 210	**1 488 210**	0.00	190.43	190.43
20	L01XE11	Pazopanib	4 346 170	0	1 649 840	176 060	994 620	4 346 170	2 820 520	**7 166 690**	189.07	242.00	206.88
21	L01XE13	Afatinib	65 970	0	3 719 340	313 160	800 140	65 970	4 832 640	**4 898 610**	181.24	217.99	217.40
22	L01XE15	Vemurafenib	0	0	153 000	0	0	0	153 000	**153 000**	—	NA	NA
23	L01XE16	Crizotinib	142 800	0	2 633 560	196 380	659 520	142 800	3 489 460	**3 632 260**	NA	NA	NA
24	L01XE17	Axitinib	70 190	0	114 280	0	131 610	70 190	245 890	**316 080**	NA	NA	NA
25	L01XE18	Ruxolitinib	2 325 820	0	869 130	121 060	770 610	2 325 820	1 760 800	**4 086 620**	NA	NA	NA
26	L01XE21	Regorafenib	0	0	174 000	75 400	127 600	0	377 000	**377 000**	—	NA	NA
27	L01XE27	Ibrutinib	316 800	0	609 830	39 600	376 870	316 800	1 026 300	**1 343 100**	NA	NA	NA
28	L01XE28	Ceritinib	0	0	727 060	207 310	354 620	0	1 288 990	**1 288 990**	—	NA	NA
29	L01XE31	Nintedanib	0	0	213 330	0	406 670	0	620 000	**620 000**	—	NA	NA
30	L01XE33	Palbociclib	0	0	4 305 080	819 520	588 850	0	5 713 450	**5 713 450**	—	NA	NA
31	L01XX02	Asparaginase	1 711 900	0	230 010	0	0	1 711 900	230 010	**1 941 910**	860.25	1 015.50	876.11
32	L01XX05	Hydro-xycarbamide	1 186 770	180 380	429 900	0	104 860	1 367 150	534 760	**1 901 910**	129.41	224.49	146.91
33	L01XX14	Tretinoin	450 030	32 850	565 900	0	0	482 880	565 900	**1 048 780**	1 560.27	1 481.82	1 516.94
34	L01XX17	Topotecan	51 660	0	53 850	0	0	51 660	53 850	**105 510**	1 396.10	2 154.06	1 701.73
35	L01XX19	Irinotecan	173 510	11 230	1 407 570	6 740	78 190	184 740	1 492 500	**1 677 240**	179.98	1 071.01	693.07

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
36	L01XX23	Mitotane	150 090	0	0	0	0	150 090	0	**150 090**	13 341.07	0.00	13 341.07
37	L01XX27	Arsenic trioxide	660 460	0	935 610	0	0	660 460	935 610	**1 596 070**	46 935.96	48 875.22	48 053.64
38	L01XX32	Bortezomib	5 517 720	0	1 757 200	345 610	450 600	5 517 720	2 553 410	**8 071 130**	8 331.43	10 728.62	8 965.16
39	L01XX35	Anagrelide	920 870	0	252 420	32 610	207740	920 870	492 770	**1 413 640**	413.21	480.75	434.49
40	L01XX41	Eribulin	14 620	0	2 739 240	18 370	15 310	14 620	2 772 920	**2 787 540**	4 872.00	6 367.20	6 356.97
41	L01XX44	Aflibercept	0	0	691 980	114 430	231 370	0	1 037 780	**1 037 780**	—	NA	NA
42	L01XX46	Olaparib	0	0	260 010	47 210	404 540	0	711 760	**711 760**	—	NA	NA
43	L02AB01	Megestrol	23 840	0	488 960	0	25 980	23 840	514 940	**538 780**	NA	NA	NA
44	L02AB02	Medroxy-progesterone	78 920	5 230	0	0	0	84 150	0	**84 150**	NA	NA	NA
45	L02AE01	Buserelin	0	0	203 510	283 170	15 820	0	502 500	**502 500**	—	NA	NA
46	L02AE02	Leuprorelin	6 250 650	950	5 219 640	1 635 970	268 300	6 251 600	7 123 910	**13 375 510**	NA	NA	NA
47	L02AE03	Goserelin	978 840	0	1 029 900	177 920	71 060	978 840	1 278 880	**2 257 720**	NA	NA	NA
48	L02AE04	Triptorelin	160 770	40 490	851 450	693 220	8 660	201 260	1 553 330	**1 754 590**	NA	NA	NA
49	L02BA01	Tamoxifen	1 118 360	4 980	2 181 100	454 360	1 679 540	1 123 340	4 315 000	**5 438 340**	NA	NA	NA
50	L02BA03	Fulvestrant	0	0	969 760	225 910	261 810	0	1 457 480	**1 457 480**	—	NA	NA
51	L02BB01	Flutamide	8 200	0	81 520	0	0	8 200	81 520	**89 720**	NA	NA	NA
52	L02BB03	Bicalutamide	150 280	34 430	506 020	202 930	603 020	184 710	1 311 970	**1 496 680**	NA	NA	NA
53	L02BB04	Enzalutamide	0	0	1 626 000	826 550	1 395 650	0	3 848 200	**3 848 200**	—	NA	NA
54	L02BG03	Anastrozole	475 130	26 300	1 065 440	359 080	555 020	501 430	1 979 540	**2 480 970**	NA	NA	NA

