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MINISTRY OF HEALTH MALAYSIA
PHARMACEUTICAL SERVICES PROGRAMME

IMPACT OF POOLED PROCUREMENT ON MEDICINES PRICING IN THE PUBLIC SECTOR 2024

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Ministry of Health Malaysia
Pharmaceutical Services Programme

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Ministry of Health Malaysia

IMPACT OF POOLED PROCUREMENT ON MEDICINES PRICING IN THE PUBLIC SECTOR
2025

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%	*Percentage*	**LP**	*Local Purchase*
AHJ	*"Anggaran Harga Jabatan"/ Departmental Indicative Price*	**MAFHS**	*Malaysian Armed Forces Health Services*
APPL	*Approved Medicine Purchase List*	**mcg**	*Microgram*
ARV	*Antiretroviral*	**mg**	*Milligram*
BNM	*Bank Negara Malaysia*	**ml**	*Milliliter*
CCNPM	*Coordinating Commission for Negotiating the Price of Medicines and Other Health Inputs*	**MLR**	*Multiple Linear Regression*
CHEeR	*Centre for Health Economics Research*	**MNMP**	*Malaysian National Medicines Policy*
FORSIHAT	*Formulari Ubat-ubatan Perkhidmatan Kesihatan Angkatan Tentera*	**MOD**	*Ministry of Defence*
GNI	*Gross National Income*	**MOF**	*Ministry of Finance*
GPRM	*Global Price Report Mechanism*	**MOH**	*Ministry of Health*
HASA	*Al-Sultan Abdullah Hospital*	**MOHE**	*Ministry of Higher Education*
HCTM	*Canselor Tuanku Muhriz Hospital*	**MTB**	*Military Therapeutic Benefits*
HPUSM	*Hospital Pakar Universiti Sains Malaysia/ University of Science Malaysia Specialist Hospital*	**NHI**	*National Health Insurance*
HSAAS	*Sultan Abdul Aziz Shah Hospital*	**NHIS**	*National Health Insurance Service*
LMIC	*Low-income and middle-income countries*	**NIH**	*National Institute of Health*
LOA	*Letter of Acceptance/ Surat Setuju Terima (SST)*	**NHSO**	*National Health Security Office*

NMRR	*National Medical Research Register*	**Tab/cap**	*Tablet/capsule*
NVBP	*National Volume-Based Procurement*	**UMMC**	*University of Malaya Medical Centre*
O&G	*Obstetrics and Gynecology*	**USD**	*United States Dollar*
OECD	*Organisation for Economic Co-operation and Development*	**UTHs**	*University teaching hospitals*
PBS	*Pharmaceutical Benefits Scheme*	**VIF**	*Variance Inflation Factor*
PR	*Price Ratio*	**WHO**	*World Health Organisation*
PRH	*Product Registration Holder*		
Q25	*25th Percentile*		
Q75	*75th Percentile*		
R&D	*Research & Development*		
RM	*Ringgit Malaysia*		
SAA	*Skim Anak Angkat*		
SASMEC	*Sultan Ahmad Shah Medical Centre @IIUM*		
SEP	*Single Exit Pricing*		
SKU	*Small Keeping Unit*		

Executive Summary

METHODOLOGY

- **Study Design:** Retrospective, cross-sectional study
- **Procurement Period:** Two-year contract before pooled procurement (May 2018 – May 2020) and two-year contract after pooled procurement (June 2020 – August 2022)
- **Ministries involvement:** MOH, MOD, and MOHE (6 university-teaching hospitals)
- **Number of medicines procured:** 82 items

OVERALL ESTIMATED SAVINGS OF

RM 179.6 MILLION saved (17.7%)

- RM 186.6 million in estimated savings
- RM 7.1 million in estimated dissavings

Total estimated procurement: RM 1.01 billion

HIGHEST CONTRIBUTORS

Ministry of Health

- The largest savings due to its function as the main healthcare provider

Ministry of Defense

- The largest price reduction from switching innovator to generics
- Early adoption of generics and strategic procurement

Ministry of Higher Education

- HSAAS achieved the highest cost-savings from switching innovator to generics
- Leveraged pooled procurement for better pricing

FUTURE GOALS

- Expand pooled procurement to include more medicines
- Strengthen pricing policies for further cost-equity and savings

RECOMMENDATIONS

- Promoting the use of generic medicines in pooled procurement
- Addressing the event of underestimated contract quantity
- To include designated quantity in the Letter of Acceptance (LOA) by stakeholder
- Adopting digitalization in pooled procurement quantity forecasting

"The government achieved significant savings by purchasing medicines in bulk through a coordinated procurement system. This approach lowered costs, stabilized prices, and prevented overcharging."

1.0 INTRODUCTION

1.1 PROCUREMENT IN PUBLIC SECTOR

In Malaysia, public sector medicines procurement facilities encompass a range of agencies, including federal, state, and statutory bodies (Pharmaceutical Services Programme, 2023a). Among these agencies, public healthcare services delivery is predominantly sourced by the following ministries: the Ministry of Health (MOH), the Ministry of Defence (MOD), and the Ministry of Higher Education (MOHE). Each of these ministries has distinct responsibilities which contribute to the overall efficiency of the public healthcare system. The MOH is the largest public healthcare provider, primarily responsible with the direct procurement of essential medicines and managing the associated budgets to ensure the availability of medicines in its healthcare facilities. Meanwhile, the MOHE plays a role in curative care services, health-related training and research which contribute to the development of new pharmaceuticals and the improvement of existing ones. Conversely, the MOD provides health services through its Armed Forces Hospitals, polyclinics, medical centres, sick quarters, and dental centres, meeting the healthcare needs of military personnel and their families. Together, these ministries work to improve the accessibility and affordability of medicines, addressing the diverse needs of the population.

All the public sector agencies are subject to procurement processes governed by the Ministry of Finance (MOF), the administrator of national financial allocation. MOF establishes standard procurement directives to ensure fairness, transparency, efficiency, and accountability in the purchasing process, ultimately optimising value for public funds (MOF, 2022). In general, government medicines procurement is conducted via three methods to ensure more economical prices:

1. A national concession agreement with a single authorized supplier (currently Pharmaniaga Logistics Sdn. Bhd), a government-linked company that provides pharmaceuticals to public healthcare facilities at MOH negotiated prices.

1. Tenders for pharmaceuticals with an annual procurement value surpassing RM500,000 are conducted at the national, state, or institutional levels.

2. Direct procurement by agencies or institutions for purchases between RM50,000 and RM500,000 requires a minimum number of quotations from registered suppliers. For transactions under RM50,000, agencies or institutions can make direct purchases at their discretion.

Both MOH and MOD use the *e-Perolehan* system for medicine procurement. Similarly, some University Teaching Hospitals (UTHs) under MOHE use a comparable system with similar

processes. For tendering procurement, the process begins with the preparation of medicine specifications (see Figure 1.1). An advertisement is posted on the *e-Perolehan* system for 21-120 days. Bidders will be evaluated based on medicine details, prices, and financial stability. The Procurement Board reviews the bids and selects the best options for the respective agencies, potentially negotiating prices for better deals. Once a bidder is selected, a Letter of Acceptance (LOA), an official document issued by the party (usually an organization, institution, or company) to the recipient as confirmation that their offer has been accepted. This document is typically used in the context of contracts and tenders to be issued, permitting the respective agencies or institutions to purchase the medicines (MOF, 2024).

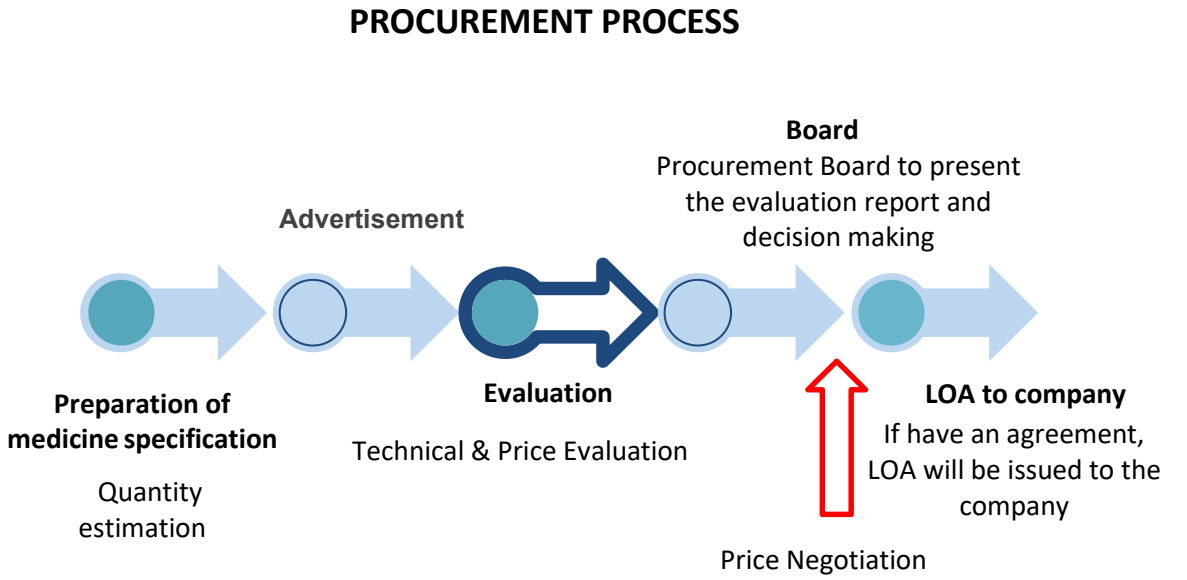


Figure 1.1 Procurement process for national tendering

Although MOF has established standardized procurement directives for MOH, MOD, and MOHE, each ministry procures medicines independently to fulfill its specific healthcare responsibilities. As the largest public sector provider, MOH relies on national tendering and concession mechanisms, while MOD and MOHE procure medicines based on budget allocations, prescriber demand, and service delivery needs. In contrast with the procurement medicines methods between MOH, MOD and MOHE, fragmental purchases lead to missed opportunities for economies of scale. With lower volumes of purchase, MOD and MOHE are often subject to paying higher prices than MOH for the same medicines, causing price variations across public facilities (Pharmaceutical Services Programme, 2022). In addition to inefficient public sector spending, such practice reflects operational inefficiency with increased administrative costs.

Thus, in 2017, MOHE proposed implementing a pooled procurement (PP) process between MOH, MOD, and MOHE to gain more bargaining power and benefit from cost-savings

(see Figure 1.2). After a few engagements with ministries, the list of medicines and process of managing contract in PP had been finalized. MOF, through letter No. Ref. MOF.BPK(S)600-1/10/13(7) dated 27 February 2019, approved the implementation of PP between the ministries, allowing a pilot project for 85 medicines using the open tender method (MOF, 2019; MOH, 2020a). In 2020, three (3) additional medicines were approved, increasing the total number of medicines for inter-ministerial procurement to 88. This approval was granted through letter No. MOF.BPK(S)600-1/10/13 Jld 2(11) dated 10 December 2020 (MOF, 2020). Table 1.1 presents the number of medicines involved in PP.

Table 1.1 Number of medicines (n) included for pooled procurement

	No of medicines (n)
Medicines involved in PP[a,d]	88
Additional approved list[b]	3
Medicines not involved in PP[c]	9
Latest number of medicines involved in PP	**82**

[a] Original list of medicines procured through pooled procurement inter-ministries (refer Appendix I)
[b] Additional medicines procured through pooled procurement inter-ministries (refer Appendix II)
[c] Medicines not involved in PP due to several factors; seven (7) medicines unable to be procured (refer Appendix III) and two (2) medicines excluded due to LOA (refer Appendix IV)
[d] Medicines with two (2) brands (refer Appendix V)

Selection of medicines in the pilot project PP were according to the usage in the three (3) ministries; MOH, MOD and MOHE. The six (6) university teaching hospitals (UTHs) involved in MOHE are:

1. Canselor Tuanku Muhriz Hospital **(HCTM)**
   [also known as Hospital Universiti Kebangsaan Malaysia]
2. University Malaya Medical Centre **(UMMC)**
3. University of Science Malaysia Specialist Hospital **(HPUSM)**
4. Sultan Ahmad Shah Medical Centre @IIUM, **(SASMEC @IIUM)**
   [also known as International Islamic University Medical Center]
5. Al-Sultan Abdullah Hospital **(HASA)**
   [also known as Pusat Perubatan Universiti Teknologi MARA (PPUiTM)]
6. Sultan Abdul Aziz Shah Hospital **(HSAAS)**
   [also known as Universiti Putra Malaysia Teaching Hospital]

This inter-ministerial cooperation marks a significant step toward streamlining procurement, reducing costs, and enhancing public healthcare delivery. Continuous refinement of this process is crucial to ensure sustainable cost-savings and optimal resource utilization. Thus, evaluation is required to assess the impact of PP on cost efficiency, supply

chain performance, and patient access, providing insights for further policy adjustments and process improvements.

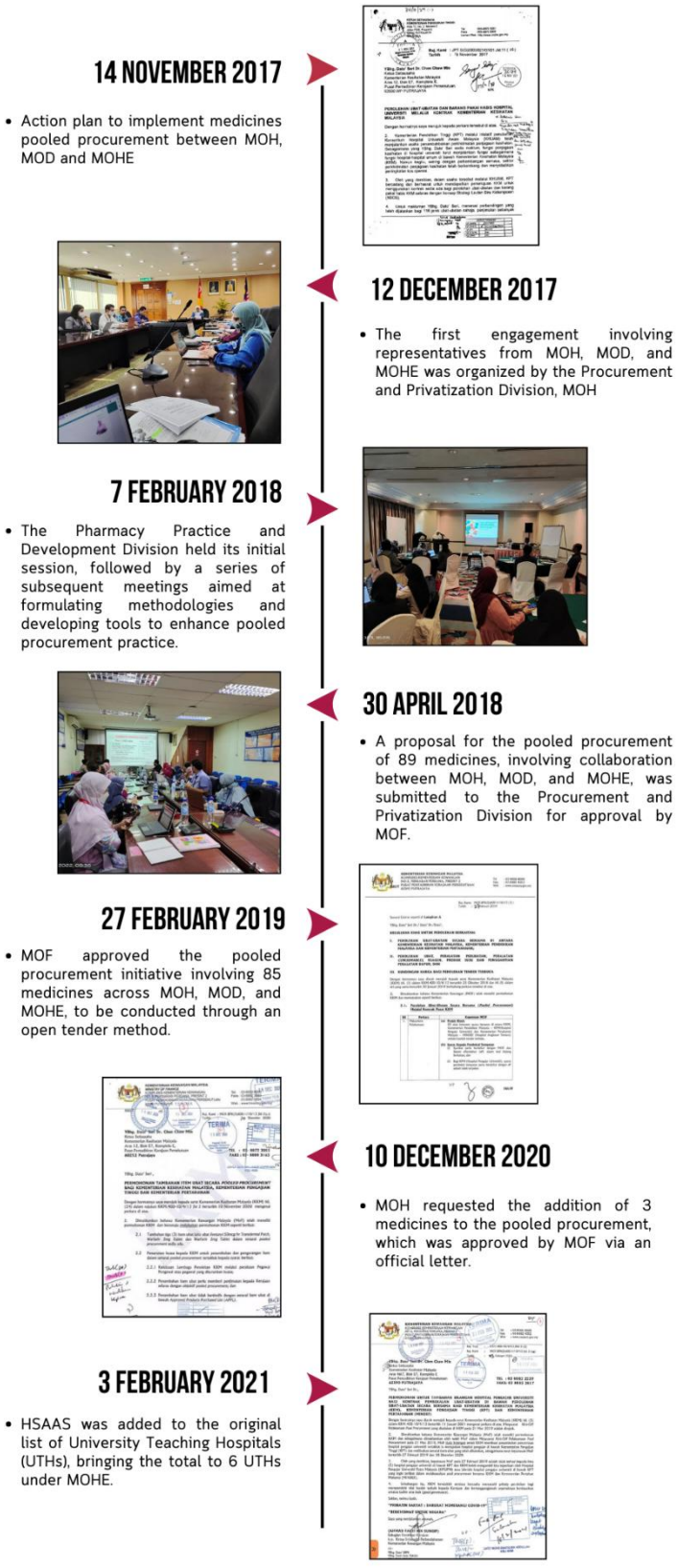


Figure 1.2 The chronology of pooled procurement implementation

1.2 OBJECTIVE AND RATIONALE OF STUDY

Pooled procurement (PP) mechanisms have been implemented to achieve various goals, including price savings, increased availability, improved procurement efficiency and shared technical capacity. Various factors were known to influence the success and outcomes of PP mechanisms. Differences in procurement strategies and institutional practices across participating ministries or organizations impact the extent of savings achieved. Higher competition, driven by multiple Product Registration Holders (PRHs) and a larger pool of bidders, encourages suppliers to offer more favourable prices and terms. Price savings are more likely when transitioning from expensive innovator medicines to lower-cost generics, especially as generic alternatives become available after patent expiration. Product patents can also limit price savings by restricting market competition, thus effective price negotiations play a crucial role in further reducing procurement costs (Parmaksiz et al., 2022; Parmaksiz, Bovenkamp & Bal., 2023; Barton & Emanuel, 2005).

Thus, within the perspectives discussed above, this study aimed to assess the impact of PP in the public sector on medicine prices with the following objectives:

i. To evaluate estimated savings and procurement price differences in medicines before and after implementing inter-ministerial PP.
ii. To analyse the factors influencing medicine prices in PP concerning estimated savings.
iii. To compare PP medicines prices with reference countries' prices.

1.3 POOLED PROCUREMENT PRACTICE

Pooled procurement (PP), also known as centralised procurement is a demand-side strategic approach that aims at mitigating supply chain risks particularly in public health markets, including demand fragmentation, inefficient procurement processes, elevated per-unit product costs, and inaccuracies or delays in forecasting and supply planning (Bare, 2015). Fundamentally, PP allows the procurement agencies to consolidate member product needs, creating financing and supplier payment systems, and implementing prequalification criteria to ensure reliable and timely product delivery at favourable prices. PP practice emerged more than twenty years ago, in certain industrialised nations and the effects of PP are well-documented.

Centralized and PP of medicines have been effective in achieving cost savings, enhancing access to medicines, and improving price transparency in various countries such as Portugal, India, and Tanzania (Vogler et al. 2021, Hannah et al. 2023, Nemzoff et al., 2019). In China, National Volume-Based Procurement (NVBP) saved over 260 billion Yuan (US$36.3 billion) and improved the efficiency of health insurance funds (Zhu et al., 2023). NVBP also reduced

corruption, fostered fair competition, and implemented a market-oriented pricing mechanism. From patients' perspectives, NVBP improved access to affordable, quality-assured medicines, with certified medicines now comprising over 90% of the market.

Pooled procurement (PP) significantly drives cost savings by involving a greater number of suppliers, increasing procurement volume, and offering a wider variety of product types (innovator and generic medicines). By consolidating the purchasing power of multiple buyers, pooled procurement increases order volumes, enabling buyers to secure volume discounts and lower unit prices across various products and markets (Nemzoff et al., 2019). Besides, larger savings is often be observed when generic medicines replace their innovator counterparts due to price differences. This substitution not only reduces direct medicines expenditures but also indirectly contributes to overall healthcare cost reduction. Additionally, effective negotiation strategies that incorporate comprehensive market analysis and well-timed purchases allow buyers to secure better pricing and terms, ultimately optimizing cost outcomes. (WHO, 2020).

Despite the benefits of PP strategies, non-price factors such as understanding supply chain dynamics and mitigating supplier payment risks significantly impact their effectiveness. Diversifying the medicines supply by awarding multiple contracts to different manufacturers fosters a sustainable and robust supply chain of cost-effective pharmaceuticals. Implementing shorter payment terms for PP will subsequently alleviate the financial strain on pharmaceutical manufacturers within healthcare systems. This can mitigate cash flow limitations, allowing manufacturers to enhance investment in research and development (R&D), augment production capabilities, and ensure a consistent supply of medicines (Zhu et al., 2023). While PP reduces buyer competition and strengthens supply chains, effective negotiation and payment strategies are essential to ensure sustainability. Managing supply chain risks and supporting manufacturers through favourable payment terms further enhances its impact, making it a mutualistic strategy for public healthcare systems.

2.0 METHODOLOGY

2.1 STUDY DESIGN

The study employed a cross-sectional design and collected retrospective data on the quantity and price of PP across multiple healthcare facilities (see Figure 2.1). Specifically, the research focused on procurement practices within three ministries; the Ministry of Health (MOH), the Ministry of Defence (MOD), and the Ministry of Higher Education (MOHE).

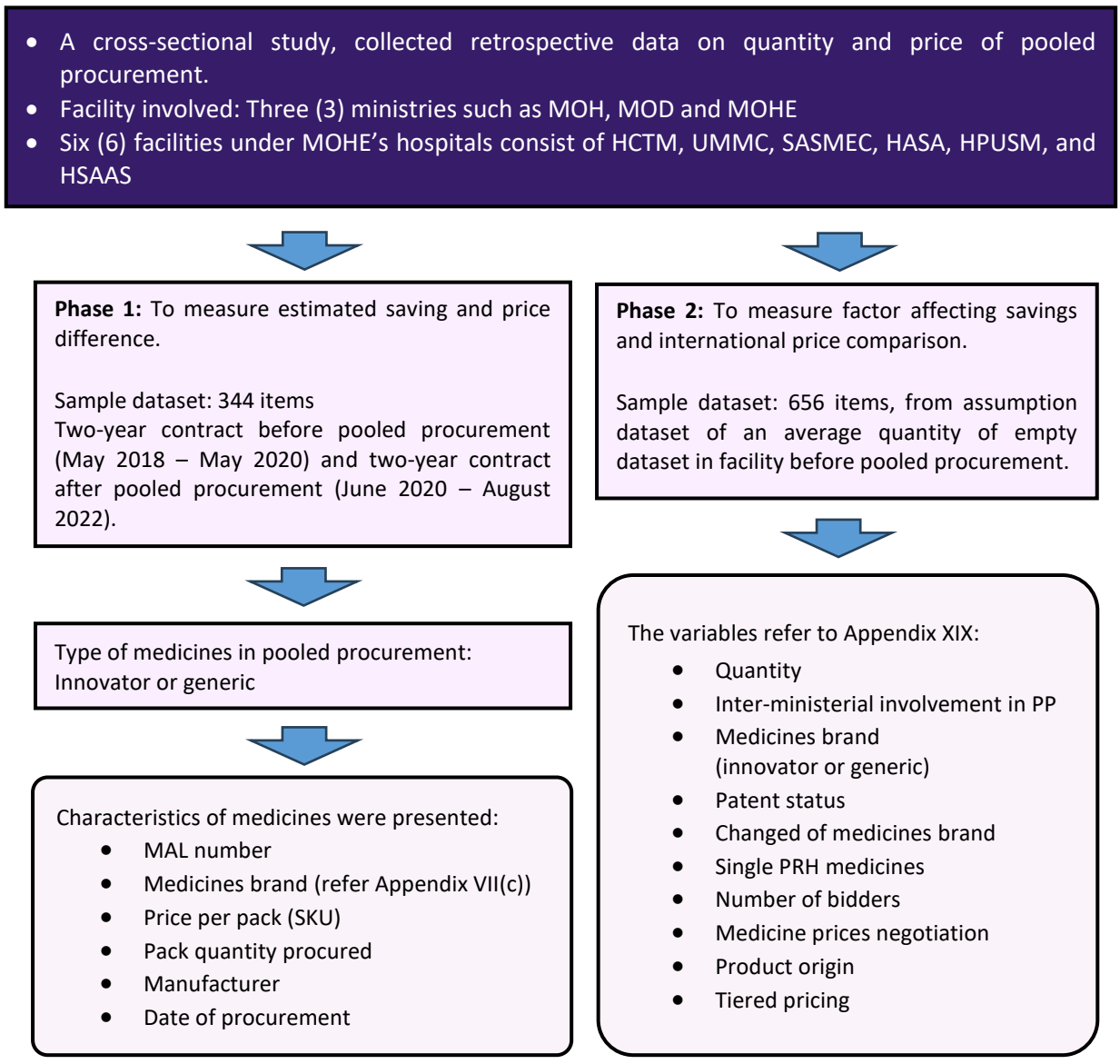


Figure 2.1 Study design

The inter-ministerial PP initiative in Malaysia was approved in 2019 and implemented effectively in 2020. At the national PP tendering process, all prices and procurement agreements are set to remain valid for a period of two years. The price and quantity procured 2 years before the year 2020 (May 2018 – May 2020) was defined as procurement data before PP implementation, while the price and quantity procured within 2 years after implementation of PP (June 2020 - August 2022) was defined as procurement data after PP implementation. Product information, procurement prices, quantity procured, and period of procurement before and after the implementation of PP was collected during data collection.

2.2 DATA COLLECTION

A total of 16 pharmacists were appointed as data collectors, comprising two (2) representatives from MOH, two (2) from MOD, and two (2) from each of the six (6) UTHs under MOHE. In Phase 1, the retrospective data collection on the procurement price data before and after the implementation of pooled procurement was conducted over the course of two (2) weeks in September 2022. A standardized Microsoft Excel data collection form (refer Appendix VI) was used to record the data. All submitted data were thoroughly reviewed by respective data collectors during a two (2) day workshop for completeness, accuracy, and potential outliers or missing data.

Meanwhile in Phase 2, a power statistical analysis was conducted in 2023 using an assumed dataset to measure the factor affecting savings and international price comparison. This assumption dataset (n= 82 medicines, 656 datasets) was made to enhance the robustness of the analysis, given that not all PP medicines in MOD and MOHE facilities involved in the pooled procurement process. To maintain consistency, the missing quantities and procurement data for both before and after PP were adjusted based on available data from other facilities. The statistical analysis tested various factors influencing the success of PP, including quantity, inter-ministerials involvement in PP, medicines brand (innovator or generic), patent status, changed of medicines brand, single PRH medicines, number of bidders, medicine prices negotiation, product origin and tiered pricing.

2.2 DATA ANALYSIS

Data collected were analysed using the statistical software STATA/IC version 15. Descriptive analysis was employed to compare median, average, minimum, maximum, 25th percentile, and 75th percentile procurement prices per standard unit. Non-parametric statistical tests were used for group comparisons, as normality analysis using the Kolmogorov-Smirnov test indicated that the data were not normally distributed.

The Wilcoxon signed-rank test was utilized for statistical analysis to compare medicine prices before and after pooled procurement, with a p-value of less than 0.05 is considered as

statistically significant. The Pearson correlation test, Mann-Whitney test and Kruskal-Wallis H test were employed to examine the association between independent and dependent variables, while multiple linear regression analysis (MLR) was used to identify and project cost-saving factors at multifactorial analysis.

The assumptions of multiple linear regression were evaluated. The Kruskal-Wallis H test indicated no significant differences in the distribution of residuals across groups, suggesting approximate normality. Variance Inflation Factor (VIF) values were all below 10, indicating no severe multicollinearity among the independent variables. Additionally, the residual vs. fitted values plot showed a random dispersion, confirming the assumption of homoscedasticity.

2.2.1 Estimated savings, procurement price differences and tiered pricing

The formulas for determining estimated savings and procurement price differences in medicines before and after the implementation of the inter-ministerial PP are detailed as follows:

1) **Estimated Savings and Estimated Dissavings:**

- Estimated savings and dissavings refer to the projected change in total medicine costs by comparing expenditures before and after implementing pooled procurement, based on the agreed-upon quantities outlined in the Letter of Acceptance (LOA).

- Formula:

Estimated Savings = (Price before PP × Quantity PP) – (Price after PP × Quantity PP)

- A positive change reflects estimated savings, while a negative change indicates estimated dissavings, where costs exceed initial projections.

2) **Overall Estimated Savings:**

- Refers to the estimated net cost reduction achieved after accounting for both estimated savings and estimated dissavings. This formula calculates the true financial benefit of pooled procurement by subtracting estimated dissavings from the total estimated savings. It reflects the final cost outcome, capturing both estimated savings and any price increases.

- Formula:

Overall Estimated Savings = Estimated Savings – Estimated Dissavings

3) Savings proportion percentage formula (%)

- The formula represents the Estimated Savings Percentage, which quantifies the reduction in total expenditure resulting from pooled procurement relative to the original cost.

- Formula:

$$\text{Savings proportion percentage (\%)} = \frac{(\text{Price before PP} \times \text{Quantity PP}) - (\text{Price after PP} \times \text{Quantity PP})}{\text{Overall estimated savings}}$$

4) Price difference formula

- The price difference formula quantifies the reduction in unit cost achieved through pooled procurement. It calculates this by subtracting the unit price after PP from the unit price before PP, providing an objective measure of cost savings per unit of medicine.

- Formula:

$$\text{Price difference (RM)} = \text{Price per unit before PP} - \text{Price per unit after PP}$$

$$\text{Percentage price difference (\%)} = \frac{\text{Price per unit before PP} - \text{Price per unit after PP}}{\text{Price per unit before PP}}$$

In addition to analyzing estimated savings and procurement price differences, this study categorizes medicines into price tiers based on unit costs (refer Table 2.1). The classification is determined using quartile segmentation of the unit prices within the pooled procurement data, providing a structured approach to assess price variations across different medicines. The evaluation of tiered pricing in this study can provide insights into regional differences in supply chain costs, logistics, and procurement methods.

Table 2.1 Classification of price tiers based on unit costs

Tier	Price Tier
1	RM0.01 - RM1.00
2	RM1.01- RM10.00
3	RM10.01 – RM30.00
4	RM30.01 – RM200.00
5	> RM200.00

2.2.2 Variable definitions

The variables used in the Multiple Linear Regression (MLR) analysis are summarized in Table 2.2 to provide a clear understanding of their contributions to the model.

Table 2.2 Overview of variables used in the Multiple Linear Regression analysis (MLR)

Type	Variable type	Variable name	Variable name and definition
Dependent variable	Categorical / Continuous	Cost-savings	Savings Dissavings
Independent variable	Categorical	Inter-ministrials involvement in PP	MOH, MOD and MOHE
Independent variable	Categorical	Medicines brand	Innovator Generic
Independent variable	Categorical	Product origin	Local medicines Imported medicines
Independent variable	Categorical	Tiered pricing	Tier 1 (RM0.01 - RM1.00) Tier 2 (RM1.01- RM10.00) Tier 3 (RM10.01 – RM30.00) Tier 4 (RM30.01 – RM200.00) Tier 5 (> RM200.00)

Type	Variable type	Variable name	Variable name and definition
Independent variable	Categorical	Single PRH medicines	Single PRH More than one PRH
Independent variable	Categorical	Medicine prices negotiation	Negotiation required No negotiation required
Independent variable	Categorical	Number of bidders	Single bidder More than one bidder
Independent variable	Categorical	Changed of medicines brand	Switching brand before and after PP: i. Generic to same generic brand ii. Generic to different generic brand iii. Generic to innovator brand iv. Innovator to innovator brand v. Innovator to generic brand
Independent variable	Categorical	Quantity	The pack quantity

2.3 ETHICAL CONSIDERATION

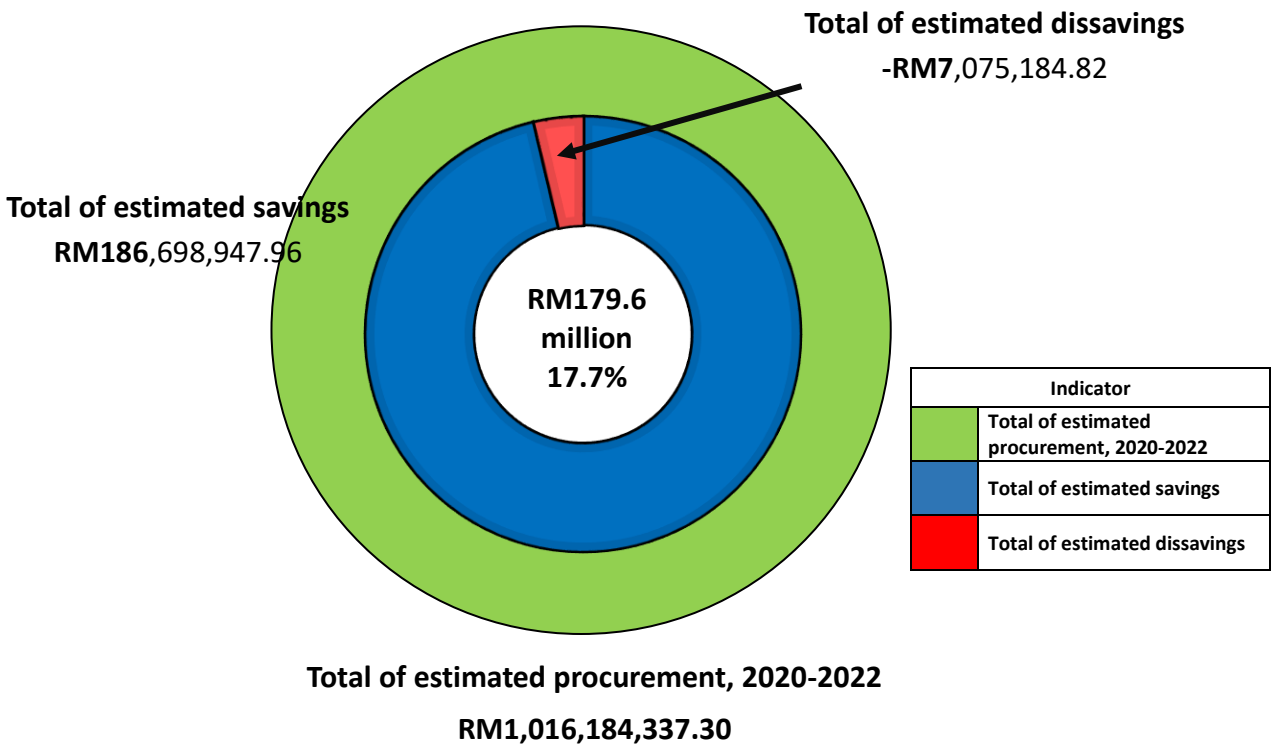
This study collected no patient personal information and kept the facility information confidential. Data in aggregate were presented without identifying specific facilities. The Medical Research and Ethics Committee of the Ministry of Health Malaysia granted this study's ethical approval with the National Medical Research Register number NMRR ID-22-02009-S9V(IIR).