ANNEX 4. Pharmaceutical costs by drug type, cancer, Malaysia, 2017 *(continued)*

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
55	L02BG04	Letrozole	632 810	0	2 349 760	354 600	1 435 080	632 810	4 139 440	**4 772 250**	NA	NA	NA
56	L02BG06	Exemestane	930 140	44 060	457 510	89 740	382 880	974 200	930 130	**1 904 330**	NA	NA	NA
57	L02BX02	Degarelix	19 150	0	135 900	64 220	22 240	19 150	222 360	**241 510**	NA	NA	NA
58	L02BX03	Abiraterone	96 880	0	1 300 060	965 920	1 869 140	96 880	4 135 120	**4 232 000**	NA	NA	NA
59	L03AA02	Filgrastim	7 118 080	0	2 426 210	162 810	36 000	7 118 080	2 625 020	**9 743 100**	NA	NA	NA
60	L03AA10	Lenograstim	0	0	268 230	74 320	0	0	342 550	**342 550**	—	NA	NA
61	L03AA13	Pegfilgrastim	192 190	0	3 265 250	375 080	54 480	192 190	3 694 810	**3 887 000**	NA	NA	NA
62	L03AB04	Interferon Alpha 2a	50 030	0	0	530	0	50 030	530	**50 560**	NA	NA	NA
63	L03AB05	Interferon Alpha 2b	873 340	0	45 700	0	2 520	873 340	48 220	**921 560**	NA	NA	NA
64	L03AB07	Interferon beta-1a	591 040	35 740	121 230	31 670	90 460	626 780	243 360	**870 140**	NA	NA	NA
65	L03AB08	Interferon beta-1b	26 570	0	35 150	19 530	31 240	26 570	85 920	**112 490**	NA	NA	NA
66	L03AB10	Peginterferon alfa-2b	51 010	0	0	32 970	0	51 010	32 970	**83 980**	NA	NA	NA
67	L03AB11	Peginterferon alfa-2a	4 151 300	0	665 030	108 480	277 650	4 151 300	1 051 160	**5 202 460**	NA	NA	NA
68	L03AX03	BCG vaccine	11 760	13 370	0	0	0	25 130	0	**25 130**	NA	NA	NA
69	L03AX16	Plerixafor	0	0	333 450	51 300	0	0	384 750	**384 750**	—	NA	NA