3.0 RESULTS

3.1 ESTIMATED SAVINGS AND PROCUREMENT PRICE DIFFERENCES IN MEDICINES POOLED PROCUREMENT FOR THE PUBLIC SECTOR

3.1.1 Estimated Savings

The total estimated savings for inter-ministerial PP in the public sector were presented in Figure 3.1. The total estimated procurement from December 2020 to August 2022 is RM1.01 billion. In general, the overall estimated savings in the public sector across three (3) ministries from implementing PP amounted to RM179.6 million, representing 17.7% of the total estimated procurement cost ($p<0.05$). From the overall estimated savings, there were both estimated savings and dissavings values. Total estimated savings in the public sector were RM186.6 million and a total estimated dissavings were RM7.1 million.



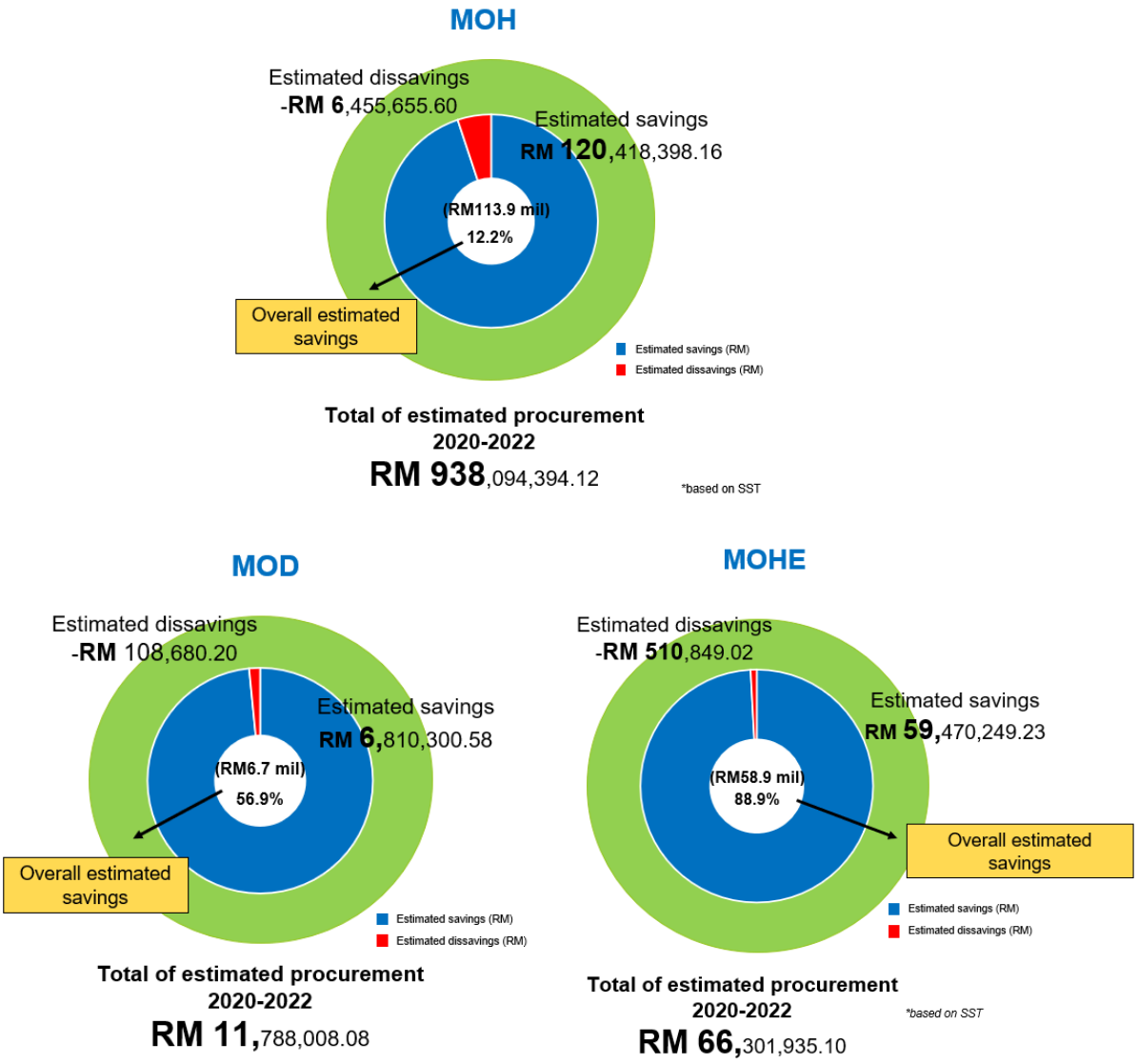
*The significant *p*-value was less than 0.05.

Figure 3.1 Total estimated savings of pooled procurement in the public sector

The estimated savings and dissavings by the three (3) ministries involved in PP were presented in Figure 3.2. The MOH had the highest total estimated procurement between 2020 and 2022, amounting to RM938,094,394.12 (92.3%), followed by MOHE with RM66,301,935.10 (6.5%) and MOD with RM11,788,008.08 (1.2%).

The findings showed that MOH had the highest overall estimated savings, amounting to RM113,962,742.56, followed by MOHE with RM58,959,400.21 and MOD with RM6,701,620.38. Similarly, MOH also recorded the highest estimated savings, totaling RM120,418,398.16, compared to RM59,470,249.23 for MOHE and RM6,810,300.58 for MOD.

Nevertheless, MOH also accounted for the highest estimated dissavings among the three (3) ministries; RM6,455,655.60, followed by MOHE with RM510,848.02 and MOD with RM108,680.20.



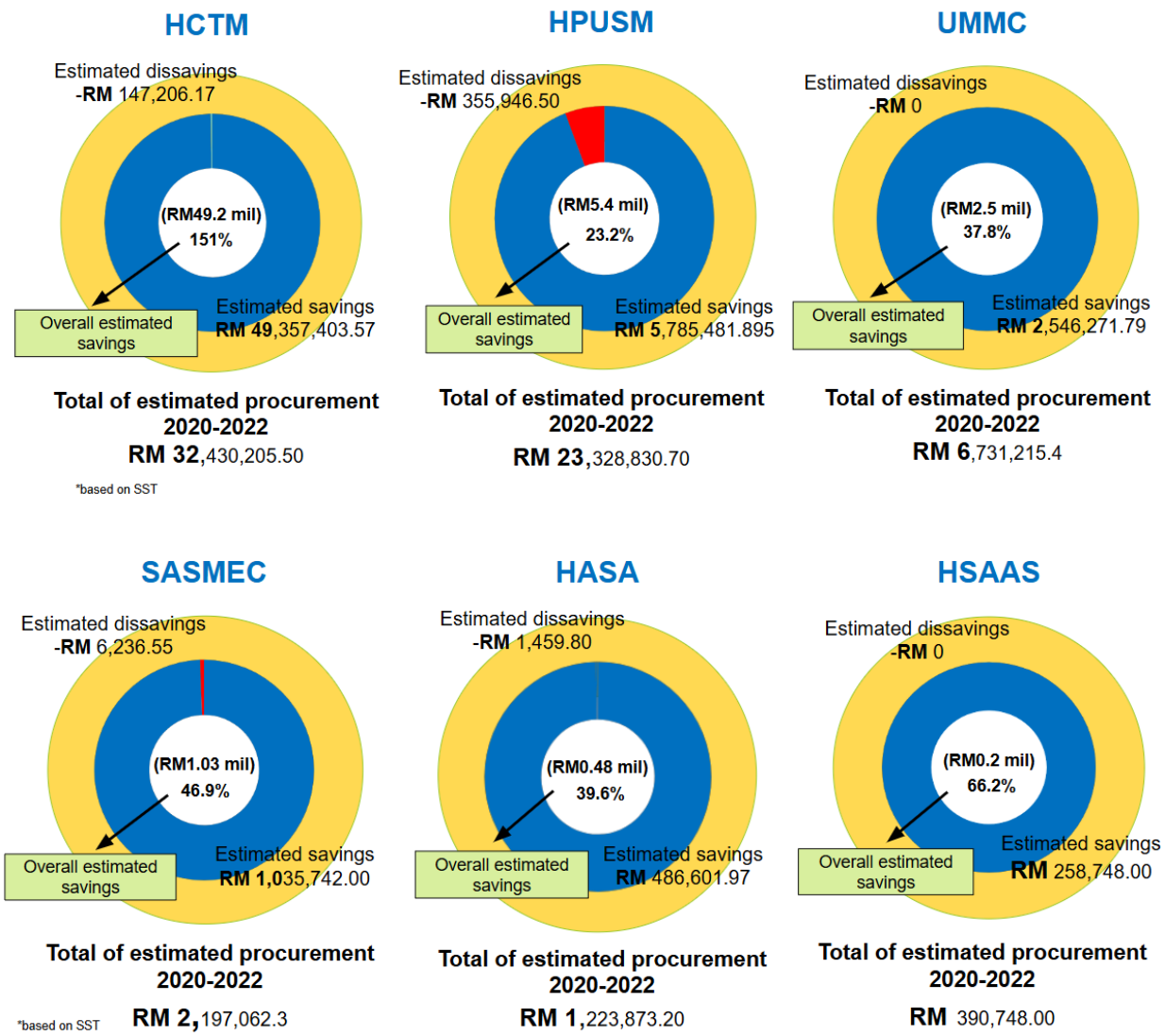
*The significant *p*-value was less than 0.05.

Figure 3.2 Estimated savings and dissavings by ministries between 2020 and 2022

Table 3.1 Number of medicines (n) involved in pooled procurement according to ministries

Ministries	Number of medicines involved in PP (n)
MOH	82
MOD	65
MOHE	
1. HPUSM	68
2. HCTM	56
3. SASMEC	28
4. HASA	23
5. UMMC	13
6. HSAAS	9

Meanwhile, Figure 3.3 presents the total estimated procurement for six (6) UTHs; HCTM, HPUSM, UMMC, SASMEC, HASA, and HSAAS during the period from 2020 to 2022. HCTM had the highest total estimated procurement of RM32.4 million, followed by HPUSM (RM23.3 million), UMMC (RM 6.7 million), SASMEC (RM 2.2 million), HASA (RM 1.2 million), and HSAAS (RM390,748.00). Current findings showed that HCTM had the highest overall estimated savings with RM 49.2 million, followed by HPUSM (RM 5.4 million), UMMC (RM 2.5 million), SASMEC (RM 1.03 million), HASA (RM480,000) and HSAAS (RM200,000.00). However, HPUSM showed the highest dissavings with an estimated value of RM355,946.50, followed by HCTM with RM147,206.17, SASMEC with RM6,236.55, and HASA with RM RM1,459.80. There was no estimated dissavings observed for both UMMC and HSAAS.



*The significant *p*-value was less than 0.05; while n refers to the number of medicines procured for each university teaching hospital

Figure 3.3 Estimated savings and dissavings by university teaching hospitals between 2020 and 2022

3.1.1.1 Tier price per unit of savings

Findings on the estimated savings based on the price tier of PP medicines by ministry were illustrated in Appendix IX. A significant difference was observed between the price tiers per unit. However, the price tier can only be discussed as descriptive analysis.

All three (3) ministries exhibited consistent patterns in their savings distribution across price tiers. In each ministry, medicines in Tier 1 account for the highest savings, followed by Tier 3 and Tier 2. On the contrary, the findings on the estimated dissavings show that each ministry recorded the highest dissavings at different price tiers. MOH had the highest dissavings for medicines in Tier 3 (RM2.0 million, n=7), while MOD and MOHE showed the

highest dissavings in Tier 1 (RM81,271.20, n=2) and Tier 2 (RM237,471.80, n=1-7), respectively.

Other than that, the results of the estimated savings by UTHs revealed a consistent trend across HCTM, HPUSM, HASA and HSAAS as indicated in Appendix X. All these hospitals recorded their highest overall savings in Tier 1, followed by Tier 3. In comparison, UMMC and SASMEC exhibited a different pattern, with the highest overall savings recorded in Tier 3, followed by Tier 2.

The pattern of estimated dissavings across price tiers varied among the UTHs. In HCTM and HASA, Tier 2 (HCTM: RM80,018.00, n=3; HASA: RM1,252.80, n=1) recorded the highest dissavings across the price tiers. In comparison, HPUSM and SASMEC observed the highest dissavings in Tier 3 (HPUSM: RM194,480.50, n=5; SASMEC: RM4,654.55, n=2).

3.1.1.2 Overall estimated savings by changed of medicines brand

The findings showed that switching medicines to a different brand in the PP process resulted in a higher overall estimated savings (RM111.0 million) compared to maintaining the same brands, which saved RM68.5 million (see Figure 3.4). In contrast, PP that retained the same brand resulted in considerably higher estimated dissavings (RM6.7 million) compared to switching to a different brand, which showed only minimal dissavings of RM360,930.00.

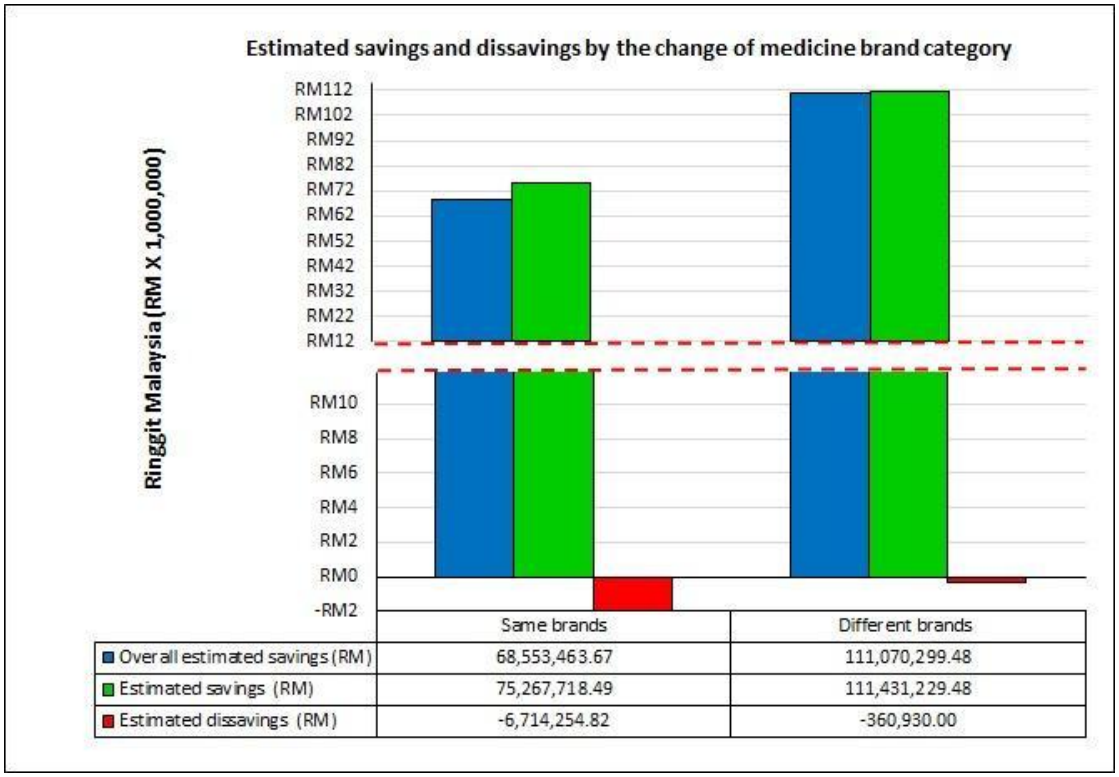


Figure 3.4 Same and different brands based on the overall estimated savings

The estimated savings based on changed of medicines brand before and after PP was further analyzed according to three (3) ministries (see Table 3.2). The switching of medicines within the same brand for innovator resulted in a higher overall estimated savings for the MOH (RM28.1 million) compared to generic (RM23.9 million). Similar findings were observed for the MOD, which reported overall estimated savings of RM2.9 million for same brand innovator and RM198,445.20 for same brand generics. However, MOHE showed a different trend, with higher overall savings in same brand generics amounting to RM8.5 million, compared to RM4.9 million for same brand innovator.

In comparing the estimated dissavings within the same brand across the three (3) ministries, MOH exhibited the highest dissavings; RM5.1 million for innovators and RM1.2 million for generics. Following MOH, MOHE reported dissavings of RM310,541.02 for same brand innovators and RM34,258.00 for generics. However, MOD only reported an estimated dissavings of RM27,680.20 for same brand innovator with no dissavings for generics.

On the other hand, the comparison between different brands showed that the changes of innovator to generic offers the highest overall estimated savings for MOH (RM54.1 million), followed by MOHE (RM44.4 million), and MOD (RM2.7 million). There is a no estimated dissavings reported for this category. Additionally, switching from one generic brand to another also contributes to savings for all three (3) ministries, with values of RM7.8 million for MOH, RM1.2 million for MOHE, and RM943,013.75 for MOD. There were estimated dissavings reported when changing from one generic brand to another with a value of RM113,880 for MOH and RM81,000.00 for MOD. Moreover, only MOHE reported estimated savings from switching from generics to innovator. Nevertheless, the estimated dissavings were found to be higher than the estimated savings, resulting in a negative overall estimated savings balance (-RM125,570.46).

Table 3.2 Estimated savings based on changed of medicines brand before and after pooled procurement, according to ministry

Changed of medicine brand		Overall estimated savings			Estimated savings			Estimated dissavings		
		No of medicines (n)	Value (RM)	Percentage (%)	No of medicines (n)	Value (RM)	Percentage (%)	No of medicines (n)	Value (RM)	Percentage (%)
Ministry of Health (MOH)										
Same brand	**Innovator**	55	**28,075,852.86**	24.64	41	**33,258,143.86**	27.62	14	**5,182,291.00**	80.28
	Generic	14	**23,978,636.20**	21.04	9	**25,138,120.80**	20.88	5	**1,159,484.60**	17.96
Total same brand		-	**52,054,489.06**	-	-	**58,396,264.66**	-	-	**6,341,775.60**	-
Different brand	**Innovator to generic**	8	**54,079,901.00**	47.45	8	**54,079,901.00**	44.91	-	**-**	-
	Generic to other generic	5	**7,828,352.50**	6.87	4	**7,942,232.50**	6.60	1	**113,880.00**	1.76
	Generic to Innovator	-	**-**	-	-	**-**	-	-	**-**	-
Total different brand		-	**61,908,253.50**	-	-	**62,022,133.50**	-	-	**113,880.00**	-
Overall MOH		**82**	**113,962,742.56**	**100.00**	**62**	**120,418,398.16**	**100.00**	**20**	**6,455,655.60**	**100.00**
Ministry of Defence (MOD)										
Same brand	**Innovator**	42	**2,877,847.88**	42.94	33	**2,905,528.08**	42.66	9	**27,680.20**	25.47
	Generic	7	**198,445.20**	2.96	7	**198,445.20**	2.91	-	**-**	-
Total same brand		-	**3,076,293.08**	-	-	**3,103,973.28**	-	-	**27,680.20**	-
Different brand	**Innovator to generic**	10	**2,682,313.55**	40.02	10	**2,682,313.55**	39.39	-	**-**	-

Cont.

Changed of medicine brand		Overall estimated savings			Estimated savings			Estimated dissavings		
		No of medicines (n)	Value (RM)	Percentage (%)	No of medicines (n)	Value (RM)	Percentage (%)	No of medicines (n)	Value (RM)	Percentage (%)
	Generic to other generic	6	**943,013.75**	14.07	5	**1,024,013.75**	15.04	1	**81,000.00**	74.53
	Generic to Innovator	-	**-**	-	-	**-**	-	-	**-**	-
Total different brand		-	**3,625,327.30**	-	-	**3,706,327.30**	-	-	**81,000.00**	-
Overall MOD		**65**	**6,701,620.38**	**100.00**	**55**	**6,810,300.58**	**100.00**	**10**	**108,680.20**	**100.00**
Ministry of Higher Education (MOHE)										
Same brand	**Innovator**	5-43	**4,933,520.34**	8.37	5-33	**5,244,061.36**	8.82	2-10	**310,541.02**	60.79
	Generic	1-13	**8,489,161.19**	14.40	1-12	**8,523,419.19**	14.33	1-2	**34,258.00**	6.71
Total same brand		-	**13,422,681.53**	-	-	**13,767,480.55**	-	-	**344,799.02**	-
Different brand	**Innovator to generic**	1-5	**44,426,617.79**	75.35	1-5	**44,426,617.79**	74.70	-	**-**	-
	Generic to other generic	2-6	**1,235,671.35**	2.10	2-6	**1,235,671.35**	2.08	-	**-**	-
	Generic to Innovator	1-2	**-125,570.46**	-0.21	1	**40,479.54**	0.07	1-2	**166,050.00**	32.50
Total different brand		-	**45,536,718.68**	-	-	**45,702,768.68**	-	-	**166,050.00**	-
Overall MOHE		**9-68**	**58,959,400.21**	**100.00**	**9-55**	**59,470,249.23**	**100.00**	**2-13**	**510,849.02**	**100.00**

Table 3.3 illustrated the estimated overall savings based on changed of medicines brand before and after PP for six (6) UTHs. The overall estimated savings from PP across HCTM, HPUSM, and UMMC showed a similar trend for the same brand medicines, with generics medicines offering higher savings compared to innovators. In contrast, SASMEC, HASA, and HSAAS achieved greater savings with innovator medicines.

In terms of overall estimated savings from switching to a different brand, most UTHs observed a similar trend, with changes from innovator medicines to generics resulting in greater savings. However, SASMEC was an exception, where higher savings were observed when switching from one generic brand to another, resulting dissavings of RM50,760.50 (refer Table 3.3). Further findings on estimated dissavings revealed that PP of the same brand innovator led to higher dissavings compared to the same brand generics. For instance, the same brand innovator for HCTM showed a dissavings of RM69,670.17, whereas the same brand generic resulted in a much smaller dissavings of RM736.00. On the other hand, switching of generic medicines to innovator medicines before and after PP led to a higher dissavings for both HCTM (RM76,800.00) and HPUSM (RM89,250.00). There was no estimated dissavings recorded for SASMEC, HASA, and HSAAS when changing to a different brand before and after PP.

Table 3.3 Overall estimated savings based on changed of medicines brand before and after pooled procurement, according to UTHs

Changed of medicine brand		Overall estimated savings			Estimated savings			Estimated dissavings		
		No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)
Canselor Tuanku Muhriz Hospital (HCTM)										
Same brand	**Innovator**	36	**2,258,486.18**	4.59	28	**2,328,156.35**	4.72	8	**69,670.17**	47.33
	Generic	9	**5,665,453.25**	11.51	8	**5,666,189.25**	11.48	1	**736.00**	0.50
Total same brand		-	**7,923,939.43**	-	**-**	**7,994,345.60**	-	-	**70,406.17**	-
Different brand	**Innovator to generic**	5	**40,956,864.00**	83.23	**5**	**40,956,864.00**	82.98	-	**-**	-
	Generic to other generic	5	**406,193.97**	0.83	**5**	**406,193.97**	0.82	-	**-**	-
	Generic to Innovator	1	**-76,800.00**	-0.16	**-**	**-**	-	1	**76,800.00**	52.17
Total different brand		-	**41,286,257.97**	-	**-**	**41,363,057.97**	-	-	**76,800.00**	-
Overall HCTM		**56**	**49,210,197.40**	**100.00**	**46**	**49,357,403.57**	**100.00**	**10**	**147,206.17**	**100.00**
University of Science Malaysia Specialist Hospital (HPUSM)										
Same brand	**Innovator**	43	**1,329,797.45**	24.49	33	**1,565,523.96**	27.06	10	**235,726.50**	66.23
	Generic	13	**1,668,455.94**	30.73	12	**1,699,425.94**	29.37	1	**30,970.00**	8.70
Total same brand		-	**2,998,253.39**	-	-	**3,264,949.90**	-	-	**266,696.50**	-

Changed of medicine brand		Overall estimated savings			Estimated savings			Estimated dissavings		
		No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)
Different brand	Innovator to generic	4	**1,826,047.50**	33.63	4	**1,826,047.50**	31.56	-	-	-
	Generic to other generic	6	**694,484.50**	12.79	6	**694,484.50**	12.00	-	-	-
	Generic to Innovator	2	**-89,250.00**	-1.64	-	-	-	2	**89,250.00**	25.07
Total different brand		-	**2,431,282.00**	-	-	**2,520,532.00**	-	-	**89,250.00**	-
Overall HPUSM		**68**	**5,429,535.39**	**100.00**	**55**	**5,785,481.90**	**100.00**	**13**	**355,946.50**	**100.00**
University Malaya Medical Center (UMMC)										
Same brand	Innovator	7	**446,398.25**	17.53	7	**446,398.25**	17.53	-	-	-
	Generic	2	**732,465.00**	28.77	2	**732,465.00**	28.77	-	-	-
Total same brand		-	**1,178,863.25**	-	-	**1,178,863.25**	-	-	-	-
Different brand	Innovator to generic	3	**1,336,832.00**	52.50	3	**1,336,832.00**	52.50	-	-	-
	Generic to other generic	-	-	-	-	-	-	-	-	-
	Generic to Innovator	1	**30,576.54**	1.20	1	**30,576.54**	1.20	-	-	-
Total different brand		-	**1,367,408.54**	-	-	**1,367,408.54**	-	-	-	-
Overall UMMC		**13**	**2,546,271.79**	**100.00**	**13**	**2,546,271.79**	**100.00**	-	-	-

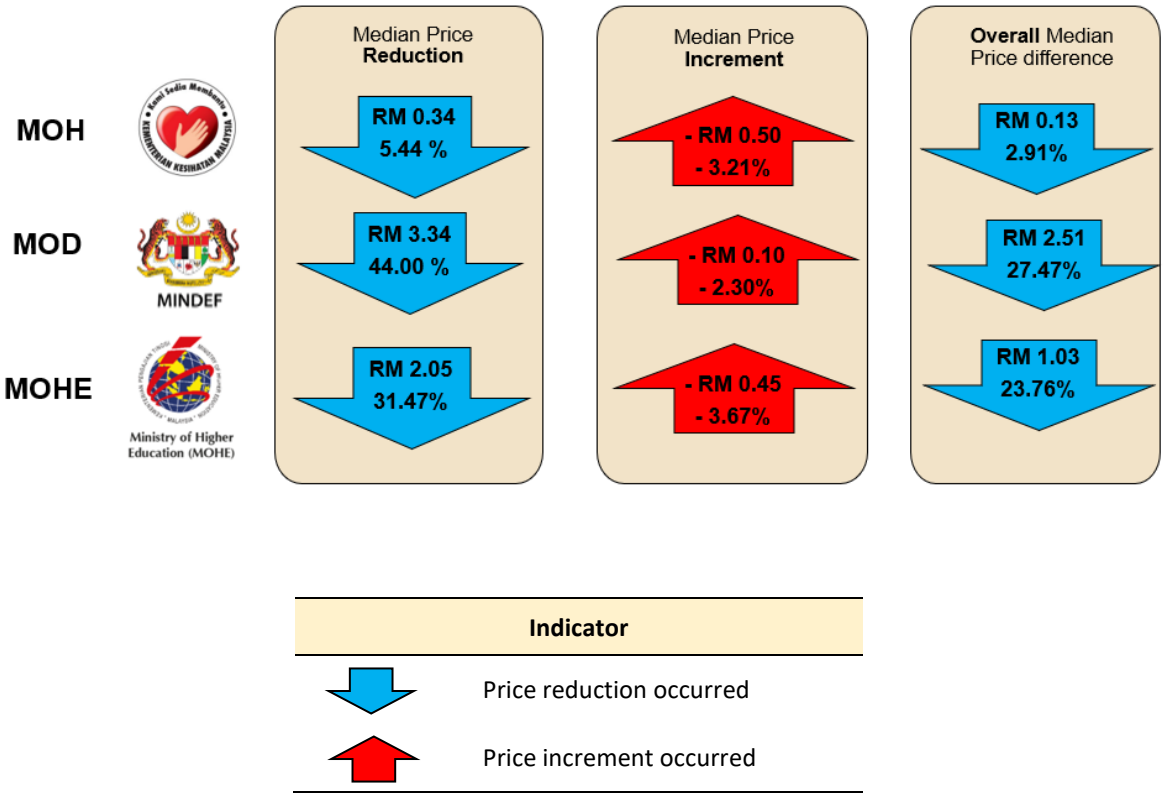
Changed of medicine brand		Overall estimated savings			Estimated savings			Estimated dissavings		
		No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)
Sultan Ahmad Shah Medical Centre (SASMEC)										
Same brand	**Innovator**	16	**577,754.95**	56.12	14	**581,439.50**	56.14	2	**3,684.55**	59.08
	Generic	7	**354,482.00**	34.43	5	**357,034.00**	34.47	2	**2,552.00**	40.92
Total same brand		-	**932,236.95**	-	-	**938,473.50**	-	-	**6,236.55**	-
Different brand	**Innovator to generic**	1	**36,605.00**	3.56	1	**36,605.00**	3.53	-	**-**	-
	Generic to other generic	3	**50,760.50**	4.93	3	**50,760.50**	4.90	-	**-**	-
	Generic to Innovator	1	**9,903.00**	0.96	1	**9,903.00**	0.96	-	**-**	-
Total different brand		-	**97,268.50**	-	-	**97,268.50**	-	-	**-**	-
Overall SASMEC		**28**	**1,029,505.45**	**100.00**	**24**	**1,035,742.00**	**100.00**	**4**	**6,236.55**	**100.00**
Al Sultan Abdullah Hospital (HASA)										
Same brand	**Innovator**	17	**242,963.10**	50.08	15	**244,422.90**	50.23	2	**1,459.80**	100.00
	Generic	2	**48,805.00**	10.06	2	**48,805.00**	10.03	-	**-**	-
Total same brand		-	**291,768.10**	-	-	**293,227.90**	-	-	**1,459.80**	-
Different brand	**Innovator to generic**	2	**109,141.69**	22.50	2	**109,141.69**	22.43	-	**-**	-

Changed of medicine brand		Overall estimated savings			Estimated savings			Estimated dissavings		
		No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)
	Generic to other generic	2	**84,232.38**	17.36	2	**84,232.38**	17.31	-	-	-
	Generic to Innovator	-	-	-	-	-	-	-	-	-
Total different brand		-	**193,374.07**	-	-	**193,374.07**	-	-	-	-
Overall HASA		**23**	**485,142.17**	**100.00**	**21**	**486,601.97**	**100.00**	**2**	**1,459.80**	**100.00**
Sultan Abdul Aziz Shah Hospital (HSAAS)										
Same brand	**Innovator**	5	**78,120.40**	30.19	5	**78,120.40**	30.19	-	-	-
	Generic	1	**19,500.00**	7.54	1	**19,500.00**	7.54	-	-	-
Total same brand		-	**97,620.40**	-	-	**97,620.40**	-	-	-	-
Different brand	**Innovator to generic**	3	**161,127.60**	62.27	3	**161,127.60**	62.27	-	-	-
	Generic to other generic	-	-	-	-	-	-	-	-	-
	Generic to Innovator	-	-	-	-	-	-	-	-	-
Total different brand		-	**161,127.60**	-	-	**161,127.60**	-	-	-	-
Overall HSAAS		**9**	**258,748.00**	**100.00**	**9**	**258,748.00**	**100.00**	-	-	-

3.1.2 Procurement Prices Differences

3.1.2.1 By Ministry

Overall, there was a significant difference in the unit price before and after the PP ($p<0.05$) due to a significant savings for all three (3) ministries, as shown in Figure 3.5 (refer Appendix XIII). The MOD achieved the highest price estimated savings of 44.00%, with median price reduction of RM3.34 per unit [IQR: RM0.66 - RM14.62], followed by MOHE with a 31.47% estimated savings, RM2.05 [IQR: RM0.33 - RM9.72], and the MOH recorded a 5.44% estimated savings, RM0.34 [IQR: RM0.08 - RM3.63]. However, when examining the estimated price dissavings, MOH showed the largest median dissavings at 3.21%, or RM0.50 [IQR: RM0.11 - RM3.52]. Meanwhile, MOHE had a 3.67% estimated dissavings [RM0.45, IQR: RM0.15 - RM1.06], and MOD had a 2.30% estimated dissavings, RM0.10 (IQR: RM0.03 - RM1.56).