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
70	L04AA03	Antilymphocyte immunoglobulin (horse)	2 542 930	0	380 930	0	28 800	2 542 930	409 730	**2 952 660**	NA	NA	NA
71	L04AA04	Antithymocyte immunoglobulin (rabbit)	678 900	0	156 980	114 680	9 400	678 900	281 060	**959 960**	NA	NA	NA
72	L04AA06	Mycophenolic acid	11 781 090	11 320	2 221 580	1 198 970	3 279 850	11 792 410	6 700 400	**18 492 810**	NA	NA	NA
73	L04AA10	Sirolimus	113 040	10 910	23 570	46 230	91 560	123 950	161 360	**285 310**	NA	NA	NA
74	L04AA13	Leflunomide	8 149 540	0	837 100	136 180	723 260	8 149 540	1 696 540	**9 846 080**	NA	NA	NA
75	L04AA18	Everolimus	900 000	0	102 060	727 500	202 670	900 000	1 032 230	**1 932 230**	NA	190.43	190.43
76	L04AA26	Belimumab	0	0	44 900	65 880	5 860	0	116 640	**116 640**	—	NA	NA
77	L04AA27	Fingolimod	192 000	0	214 500	6 500	227 500	192 000	448 500	**640 500**	NA	NA	NA
78	L04AA29	Tofacitinib	249 090	0	1 842 380	364 450	221 280	249 090	2 428 110	**2 677 200**	NA	NA	NA
79	L04AB01	Etanercept	2 047 470	0	1 388 150	886 310	535 010	2 047 470	2 809 470	**4 856 940**	NA	NA	NA
80	L04AB02	Infliximab	678 340	0	2 466 380	1 404 200	340 890	678 340	4 211 470	**4 889 810**	NA	NA	NA
81	L04AB04	Adalimumab	3 840 590	124 930	1 366 480	811 680	745 260	3 965 520	2 923 420	**6 888 940**	NA	NA	NA
82	L04AB05	Certolizumab pegol	0	0	102 220	235 660	10 220	0	348 100	**348 100**	—	NA	NA
83	L04AB06	Golimumab	881 470	47 840	1 430 390	164 080	268 420	929 310	1 862 890	**2 792 200**	NA	NA	NA
84	L04AC02	Basiliximab	539 980	0	27 000	0	162 000	539 980	189 000	**728 980**	NA	NA	NA
85	L04AC05	Ustekinumab	1 261 180	0	506 460	310 150	245 150	1 261 180	1 061 760	**2 322 940**	NA	NA	NA

ANNEX 4. Pharmaceutical costs by drug type, cancer, Malaysia, 2017 *(continued)*

No.	ATC Code	DRUG TYPE	COST (in thousands RM)								COST per Defined Daily Dose, 2107 (RM)		
			PUBLIC SECTOR		PRIVATE SECTOR			ALL SECTORS					
			Hospital	Clinic	Hospital	Clinic	Pharmacy	Public	Private	TOTAL	Public	Private	TOTAL
86	L04AC07	Tocilizumab	1 111 990	0	2 217 120	505 640	598 140	1 111 990	3 320 900	**4 432 890**	NA	NA	NA
87	L04AC10	Secukinumab	53 040	0	1 590 980	403 200	1 644 200	53 040	3 638 380	**3 691 420**	NA	NA	NA
88	L04AD01	Ciclosporin	13 363 720	25 060	1 007 250	405 390	755 820	13 388 780	2 168 460	**15 557 240**	NA	NA	NA
89	L04AD02	Tacrolimus	6 326 870	28 750	669 480	952 940	1 289 400	6 355 620	2 911 820	**9 267 440**	NA	NA	NA
90	L04AX01	Azathioprine	3 139 880	19 450	604 310	46 590	126 130	3 159 330	777 030	**3 936 360**	NA	NA	NA
91	L04AX02	Thalidomide	314 430	4 370	488 190	0	0	318 800	488 190	**806 990**	NA	NA	NA
92	L04AX03	Methotrexate	1 029 010	17 160	860 690	429 220	778 710	1 046 170	2 068 620	**3 114 790**	NA	NA	NA
93	L04AX04	Lenalidomide	664 610	0	1 473 130	116 920	724 870	664 610	2 314 920	**2 979 530**	NA	NA	NA
94	L04AX06	Pomalidomide	255 240	0	36 000	0	72 000	255 240	108 000	**363 240**	NA	NA	NA
95	L04AA31	Teriflunomide	51 660	0	0	3 980	89 640	51 660	93 620	**145 280**	NA	NA	NA
96	L04AA33	Vedolizumab	0	0	108 450	0	0	0	108 450	**108 450**	—	NA	NA
97	L04AX05	Pirfenidone	0	0	37 200	0	9 300	0	46 500	**46 500**	—	NA	NA
TOTAL CANCER DRUGS COST													
			183 345 840	**2 626 500**	**153 291 570**	**26 533 560**	**42 301 560**	**185 972 340**	**222 126 690**	**408 099 030**			

RM: Malaysian ringgit – NA: not applicable

Source: MoH Pharmacy Research and Development Branch.

Ministry of Health Malaysia

World Health Organization

Malaysia, Brunei Darussalam and Singapore

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The Direct Health-Care Cost of NonCommunicable Diseases