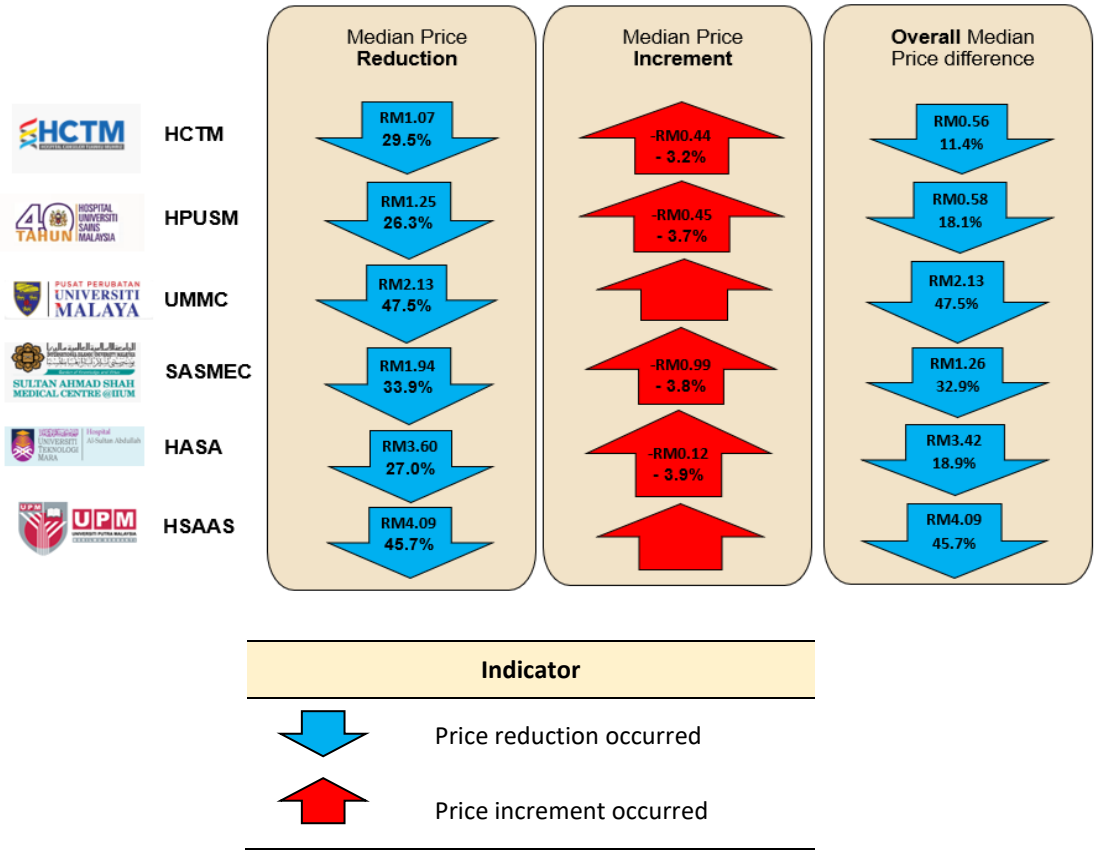


*The significant *p*-value was shown is less than 0.05

Figure 3.5 The comparison of procurement prices before and after implementation of inter-ministerial pooled procurement

3.1.2.2 By six (6) University Teaching Hospitals (UTHs)

The six (6) UTHs under MOHE that participated in the PP program demonstrated significant estimated cost savings, as presented in Figure 3.6 (refer to Appendix XIV). The highest estimated savings were achieved by UMMC, at 47.45%, amounting to median price reduction of RM2.13 (IQR: RM0.53 – RM7.10). HSAAS followed with estimated savings of 45.74% (RM4.09, IQR: RM2.07 – RM4.70). Other institutions also demonstrated notable savings, including SASMEC (33.89%), HCTM (29.48%), HASA (27.02%), and HUSM (26.28%). In contrast, four (4) UTHs recorded estimated dissavings, with HASA reporting the highest at 3.86%, equivalent to RM0.12 (IQR: RM0.10 – RM0.13). This was followed by SASMEC at 3.79% (RM0.99, IQR: RM0.69 – RM3.67), HUSM at 3.67% (RM0.45, IQR: RM0.25 – RM1.75), and HCTM at 3.17% (RM0.44, IQR: RM0.16 – RM0.97). Notably, UMMC and HSAAS reported only estimated savings, with no observed dissavings.



*The significant *p*-value was less than 0.05.

Figure 3.6 Comparison of procurement prices before and after implementation of pooled procurement by UTHs

3.2 FACTORS AFFECTING ESTIMATED COST-SAVINGS IN POOLED PROCUREMENT

The factors influencing estimated cost-savings in PP were illustrated in Table 3.4 and Table 3.5, based on the assumption that all facilities had access to quantity and procurement data (n= 82 medicines, 656 datasets) for both before and after PP. This assumption data was made to achieve a powerful statistical analysis. Each factor was analyzed, followed by a multifactorial analysis using MLR.

3.2.1 Single factors affecting estimated cost-savings in pooled procurement

The correlation analysis demonstrated that quantity of medicines procured explained 3.85% of the variance in estimated savings, confirming a positive relationship between procurement volume and cost-savings (refer Table 3.4). This suggests that as the procurement quantity increases, savings also increase proportionally by this percentage. The regression analysis provided further support for the model's predictive strength, with a statistically significant ($p<0.05$). Additionally, the regression's coefficients provide insights into the magnitude of the effect. It could be explained that, for every unit increase in PP quantity, estimated savings and overall savings are predicted to increase by 3.52 times, assuming all other variables remain constant.

Table 3.4 Factor of quantity affecting cost-savings in pooled procurement

Estimated cost-savings category	Coefficient	r-squared (r^2)	SE	t	p-value	95% CI	
						Lower	Upper
Savings	3.52	0.0385	0.76	4.67	**<0.05**	2.05	5.01
Dissavings	-0.08	0.0145	0.64	-1.25	0.215	-0.21	0.05

SE: standard error; CI: confidence interval

Pearson-correlation analysis. Statistical analysis was observed as p-value less than 0.05

Other than quantity, various factors such as inter-ministerials involvement in PP, medicines brand (innovator or generic), changed of medicines brand, Single PRH medicines, number of bidders, medicine prices negotiation and tiered pricing factors were found to be statistically significant ($p < 0.05$) when analyzed individually (refer Table 3.5). However, the patent status observed no significant differences with overall estimated cost-savings.

Table 3.5 Single factors affecting cost-savings in pooled procurement

Parameters	N	Total estimated savings, RM ($)	Mean ± SD	P-value
1. Inter-ministerials involvement in PP				
MOH	82	120,418,398.16 (26,971,696.70)	1,942,232 ± 3,554,533	[b]**P<0.05**
MOD	82	7,842,230.55 (1,756,527.80)	110,454 ± 232,375	
MOHE	492	122,476,003.63 (27,429,665.23)	295,122.9 ± 2,051,391	
2. Medicines brand (innovator or generic)				
Innovator	349	54,969,332.21 (12,310,904.47)	157,505.2 ± 504,610.3	[a]**P<0.05**
Generic	199	195,767,300.13 (43,847,024.90)	983,755.3 ± 3,551,731	
3. Patent status				
No	521	247,075,415.40 (55,337,273.53)	474,233 ± 2,265,465	[a]0.9381
Yes	27	3,661,216.93 (819,999.68)	135,600.6 ± 206,204	
4. Changed of medicines brand				
• Generic to same generic • Generic to generic different brand	163	94,578,467.78 (21,181,693.49)	517,353.97 ± 1,337,586.54	[b]**P<0.05**
• Generic to innovator • Innovator to innovator	349	54,969,332.21 (12,310,873.43)	108,331.56 ± 469,050.03	
• Innovator to generic	36	101,188,832.34 (22,663,941.60)	2,810,800.90 ± 760,385.86	
5. Single PRH medicines				
Non- Single PRH medicines	393	234,379,847.80 (52,493,894.10)	596,386.40 ± 2,592,199.00	[a]**P<0.05**
Single PRH medicines	155	16,356,784.53 (3,663,417.84)	105,527.60 ± 279,571.10	

Parameters	N	Total estimated savings, RM ($)	Mean ± SD	P-value
6. Number of bidders				
Only one bidder	218	49,393,060.38 (11,062,233.00)	226,573.70 ± 727,108.3	**[a]P<0.05**
More than one bidder	330	201,343,571.96 (45,093,571.64)	610,132 ± 2,777,911	
7. Medicine prices negotiation				
No	333	221,661,068.82 (49,644,355.38)	608,614.00 ± 2,706,924	**[a]P<0.05**
Yes	215	29,120,563.52 (6,521,991.49)	77,288.48 ± 301,035.6	
8. Product origin				
Local	80	42,017,157.20 (9,409,773.66)	591,790.9 ± 2,412,627	**[a]P<0.05**
Imported	576	208,719,4754.14 (467,438,743.63)	437,567 ± 2,180,865	
9. Tiered pricing				
Tier 1	174	144,553,338.22 (32,374,177.70)	830,766.3 ± 3,497,062	**[b]P<0.05**
Tier 2	110	34,280,592.13 (7,677,484.28)	311,641.7 ± 1,515,272	
Tier 3	133	54,831,459.99 (12,280,058.36)	412,266.6 ± 1,285,980	
Tier 4	74	11,685,278.42 (2,616,990.97)	157,909.2 ± 759,206.8	
Tier 5	57	5,385,963.58 (1,206,220.13)	94,490.59 ± 313,936	

SD: standard deviation

[a]Mann-Whitney test, [b]Kruskal-wallis H test. Statistical analysis was observed as p-value less than 0.05. Exchange rate from Bank Negara Malaysia (BNM) of USD (RM) is equal to $1.00 (RM4.47) (Bank Negara Malaysia, 2024).

Among the three (3) ministries, MOH (RM 120 million) and MOHE (RM 122 million) achieved the highest estimated savings through the implementation of PP. While MOD (RM 7 million) also experienced cost savings, these savings were comparatively lower than those realized by MOH and MOHE.

In terms of medicines brand (innovator or generic), generic medicines demonstrated higher cost savings compared to innovator medicines, amounting to RM195 million and RM54 million, respectively. Similarly, changing the medicine brand, particularly switching from innovator to generic medicines, resulted in the highest savings of RM101 million, whereas

switching within the same innovator or generic brand or transitioning from generic to innovator medicines yielded comparatively lower savings.

Besides, Table 3.5 highlight the profound impact of adapting competition in the procurement of medicines, particularly by involving multiple PRHs rather than Single PRHs. Procurement strategies that engage multiple PRHs have consistently demonstrated higher cost-savings; RM234.4 million, compared to Single PRHs procurement (RM16.4 million). This significant difference emphasise the critical importance of competition as a cost-savings strategy.

It aligns with the findings on the number of bidders, which indicate that an increase in bidders enhances the probability of overall estimated cost savings. Higher savings were achieved when multiple bidders (RM 201 million) were involved compared to a single bidder (RM49 million), with the greatest savings occurring when several bidders competed for the same contract.

Furthermore, this study found that higher cost savings were observed in situations where negotiations were not required (RM221 million). Additionally, imported medicines in this study generated the highest savings (RM 208 million), attributed to economies of scale and competitive pricing offered by multinational manufacturers. Generally, the patent status of medicines can influence cost-savings in PP. However, in the context of government PP in this study, patent status has not demonstrated a significant impact on cost-savings as shown in Table 3.5.

In terms of tiered pricing, Tier 1 medicines (RM0.01 to RM1.00) recorded the highest savings, amounting to RM14 million across various pricing categories. Higher-priced categories tended to show relatively smaller savings due to their higher base prices and limited potential for price reductions through PP. However, price tiers were more relevant for descriptive analysis rather than demonstrating statistical significance.

3.2.2 Multiple factors influencing the estimated cost-savings in pooled procurement

A single-factor analysis identified eight factors that statistically influence cost savings in PP. However, only two (2) factors demonstrated statistically significant effects on estimated cost-savings ($p<0.05$) through multifactorial analysis. These factors were inter-ministerials involvement and the changed of medicines brand from innovator to generic medicines. Interestingly, the quantity procured did not exhibit a significant impact, which may be attributed to complex multi-variable interactions (see Table 3.6).

A MLR analysis revealed a modest 14.8% correlation between multiple considered factors and estimated cost savings in PP. While this indicates a measurable relationship, it also

suggests that other unexamined variables or complexities within the procurement process may dilute the direct effects of the analyzed factors.

Table 3.6 Multiple factors affecting cost-savings in pooled procurement

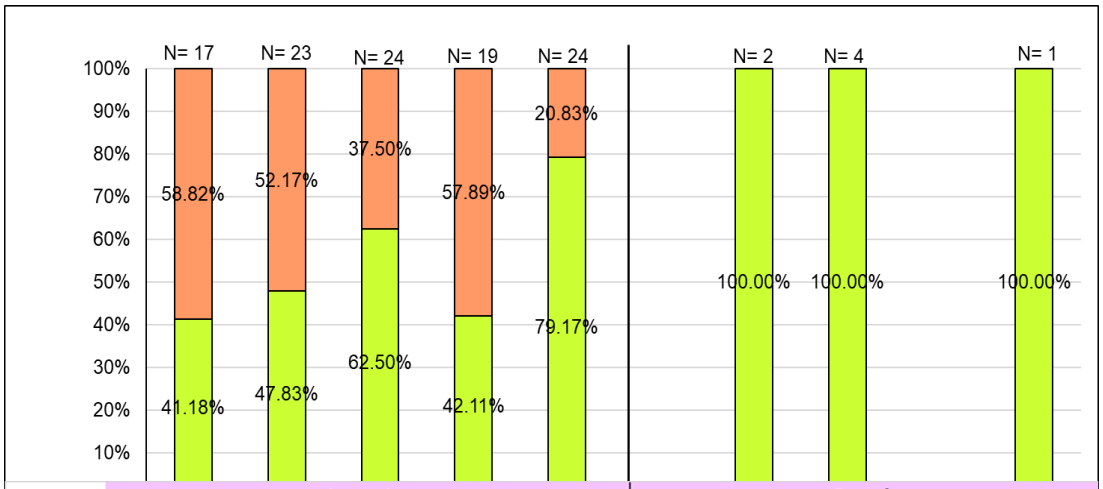
Independent variables	Coefficient	S.E	T	Sig. (p<0.05)	95% CI	
					Lower	Upper
Inter-ministerials involvement in PP	1,216,199	326,549.4	3.72	**<0.05***	574,736.6	1,857,662
Changed of medicines brand						
i. To innovator	-410,310.4	216,134.5	-1.90	0.058	-834,877.7	14,256.94
ii. To generic	1,972,598	386,466.2	5.10	**<0.05***	1,213,437	2,731,759
Single PRH medicines	461.2508	223,945.8	0.00	0.998	-439,450.4	44,032.9
Number of bidders	-22,812.02	198,664.4	-0.11	0.909	-413,061.8	367,437.8
Medicine prices negotiation	-192,551.9	204,997.8	-0.94	0.348	-595,242.7	210,138.9
Quantity	1.631	0.846	1.93	0.054	-0.031	3.293

S.E: standard error; CI: confidence interval

Multiple linear regression. R-squared (r^2) =0.1428 with significant p-value < 0.05*

3.3 COMPARISON OF MEDICINES POOLED PROCUREMENT PRICE WITH REFERENCE COUNTRIES' PRICES

In the current analysis, the PP prices were compared with reference prices from five (5) countries: Australia, Taiwan, South Korea, Thailand, and South Africa. These countries were selected based on regionality, Gross National Income (GNI) per capita, with established medicine pricing regulations.



	Innovator					Generic				
	Australia	Taiwan	Thailand	South Korea	South Africa	Australia	Taiwan	Thailand	South Korea	South Africa
Total (N)	17	23	24	19	24		2	4		1
n ≤1	7	11	15	8	19		2	4		1
% Ratio ≤1	41.18%	47.83%	62.50%	42.11%	79.17%		100.00%	100.00%		100.00%
n >1	10	12	9	11	5		0	0		0
% Ratio >1	58.82%	52.17%	37.50%	57.89%	20.83%		0.00%	0.00%		0.00%

Ratio ≤1 = Medicine prices in Malaysia is lower than prices in reference countries; Ratio >1 = Medicine prices in Malaysia is higher than prices in reference countries; N= total number of medicines, n= number of medicines

Figure 3.7 Medicines procurement price compared to reference countries

Malaysia's innovator medicine prices are lower than those of reference countries as presented in Figure 3.7. Specifically, 15 of 24 innovator medicines were procured at lower prices than in Thailand (62.50%), and 19 out of 24 were lower than in South Africa (79.17%). For instance, Budesonide & Formoterol 160mcg + 4.5mcg was procured at prices ranging from 0.51 to 0.96 (Australia: 0.86; Taiwan: 0.51; Thailand: 0.96; South Korea: 0.70; South Africa: 0.94) (refer Appendix XVI). Generic medicines such as Calcium Polystyrene Sulphonate 5gm, Capecitabine 500mg, Dexmedetomidine HCl 100 mcg/ml, and Warfarin Sodium 3mg, are procured at low prices, ranging from 0.32 to 0.88.

4.0 DISCUSSION

4.1 ESTIMATED SAVINGS AND PROCUREMENT PRICE DIFFERENCES IN MEDICINES POOLED PROCUREMENT FOR THE PUBLIC SECTOR

Public procurement in Malaysia has adopted PP for medicines since 2020 to improve access to medicines and procurement efficiency. Current findings on PP demonstrate that MOH facilities contributed to the highest total estimated PP savings at 63.3%, followed by MOHE and MOD. It is important to note that, in this study, certain facilities within the MOD and MOHE did not procure all the medicines listed under the PP medicines list. The decision not to procure the remaining medicines may be attributed to the fact that both MOHE and MOD facilities maintain their own hospital formularies, which define the range of pharmaceutical products that these healthcare facilities are authorized or required to procure (MOH,2024). For example, utilizes its own formulary known as *Formulari Ubat-ubatan Perkhidmatan Kesihatan Angkatan Tentera (FORSIHAT)*, which is a comprehensive compilation of pharmaceutical products that have been reviewed, assessed, and approved for use by the Malaysian Armed Forces Health Services (MAFHS) (Malaysian Armed Forces Health Services, 2024).

Moreover, the decision not to procure certain medicines under PP in MOD and MOHE facilities is also influenced by differences in facility practices and the clinical preferences of specialists, which can significantly impact procurement costs. Some of the facilities also have medicines brand preferences mandated by hospital policy, as approved by their Medicines and Therapeutics Committee (WHO,2014). For instance, some hospitals have policies that prioritize generic medicines for formulary medications, when available.

Brand preferences are further influenced by the specialties of physicians, who may rely on their own experiences, local studies, or practices observed in other hospitals. Negative perceptions about the safety, quality, and efficacy of generic medicines among physicians can also hinder their usage (Kumar et al, 2015). Some specialists insist on using only innovator brands for critical or life-saving medicines, such as antiepileptics and anesthetics, due to their perceived superior quality (Shaw & Hartman, 2010). Similarly, the Military Therapeutic Benefits (MTB) program implemented by MOD may prioritize certain innovator medicines, reflecting the critical necessity of safeguarding the health and ensuring the operational readiness of military personnel (Malaysian Armed Forces Health Services, 2024).

Additionally, some healthcare facilities are structured to focus on specialized medical care, prioritizing departments such as internal medicine, surgery, orthopedics, and obstetrics and gynecology (O&G), among others. This specialized approach further limits the range of medicines needed, as the institution prioritizes therapies that align with the services provided (MOH,2012).

Aside from these reasons, certain facilities in this study opted not to participate certain medicines in the PP initiative due to existing ongoing contracts. In some cases, facilities had already secured lower prices through independent negotiations, thereby reducing the potential savings from participating in the PP initiative. Among all UTHs, HSAAS has the least number of medicines involved in PP. This is because HSAAS received official approval to join the PP in 2021 and issued its first contract in 2022. As a result, HSAAS had fewer medicines involved in the procurement process compared to other UTHs that had been participating since the initial stage of PP.

Sultan Abdul Aziz Shah Hospital (HSAAS), which began operations in 2019, had only 69% of its beds fully functional by 2022, limiting its annual capacity to approximately 7,385 inpatient and 136,792 outpatient visits. This limited capacity resulted in fewer patient visits compared to other UTHs, leading to lower demand for medicine supplies. When HSAAS joined the PP initiative with larger quantities, it secured lower prices from suppliers, which effectively avoided dissavings. This strategic approach benefited the smaller facility by optimizing its procurement process and managing costs more efficiently.

As the primary healthcare provider in the country, MOH oversees a wide network of health facilities, allowing for substantial procurement volumes that drive economies of scale and cost efficiencies (WHO, 2021). Theoretically, PP volumes allow governments to negotiate better pricing, stimulate supplier competition, and improve supply chain efficiency. As the quantity of medicines purchased increases, the per-unit price tends to decrease due to the enhanced bargaining power of the purchasing entities (Parmaksiz et al., 2022; WHO, 2021).

These results align with findings from a study in China, where centralised medicines procurement significantly benefited government healthcare. In rural China, the PP of essential medicines reduced overall medicine costs, which in turn improved access to healthcare services and increased healthcare utilisation (Li et al., 2013). Furthermore, PP has resulted in price reductions and cost-savings in a number of countries, including India, Mexico, and Jordan (L. Chen et al., 2020; X. Chen et al., 2022; Seidman & Atun, 2017). Using WHO Global Price Report Mechanism (GPRM) data from 2004 to 2013, price reductions on antiretroviral therapy (ARV) medicines were observed when joint procurement was implemented (Kim & Skordis-Worrall, 2017). In Brazil, PP reduced total costs by 33%, allowing for the procurement of a greater quantity of medicines with the same budget (Do Amaral & Blatt, 2011).

Pool procurement (PP) not only leads to substantial cost reductions but also enables smaller organizations or countries to access prices that would otherwise be unavailable when purchasing independently. By centralizing procurement, public healthcare systems can standardize pricing across institutions, thereby mitigating the inefficiencies associated with fragmented purchasing practices (Pharmaceutical Services Programme, 2022). The implementation of efficient procurement strategies, such as bulk purchasing and competitive bidding, has been demonstrated to reduce costs (Fraser, 2020). Within the MOHE, HCTM

achieved the highest savings, accounting for 48.9% of total estimated procurement savings, followed by HUSM. MOHE's centralized procurement for six (6) UTHs generates substantial demand, enhances bargaining power, and results in significant cost reductions. On the other hand, UMMC experienced no estimated dissavings, as it selectively participated in pooled procurement, focusing on specific medicine prices and brands.

This study also found that following the implementation of PP, MOD achieved the highest unit price reduction at 44.00%, with an estimated median savings of RM3.34 per unit. MOHE followed with a 31.47% reduction (RM2.05 per unit), while MOH recorded the lowest reduction at 5.44% (RM0.34 per unit). These findings indicate that PP effectively reduced medicine costs across all three ministries, with the greatest impact on median price reduction per unit observed for MOD and MOHE. Prior to PP implementation, price variations across ministries led to inefficiencies. However, standardized pricing under PP allows both MOHE and MOD to achieve significant cost savings (Pharmaceutical Services Programme, 2022). By ensuring price consistency, MOHE and MOD, in particular, stand to benefit from lower overall procurement costs, which were previously inflated by inconsistent pricing structures across ministries.

Ministry of Health (MOH) achieved the highest estimated savings but had the lowest median price reduction per unit. This suggests that while PP led to substantial total cost savings, the price reduction for individual medicines was relatively small. This can be attributed to several factors. First, MOH procures medicines in much larger volumes than MOD and MOHE. Even with a smaller percentage reduction in unit prices, the overall savings remain significant due to the high purchase volume. Additionally, MOH may have already secured lower baseline prices before PP, leaving less room for further reductions (Hamzah et al, 2020). Furthermore, MOH purchases a diverse range of essential and specialized medicines, some of which may have fixed or regulated pricing, limiting the extent of cost reductions (Hamzah et al, 2020). Lastly, the MOH reported the highest median price dissavings at 3.21%, suggesting that price increases for some medicines mitigated the overall reduction in unit prices. Essentially, while some medicines saw a decrease in price, others experienced an increase, thus balancing the overall price changes.

Facilities with a centralized procurement system often benefit from economies of scale, allowing them to negotiate lower prices due to larger purchase volumes (Geropoulos, 2024). Administrative costs are minimized through streamlined contract negotiations, enhanced operational management, and efficient procurement processes. Additionally, PP helps stabilize medicine price margins through long-term contracts, preventing price fluctuations. Similar successes have been observed in countries like Brazil and China, where PP has effectively reduced costs and improved access to medicines. (Shi et al., 2018; Barbosa & Fuiza, 2011).

In overall, these cost reductions through PP implementation enable the government to allocate resources more efficiently, redirecting savings to other critical healthcare needs and improving overall healthcare delivery. This PP strategy lowers procurement costs through two key mechanisms. First, rather than incurring bilateral negotiation and transaction costs for each facility, the PP can effectively reduce such costs through the consolidated agreement on behalf of all facilities involved. Second, by anticipating multiple facilities based on the health needs, it can effectively lower unit prices by broadening negotiation and transaction costs across them, allowing each country to bear only a fraction of the costs (Chen et al., 2020).

However, some studies reported the opposite findings. In China, for example, the centralized medicines procurement was insufficient to bring down both inpatient and outpatient expenditures (Zhang et al., 2024). Besides, a study on ARV medicines discovered that the negotiated prices by Mexico's Coordinating Commission for Negotiating the Price of Medicines and Other Health Inputs (CCNPM) were higher on average than those paid by similar upper-middle income countries, and even lower-middle income countries (LMIC) (Chaumont et al., 2015). A study in Brazil, on the other hand, found that the effect of PP is dependent on the composition of the pool of buyers: if buyers with higher credit risk are added to the pool, the price may increase (Barbosa & Fiuza, 2011).

While PP presents considerable cost-saving potential, various challenges continue to impede its full optimization. Accurate forecasting of medicine needs remains difficult, particularly in UTHs, leading to over- or under-purchasing. The underestimation of required quantities at certain facilities can result in stock shortages, whereas overestimation may lead to excess inventory and wastage. Additionally, an increase in patient load, along with policy changes such as updates to treatment protocols, formularies, or clinical preferences can further disrupt the accuracy of demand forecasting. When such changes occur unexpectedly, they increase the likelihood of misaligned procurement plans (MyCC, 2017). As a result, additional procurement from local sources often incurs higher costs than the agreed PP prices. These reactive purchases can erode cost savings and create inefficiencies within the procurement system (MyCC, 2017).

To mitigate these risks, healthcare institutions must employ robust forecasting mechanisms, continuously monitor the market, and develop flexible procurement strategies that can respond to policy or demand shifts without significant cost increases (OECD, 2020). One of the most effective methods for forecasting pharmaceutical demand is analyzing past usage trends. However, this data must be adjusted to account for anticipated changes in factors such as morbidity patterns, seasonal variations, service levels, formulary updates, prescribing practices, and patient admissions (Bilal et al 2024; Safaeian et al 2015; Sharifnia et al 2018). In many countries, however, past usage data may be incomplete or fail to accurately reflect actual healthcare needs, limiting the effectiveness of demand forecasting.

In addition to these challenges, variations in practices among healthcare facilities and specialists significantly influence procurement costs. For instance, specialists in UTHs may shape clinical practices by favoring innovator medicines over generics due to their personal experience and familiarity with these products. These inconsistencies in medicine selection further complicate demand forecasting and procurement planning, potentially leading to inefficiencies in supply management. To address these challenges, harmonizing medicine formulations, packaging, and labeling is recommended. Standardizing procurement practices can help create more reliable usage data, facilitating economies of scale, improving supplier relationships, and optimizing forecasting models. By adopting a more uniform approach, healthcare institutions can enhance procurement efficiency, minimize cost variations, and improve the accuracy of pharmaceutical demand forecasting (Parmaksiz et al 2022).

Other challenges such as global supply chain disruptions caused by pandemics or geopolitical issues, often exacerbate these challenges. Global shortages reduce the availability of essential medicines and supplies, forcing UTHs to rely on local purchases or issue new tenders under tight time constraints, which typically results in higher prices (WHO, 2016). Local vendors may charge a premium due to urgency, limited competition, or increased costs due to global shortages.

While dissavings may not be the primary focus, their occurrence, reflected in negative savings values or increased procurement costs, remains a key indicator of procurement performance. Dissavings often arise at specific facilities due to price adjustments aimed at standardizing costs across all participants. For example, Alprostadil 500 mcg/ml injection resulted in dissavings for MOH facilities, while others achieved savings through PP, reflecting efforts to maintain equitable pricing. Price increases, a major driver of dissavings, stem from factors such as global market price fluctuations, currency depreciation, supply chain disruptions, and supplier pricing strategies (Janssen et al 2021; Anam et al 2022). These factors influence costs beyond the control of procurement bodies, underscoring that dissavings are not necessarily a sign of inefficiency but a reflection of complex market dynamics. Understanding these elements supports more informed assessments of procurement performance and strategies for future cost optimization.

4.2 FACTORS AFFECTING ESTIMATED COST-SAVINGS IN POOLED PROCUREMENT

Pooled procurement (PP) has become a critical strategy for reducing pharmaceutical costs by consolidating purchasing power across various entities. In countries like Malaysia, where facilities under the MOH, MOD, and MOHE engage in PP, significant financial benefits have been observed (Pharmaceutical Services Programme, 2023a). However, despite the evident potential for cost savings, the extent of these savings is shaped by a variety of factors that can affect their magnitude. This study analyzes ten (10) key factors affecting pooled procurement, based on an assumption dataset where all facilities had access to quantity and procurement data. These factors include quantity, inter-ministerial involvement in PP, medicines brand (innovator or generic), patent status, changes in medicine brand, Single PRH medicines, number of bidders, price negotiation strategies, product origin, and tiered pricing.

Among the factors examined, the quantity of medicines procured plays a crucial role in determining the overall cost savings achieved through pooled procurement (PP). In this study, while multivariable analysis showed no significant impact of procurement quantity, correlation analysis revealed a positive association with cost savings, likely obscured by complex variable interactions. These interactions could obscure the direct influence of quantity, redirecting the effect towards other variables that interplay in medicines PP.

Despite these statistical nuances, the conceptual importance of procurement quantity remains clear. The central premise of PP lies in aggregating demand across multiple institutions to leverage economies of scale. As procurement quantities increase, buyers are better positioned to negotiate lower unit prices, particularly when purchasing directly from manufacturers or large-scale distributors. These findings underscore the importance of procurement volume in enhancing cost efficiency through PP.

Larger procurement volumes offer significant administrative and logistical advantages. Suppliers benefit from reduced transaction costs, lower packaging and distribution expenses, and more predictable sales forecasts, all of which encourage them to offer more competitive pricing (Parmaksiz et al 2022). From the buyer’s standpoint, purchasing in bulk decreases the frequency of tendering processes, thereby reducing administrative burdens (Domfeh et al 2021, Parmaksiz et al. 2022). Additionally, it enhances inventory predictability, reducing the need for emergency purchases from higher-priced local suppliers (WHO Regional Office for South-East Asia, 2014). These efficiencies play a crucial role in driving cost reductions and optimizing the overall procurement process.

The "4+7" drug procurement reform in China represents a practical application of pooled procurement at a national scale (Xiao Yue, 2019). By aggregating the purchasing demand of 11 major cities, the initiative effectively consolidated market power, enabling the central authority to negotiate more favorable terms with pharmaceutical suppliers. A key

feature of this model was the guarantee of a minimum 60% market share to selected suppliers, a commitment made feasible only through the scale achieved by pooling demand. This guaranteed volume reduced market uncertainty for manufacturers, lowered their marginal costs through economies of scale, and facilitated significant price reductions. An empirical evaluation by Chen et al. (2021) using interrupted time-series analysis found that the "4+7" policy not only led to a sharp increase in the use of selected generics but also resulted in a significant decline in drug expenditures in the pilot cities. These findings demonstrate how pooled procurement, when supported by predictable volume commitments, can enhance market efficiency and improve access to affordable medicines.

Similarly, the concept of collaborative purchasing and its role in driving cost savings is reinforced by evidence that interministerial participation significantly contributes to improved procurement outcomes. Ministries such as MOH, MOD, and MOHE can achieve substantial savings through shared resources and collective purchasing. While the sheer quantity of procurement plays a crucial role in achieving cost efficiencies, interministerial collaboration adds another layer of value. By coordinating across ministries, procurement becomes more efficient and effective, allowing for better-negotiated contracts, lower prices, and optimized resource use. This study demonstrates that interministerial collaboration not only strengthens collective purchasing power but also enhances negotiation leverage, leading to more favorable contracts, reduced per-unit costs, and more efficient budget allocation (Seidman & Atun, 2017).

The study reveals a significant association between interministerial involvement and increased cost savings, underscoring the importance of cross-institutional collaboration in optimizing procurement processes. Ministries collaborating is better positioned to negotiate lower prices, secure bulk discounts, and streamline procurement procedures. In addition to financial savings, collaborative procurement facilitates more efficient resource utilization, reduces administrative costs, and improves overall procurement outcomes (Hannah et al. 2023, Parmaksiz et al. 2022). These findings highlight the critical role of interministerial coordination in maximizing procurement efficiency and cost savings in government initiatives.

In addition to interministerial collaboration, the role of generic medicines further enhances the cost savings achievable through pooled procurement. Generic medicines, which are generally priced lower than their innovator counterparts, represent a significant opportunity for cost reduction within procurement processes. This study finds that the substitution of generic medicines has a statistically significant impact on cost savings in PP ($p < 0.05$), emphasizing the importance of prioritizing more affordable alternatives.

This finding is consistent with the MOH's Promoting Generic Medicines Policy, as outlined in the Malaysian National Medicines Policy (MNMP). The policy advocates for the increased use of generic medicines in procurement, prescribing, and dispensing within MOH healthcare facilities (Pharmaceutical Services Programme, 2023b). By encouraging the

widespread adoption of generics, the MOH has significantly contributed to observed cost savings across the healthcare sector. Studies indicate that generic medicines can cost up to 85% less than innovator drugs (Straka et al., 2017), emphasising their potential to significantly reduce healthcare expenditures, particularly when procured in large volumes.

The cost reduction associated with generic medicines is further supported by market dynamics following the expiration of patents on innovator drugs. Patented medicines tend to be more expensive due to the market exclusivity granted to manufacturers (Vondeling et al., 2018). However, once patents expire, the introduction of generic alternatives fosters competition, driving prices down. Research has shown that this competitive environment results in lower prices for generics, making them a more cost-effective option for healthcare systems (Conrad & Lutter, 2019). These findings highlight the role of generics in pooled procurement models, where both strategic policies and market competition collaborate to maximize cost savings.

Building on this understanding, increasing the proportion of generic medicines in future pooled procurement efforts could prove highly beneficial for the government. However, it is noteworthy that 67% of the medicines included in the procurement for this study remain innovator medicines. This continued reliance on innovator medicines may limit the overall cost-saving potential. To maximize financial efficiency, it is crucial to adopt a balanced procurement strategy that integrates both generic and innovator medicines. While generics offer considerable cost reductions, innovator medicines may still be necessary to ensure access to patented treatments or specialized therapeutic options not yet available as generics. A dual approach would enable the government to maximize financial savings while maintaining a comprehensive and diverse supply of medicines to meet public health needs effectively.

Although patent status did not show a significant impact in this study, it remains a critical factor to consider in this context. For example, the loss of U.S. patent exclusivity between 2001 and 2007 notably affected the pricing and utilization of specialty drugs. Following the introduction of generic alternatives, substantial price reductions were observed, with physician-administered drugs experiencing greater price declines (38–46.4%) compared to oral medications (25–26%). Moreover, pooled models indicate an overall increase in drug utilization post-generic entry, with this trend being predominantly driven by oral drugs (Berndt, 2014). These findings emphasize the ongoing relevance of patent expiration when developing a procurement strategy that effectively integrates both generic and innovator medicines to maximize cost savings.

In connection with the factors mentioned above, the shift from innovator to generic medicines significantly contributes to cost savings, primarily due to the lower prices of generic alternatives. This study demonstrates a significant association between the switching of medicine brands and cost savings, with transitions from innovator to generic medicines

yielding the highest estimated savings. Generic medicines tend to be more affordable as their manufacturers do not bear the same research and development (R&D) costs as innovator companies (Dunne, 2013). Conversely, transitioning from generics to innovator medicines often leads to greater financial burdens, as innovator medicines are typically priced higher. Even after the expiration of patents, the prices of innovator medicines remain elevated due to brand reputation and perceived quality (Vondeling, 2018). Thus, the affordability of generics plays a pivotal role in improving access to essential treatments and ensuring that quality healthcare remains accessible to all (Straka et al., 2017).

However, the full economic benefits of generic substitution are often undermined by persistent barriers to their acceptance. Despite their proven bioequivalence and lower costs, the uptake of generic medicines remains hindered by persistent concerns about their quality and efficacy. Studies in Malaysia indicate that both patients and physicians often perceive generics as inferior, with limited awareness among practitioners regarding regulatory standards (Wong et al., 2014; Kumar et al., 2015; Shrank et al., 2011). These misconceptions contribute to resistance in switching from innovator to generic medicines, limiting potential cost savings and broader access. Addressing these barriers through education and strategic procurement policies can foster confidence in generics, enhance competition, and improve the affordability and sustainability of healthcare.

The status of a medicine as a single PRH or non-single PRH represents another key variable influencing cost-saving potential. This study found that greater savings were achieved with non-single PRH medicines, largely due to the presence of multiple suppliers enabling competitive bidding. Such competition drives down prices and promotes more efficient use of public health funds. While single PRH arrangements may be appropriate in certain cases such as for specialized or low-volume medicines, they typically do not offer the same economic advantages as pooled or competitive procurement models. Furthermore, reliance on a single supplier tends to be reactive in nature, addressing issues only after disruptions occur, and is thus less effective in managing risks related to price volatility and supply shortages (Hou et al., 2010; Burke et al., 2007). In the absence of timely alternatives, systems dependent on single PRHs remain susceptible to broader supply chain shocks (Yu et al., 2009). The findings emphasize the importance of procurement policies that are transparent, competitive, and adaptable in promoting cost savings and maintaining the stability of the medicine supply chain.

Expanding on these cost-saving benefits, competition among PRHs can also lead to improvements in service quality and product offerings. By fostering a competitive market, manufacturers are driven not only to reduce prices but also to enhance the reliability, availability, and quality of their products. Thus, decisions regarding the procurement sources must focus on strengthening the organization's ability to improve product availability, quality, innovation, and accessibility, while securing reduced costs in a more secure market (Pazirandeh,2011). This is particularly significant in the procurement of innovator medicines,

which often constitute a significant portion of procurement expenditures. Even in such cases, involving multiple PRHs can lead to efficiency profits, ensuring better value for money. Additionally, competition encourages innovation in logistics, delivery, and support services as suppliers strive to outpace their competitors. This dual benefit of cost reduction and quality improvement enhances the overall procurement system, ensuring that healthcare systems can procure high-quality medicines at sustainable prices, ultimately benefiting patients and healthcare providers (Seidman & Atun, 2017).

In addition to the competitive advantages, the present study highlights the significant role of the number of bidders in enhancing procurement performance. A higher number of bidders reduces the risk of dependency on a single supplier, which in turn promotes price stability and ensures stock availability throughout the procurement process (Wafula et al., 2013). Moreover, large numbers of bidders increase the likelihood of receiving diverse and innovative proposals, leading to better value beyond just price without compromising the quality care and safety of the patients. Increased competition also enhances the government's negotiating leverage, enabling it to secure more favorable terms and conditions from multiple bidders. Previous research has demonstrated that sufficient competition is linked to lower prices for medicines and vaccines (Dubois et al., 2021).

However, it is crucial to strike a balance between the number of bidders and the quality of offers. An excessive number of bidders may complicate the administrative and evaluation process, including sending out invitations, addressing queries, evaluating bids, and communicating the outcomes to bidders. These administrative costs may increase when suppliers are infrequently awarded contracts, which could deter future participation and result in a decrease in the number of competitive bids (Costantino et al., 2012).

The presence of more bidders also enhances the effectiveness of price negotiation, a key factor for achieving cost savings in this study. With a greater number of suppliers competing for the contract, the negotiation process becomes more dynamic, offering the government greater leverage to secure lower prices and better terms. Price negotiation involves bargaining between two or more parties, each pursuing its own goals and objectives, with the aim of reaching a mutually satisfactory agreement or resolving a matter of shared interest (Procurement Services SA, 2023). In Malaysia, the MOH has been implementing pooled procurement systems for pharmaceuticals for more than two decades through two approaches such as concession-based contracts and centralized contracts. Both methods incorporate competitive bidding mechanisms, including open tenders and negotiated tenders between the government and contracted suppliers (MOF,2022).

According to guideline, government may conduct negotiations with companies for open tender methods under the following conditions such as (MOF, 2022):

1. The process for conducting negotiations has received prior approval from the Procurement Board.

2. The conditions/options for negotiations have been clearly stated in the tender advertisement/document beforehand.

3. After the tender evaluation, the agency finds that no tender offers are most advantageous based on the evaluation criteria outlined in the tender advertisement and documents. For example, all offers are nearly identical in terms of technical and financial passing marks, bid prices, and other factors.

4. The agency must conduct negotiations only with bidders who have passed the technical and financial evaluations.

Price negotiations, with the approval of the Procurement Board, are typically conducted for high-priced medicines, Single PRH medicines, or offers that exceed tender price estimations or *Anggaran Harga Jabatan (AHJ).* Medicines that are considered expensive or outside the standard price range may require negotiation to ensure they are procured at a fair price. High costs can place a strain on budgets, therefore negotiations aim to reach a cost-effective agreement that aligns with financial constraints. Single PRH medicines are typically those with limited or no competition in the market. This lack of market competition often results in higher prices, as the exclusive rights holder controls the pricing without pressure from alternative suppliers. In such cases, price negotiation becomes crucial to ensure that public funds are utilized effectively while maintaining access to essential medicines. Besides that, when a supplier's offer exceeds the AHJ, the Procurement Board may intervene to review the financial situation and negotiate the price to ensure that the price is justified, within budgetary limits, and provides the best value for money (MOF, 2022).

The results of this study indicate that the greatest cost savings were achieved in instances where price negotiations were not necessary. This can be attributed to the competitive dynamics within the market and the efficiency associated with bulk procurement. In such cases, suppliers tend to present their most competitive prices initially, influenced by the scale of the purchase and market pressures. Specifically, bulk procurement allows for significant savings to be realized without the need for further negotiation, as suppliers are incentivized to offer lower prices in order to secure large-volume contracts.

Another important factor influencing PP is the origin of the product, specifically whether it is locally or internationally manufactured. In public procurement, there is a strong emphasis on supporting local manufacturers and suppliers, which is reflected in procurement policies such as *PK 2.1 Kaedah Perolehan Kerajaan* (MOF, 2022) and the MNMP (Pharmaceutical Services Programme, 2023b). These frameworks prioritize locally produced medicines to foster the growth of the domestic pharmaceutical industry, stimulate the local economy, and ensure that public funds benefit the community. Furthermore, local

manufacturers can offer advantages such as increased flexibility, shorter lead times, and the ability to comply with international standards like Good Manufacturing Practice (WHO, 2020). This focus on local production not only supports economic development but also enhances the reliability and sustainability of the supply chain, ultimately contributing to more cost-effective procurement processes.

The Skim Anak Angkat (SAA) is an example of an initiative that prioritizes local manufacturers and Bumiputera companies in public procurement (MOF, 2022). This program is specifically designed to support and promote local manufacturers, particularly those that are still small or in the early stages of development. Under this scheme, priority is given to local and Bumiputera companies in the procurement process, creating a platform for them to compete in the market. The initiative seeks to reduce reliance on imported products by encouraging the production of domestically manufactured goods. Furthermore, it supports the enhancement of local companies' capabilities in production, quality assurance, and market competitiveness, aligning with the broader objective of fostering economic self-reliance and empowering local industries.

However, despite the policy's focus on local production, imported medicines in this study were found to contribute to the largest cost savings. These savings are primarily driven by the economies of scale and competitive pricing strategies employed by multinational manufacturers. Companies producing high volumes of generics are able to offer lower and more stable prices compared to domestic producers, who may face limitations in terms of production scale. Overseas manufacturers often adopt a high-volume, low-price strategy, which makes their products more cost-effective in comparison. In contrast, local producers vary in their approach: some focus on high-priced innovator brands, while others target cost-sensitive patients with low-cost alternatives. Ultimately, the scale of production and the pricing strategies adopted by imported generics position them as a more attractive option for achieving significant savings in the procurement process (Danzon et al., 2013).

Nevertheless, Malaysia continues to rely on imported products due to the relatively small scale of its local manufacturing market. Local manufacturers face several challenges, including limited production capacity, a lack of advanced technology, and competition from well-established international suppliers (Hassali et al, 2009). This dependence underscores the ongoing need for initiatives that strengthen local manufacturing capabilities and reduce reliance on imports over time.

Another factor influencing the estimated savings in this study is tiered pricing. The analysis revealed that the greatest savings were achieved within the lowest price tier (Tier 1: RM0.01 to RM1.00), suggesting that low-cost medicines offer considerable cost-efficiency. However, the tiered pricing structure served more as a descriptive tool rather than one yielding statistically significant findings.

The distribution of medicines across pricing tiers may shift depending on fluctuations in market conditions, supplier pricing strategies, or changes in demand. For example, a rise in the procurement of higher-priced medicines could result in more items falling into the upper tiers, thereby diminishing potential savings in lower tiers. Conversely, competitive bidding or bulk discounts could reduce the cost of certain items, shifting them into lower tiers and increasing cost-efficiency in those segments.

Given these dynamics, it is essential to periodically review and adjust pricing tiers to ensure they remain aligned with current market conditions. This adaptability enables procurement systems to better capture financial efficiencies and maintain accurate assessments of cost-saving potential across the pricing spectrum.

The implementation of PP strengthens purchasing power by consolidating demand across institutions, which in turn facilitates access to more favorable pricing. As larger total order quantities are aggregated, the unit cost of medicines tends to shift toward lower pricing tiers, resulting in substantial cost savings (Dubois et al., 2021). Higher volume commitments allow for economies of scale, enabling procuring entities to negotiate more effectively with suppliers. In this context, ministries involved in PP are better positioned to leverage total quantity requirements for each medicine, thus achieving improved pricing outcomes and enhancing procurement efficiency.

4.3 COMPARISON OF MEDICINES POOLED PROCUREMENT PRICE WITH REFERENCE COUNTRIES' PRICES

International medicine price comparison is often advocated as a strategic tool to improve access and affordability, as it reveals price disparities that can limit access to essential medicines in some countries. It also serves as a valuable tool for policy benchmarking, allowing governments and regulatory bodies to negotiate better prices, implement price controls, or regulate domestic markets more effectively (Measuring Medicine Prices Methodology, 2015).

Thus, in the current analysis, the PP prices were compared with reference prices from five (5) countries: Australia, Taiwan, South Korea, Thailand, and South Africa. These countries were selected based on regionality, Gross National Income (GNI) per capita, with established medicine pricing regulations. Each country employs national healthcare schemes that effectively regulate medicine prices to ensure affordability. Australia employs the Pharmaceutical Benefits Scheme (PBS), which subsidies medicines for patients (Australian Government, 2022). Taiwan's National Health Insurance (NHI) negotiates prices for essential medicines to keep costs manageable (Chen et al., 2018). In Thailand, the National Health Security Office (NHSO) uses international reference pricing to regulate medicine prices (Patcharanarumol et al., 2018). South Korea's National Health Insurance Service (NHIS) also negotiates prices and encourages using generics to lower costs (Kim et al., 2017). Meanwhile, South Africa regulates medicine prices through Single Exit Pricing (SEP) policy regulating prices along the distribution chain (Code for Africa, 2019).

The finding of the current study aligns with the Medicine Prices Monitoring in Malaysia Report 2022, which indicated that over 60% of medicines acquired by the public sector were priced lower than those in reference countries, including Australia, Taiwan, South Korea, Thailand, and South Africa (Pharmaceutical Services Programme, 2022).

Medicine prices vary significantly between countries due to several key factors. First, the regulatory environment plays a crucial role, as different countries have distinct frameworks for medicines approval and pricing, which can affect compliance costs. Market size and competition also impact pricing; larger markets with more competitors typically see lower prices, while smaller markets may face higher costs due to limited competition (Nguyen et al., 2022). Additionally, a country's economic conditions and purchasing power influence how much consumers and health systems can afford to pay for medicines. The structure of the healthcare system, whether public or private, affects negotiation power and reimbursement approaches, further influencing prices. The best example is on the pricing for Hepatitis C medication. The cost of hepatitis C medications varies greatly between nations, especially when national income is taken into account. It's possible that poorer nations pay higher adjusted pricing than wealthier ones (Iyengar et al., 2016). Finally, variations in intellectual property laws can lead to disparities in availability and pricing; countries with stringent patent

protections may experience higher prices due to a lack of generic alternatives, while those with more lenient policies can benefit from reduced costs (Borrell et al., 2002).

However, some medicines in Malaysia showed significant price disparities, which can be attributed to variations in regulatory environments, market sizes across different treatment modalities, and the magnitude of local pharmaceutical industries. These differences can lead to inconsistent pricing for similar medicines, affecting affordability and access to necessary treatments. Despite the potential benefits of price comparison, these disparities highlight the challenges in making accurate cross-country comparisons. Factors such as differences in drug formulations, pack sizes, and procurement mechanisms, as well as the exclusion of confidential discounts and currency fluctuations, complicate the comparison process (Mulcahy et al., 2024). Furthermore, the availability of generics and biosimilars, influenced by intellectual property laws, adds another layer of complexity to price analysis (Mulcahy et al., 2024).

To address these issues, the government should focus on strengthening its medicine pricing policies. This could involve establishing more precise regulations that promote price transparency and fairness. Additionally, expanding pooled procurement (PP) for a broader range of medicines could leverage collective purchasing power, potentially leading to better prices and improved patient access.

Global best practices offer valuable insights for improving medicine pricing strategies. Countries like New Zealand and Canada have effectively used external reference pricing and centralized procurement to reduce costs (Morgan et al., 2017; Brandt, Shearer, & Morgan, 2018). Brazil's integration of international pricing with public production of generics highlights the advantages of hybrid approaches (Homedes & Ugalde, 2005). Furthermore, strategies such as regional procurement collaboration, digital procurement platforms, and increased transparency can strengthen price negotiations and improve access to medicines (Wirtz et al., 2017). By adopting these approaches, Malaysia can promote fairer medicine prices, enhance the sustainability of its healthcare system, and improve patient outcomes.

STUDY LIMITATION

This study has several limitations that should be considered. Firstly, the model only accounts for a limited number of variables, which may overlook other influential factors affecting savings from pooled procurement. Secondly, the predominance of innovator medicines (67% of medicines) could skew the results, limiting the generalizability of findings to generic medicines. Additionally, the reliance on historical data may not capture current market dynamics or pricing strategies. Lastly, the sample size, while substantial, may not encompass all relevant procurement scenarios, potentially affecting the robustness of the conclusions drawn.

5.0 CONCLUSION

The government has significantly benefited from inter-ministerial medicines PP efforts with remarkable savings. By consolidating the purchasing power of various public institutions and expanding the 'economy of scale', the government received price reductions through larger volumes, minimising price variability and preventing overpricing. Simultaneously, the initiative reinforces the generic medicines policy by allowing switching from innovators to generics, contributing to further price reduction and cost-savings for all of the ministries. This minimises provider-dependent variations in care and promotes more equitable health outcomes across all public sector facilities.

6.0 RECOMMENDATIONS

The adoption of PP offers a strategic opportunity for the government to enhance the cost-savings, eliminate price variation and improve procurement efficiency. Nevertheless, there are opportunities for improvement, and targeted recommendations are essential to address the ongoing challenges encountered during the implementation of pooled procurement. These improvements could enhance the efficiency and effectiveness of the procurement process, ensuring better outcomes for all stakeholders involved.

Recommendations such as:

i. Promoting generic substitution in PP, hence, the government can leverage the cost advantages on a larger scale, leading to substantial savings while achieving sustainable healthcare financing while maintaining high standards of care.

ii. In the event of underestimating the contracted quantity, stakeholders have suggested that the MOH could initiate the procurement of additional quantities. This approach would help to address potential shortages and ensure a stable supply of essential medicines. By planning for extra stock, the MOH would be better equipped to manage unexpected demand, policy changes, or supply chain disruptions. This proactive strategy would not only improve healthcare delivery and patient outcomes but also help mitigate medicine shortages in other ministries.

iii. A suggestion from the MOD is to include their own agreed quantity in the LOA to help manage medicine shortages. By having a specified allotment, the MOD can secure a more reliable supply of essential medicines and reduce dependency on external sources during times of shortage. This proactive measure would allow the MOD to better address its individual healthcare demands, ensuring a more stable supply and improving preparedness in the event of supply chain disruptions.

iv. Adopting digitalization in PP would significantly enhance transparency, efficiency, and cost-savings by enabling real-time monitoring of procurement and delivery processes. The use of data analytics enables more accurate demand forecasting, optimizes procurement cycles, enhances resource efficiency, and facilitates the negotiation of more favorable contracts with suppliers. Ultimately, integrating digital technology into public procurement fosters greater accountability, transparency, and cost-effectiveness.

v. Expanding PP for medicines is essential for enhancing healthcare efficiency, ensuring consistent access to essential medicines, and achieving long-term cost-savings. By broadening the scope to include more healthcare facilities and a wider range of

medicines—especially generics—the government can amplify economies of scale, negotiate better prices, and reduce supply chain fragmentation.

vi. Improving capacity building by providing training for procurement officials on best practices and negotiation techniques can improve procurement outcomes. Well-trained staff can better navigate the complexities of procurement and secure favourable terms.

7.0 REFERENCES

Anam, Raven A., Arias, Ces Danielle S ., Benga, Lovea M, Musong, Carlo Miguel M, Vadil, Zhandy Marielle L., Faller, & Erwin M. (2022). The Impact of the Inflation Crisis in Medication Pricing in Asean Countries: A Review. https://ijrpr.com/uploads/V3ISSUE12/IJRPR8740.pdf

Australian Goverment. (2022). Pharmaceutical Benefits Scheme

Bank Negara Malaysia. (2024). Exchange rates, retrieved November 2024, https://www.bnm.gov.my/exchange-rates

Barbosa, K., & Fiuza, E. (2011). *Demand Aggregation and Credit Risk Effects in Pooled Procurement:Evidence from the Brazilian Public Purchases of Pharmaceuticals and Medical Supplies*. www.eesp.fgv.br

Bare, A. (2015). December 2015 Pooled Procurement in the Vaccine Market: UNICEF's Experience. *William Davidson Institute, University of Michigan*.

Barton J.H. & Emanuel E.J. (2005). The Patents-Based Pharmaceutical Development Process: Rationale, Problems, and Potential Reforms. *JAMA.* ;294(16):2075–2082. doi:10.1001/jama.294.16.2075

Bilal, A. I., Bititci, U. S., & Fenta, T. G. (2024). Challenges and the Way Forward in Demand-Forecasting Practices within the Ethiopian Public Pharmaceutical Supply Chain. *Pharmacy (Basel, Switzerland)*, *12*(3), 86. https://doi.org/10.3390/pharmacy12030086

Borrell, J. R., & Watal, J. (2002). Impact of patents on access to HIV/AIDS drugs in developing countries. *CID Working Paper Series*.

Brandt, J., Shearer, B., & Morgan, S. G. (2018). Prescription drug coverage in Canada: a review of the economic, policy and political considerations for universal pharmacare. *Journal of Pharmaceutical Policy and Practice*, *11*(1). https://doi.org/10.1186/s40545-018-0154-x

Burke, G.J., Carrillo, J.E., & Vakharia, A.J. (2007). Single versus multiple supplier sourcing strategies. European Journal of Operational Research, 182(1), 95–112. http://dx.doi.org/10.1016/j.ejor.2006.07.007

Chaumont, C., Bautista-Arredondo, S., Calva, J. J., Bahena-González, R. I., Sánchez-Juárez, G. H., González de Araujo-Muriel, A., Magis-Rodríguez, C., & Hernández-Ávila, M. (2015). Antiretroviral purchasing and prescription practices in Mexico: constraints, challenges and opportunities. *Salud publica de Mexico*, *57 Suppl 2*, s171–s182. https://doi.org/10.21149/spm.v57s2.7606

Chen, L., Yang, Y., Luo, M., Hu, B., Yin, S., & Mao, Z. (2020). The Impacts of National Centralized Medicine Procurement Policy on Medicine Utilization and Medicine Expenditures: The Case of Shenzhen, China. *International Journal of Environmental Research and Public Health*, *17*(24), 1–11. https://doi.org/10.3390/IJERPH17249415

Chen, X., Wang, Y., & Webster, S. (2022). Pooled Procurement of Health Medicines for LMICs. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4115950

Chen, Y., Ji, X., Xiao, H., Unger, J. M., Cai, Y., Mao, Z., & Yeung, K. (2021). Impact of the Pilot Volume-Based Drug Purchasing Policy in China: Interrupted Time-Series Analysis with Controls. *Frontiers in pharmacology*, *12*, 804237. https://doi.org/10.3389/fphar.2021.804237

Code for Africa. (2019). South Africa Medicine Prices

Conrad, R & Lutter R. (2019). Generic Competition and Drug Prices: New Evidence Linking Greater Generic Competition and Lower Generic Drug Prices, Generic competition and Drug Prices: New Evidence Linking Greater Generic Competition and Lower Generic Drug Prices

Costantino, N., Dotoli, M., Falagario, M., Fanti, M. P., & Mangini, A. M. (2012). A model for supply management of agile manufacturing supply chains. International Journal of Production Economics, 135(1), 451-457.

Danzon, P. M., Mulcahyb, A. W, & Towsec, A. K. (2013). Pharmaceutical Pricing In Emerging Markets: Effects Of Income, Competition, And Procurement. Health Econ. 24: 238–252 (2015) https://onlinelibrary.wiley.com/doi/pdf/10.1002/hec.3013

Do Amaral, S. M. S., & Blatt, C. R. (2011). Municipal consortia for medicine procurement: impact on the stock-out and budget. *Revista de Saude Publica*, *45*(4), 799–801. https://doi.org/10.1590/S0034-89102011005000016

Domfeh, K. A. (2021). Pooled procurement programme: efficiency and challenges in medicinal health care – perspectives from National Catholic Health Service in Ghana. *Journal of Pharmaceutical Health Services Research*, *12*(4), 552–558. https://doi.org/10.1093/jphsr/rmab062

Dubois, P., Lefouili, Y., & Straub, S. (2021). Pooled procurement of medicines in low and middle income countries. *European Economic Review*, *132*, 103655. https://doi.org/https://doi.org/10.1016/j.euroecorev.2021.103655

Dunne, S., Shannon, B., Dunne, C. et al. (2013). A review of the differences and similarities between generic drugs and their originator counterparts, including economic benefits associated with usage of generic medicines, using Ireland as a case study. BMC Pharmacol Toxicol 14, 1. https://doi.org/10.1186/2050-6511-14-1

Geropoulos N, Voultsos P, Geropoulos M, Tsolaki F, Tagarakis G. Hybrid model: a promising type of public procurement in the healthcare sector of the European Union. Front Public Health. 2024 Feb 15;12:1359155. doi: 10.3389/fpubh.2024.1359155. PMID: 38425461; PMCID: PMC10902422.

Hamzah, N., Perera, P. N., & Rannan-Eliya, R. P. (2020). How well does Malaysia achieve value for money in public sector purchasing of medicines? Evidence from medicines procurement prices from 2010 to 2014. *BMC Health Services Research*, *20*(1). https://doi.org/10.1186/s12913-020-05362-8

Hannah E., Basheer N., Dumka N., Kotwal A. (2023). *Access to medicines in the Indian Public Health System – what works and what does not? A review of the National Health Mission Common Review Mission Reports (2007-2021). Journal of Global Health Reports ;7:e2023054. doi:10.29392/001c.84486*

Hassali, M. A., Yuen, K. H., Ibrahim, M. I. M., Wong, J. W., Ng, B. H., & Ho, D. S. S. (2009). Malaysian pharmaceutical industry: opportunities and challenges. *Journal of Generic Medicines the Business Journal for the Generic Medicines Sector*, *6*(3), 246–252. https://doi.org/10.1057/jgm.2009.12

Homedes, N., & Ugalde, A. (2005). Multisource drug policies in Latin America: survey of 10 countries. *Bulletin of the World Health Organization*, *83*(1), 64–70.

Hou, J., Zeng, A, Z., & Zhao, L. (2010). Coordination with a backup supplier through buy-back contract under supply disruption. Transportation Research Part E, 46, 881–895.
https://www.cgdev.org/publication/aggregating-demand-pharmaceuticals-appealing-pooling-not-panacea

Iyengar, S., Tay-Teo, K., Vogler, S., Beyer, P., Wiktor, S., de Joncheere, K., & Hill, S. (2016). Prices, costs, and affordability of new medicines for hepatitis C in 30 countries: an economic analysis. *PLoS medicine*, *13*(5), e1002032.

Janssen Daalen, J. M., den Ambtman, A., Van Houdenhoven, M., & van den Bemt, B. J. F. (2021). Determinants of drug prices: a systematic review of comparison studies. *BMJ open*, *11*(7), e046917. https://doi.org/10.1136/bmjopen-2020-046917

Kim, J. A., Yoon, S., Kim, L. Y., & Kim, D. S. (2017). Towards Actualizing the Value Potential of Korea Health Insurance Review and Assessment (HIRA) Data as a Resource for Health Research: Strengths, Limitations, Applications, and Strategies for Optimal Use of HIRA Data. Journal of Korean Medical Science, 5(32), 718–728. https://doi.org/https://doi.org/10.3346%2Fjkms.2017.32.5.718

Kim, S. W., & Skordis-Worrall, J. (2017). Can voluntary pooled procurement reduce the price of antiretroviral medicines? a case study of Efavirenz. *Health Policy and Planning*, *32*(4), 516–526. https://doi.org/10.1093/HEAPOL/CZW165

Kumar, R., Hassali, M. A., Saleem, F., Alrasheedy, A. A., Kaur, N., Wong, Z. Y., & Kader, M. A. S. A. (2015). Knowledge and perceptions of physicians from private medical centres

towards generic medicines: a nationwide survey from Malaysia. *Journal of pharmaceutical policy and practice*, *8*(1), 11.

Li, Y., Ying, C., Sufang, G., Brant, P., Bin, L., & Hipgrave, D. (2013). Evaluation, in three provinces, of the introduction and impact of China's National Essential Medicines Scheme. *Bulletin of the World Health Organization*, *91*(3), 184–194. https://doi.org/10.2471/BLT.11.097998

Malaysia Competition Commission (MyCC). (2017). Market Review on Priority Sector Under Competition Act 2010: Pharmaceutical Sector. Suruhanjaya Persaingan Malaysia.

Malaysian Armed Forces Health Services. (2024). *eFORSIHAT: Drug formulary*. https://www.pfat.org/home

Measuring Medicine Prices Methodology. (2015). In *International Comparisons* (pp. 170–176). essay. Retrieved March 14, 2025, from https://haiweb.org/wp-content/uploads/2015/07/Chapter-10-EN-Measuring-Medicine-Prices-Methodology.pdf.

Ministry of Finance Malaysia, MOF. (2019). *Kelulusan Khas untuk Perolehan Berkaitan.*

Ministry of Finance Malaysia, MOF. (2020). *Permohonan Tambahan Item Pooled Procurement bagi KKM, KPT dan MINDEF*

Ministry of Finance Malaysia, MOF. (2022). *Perolehan Kerajaan. https://ppp.treasury.gov.my/*

Ministry Of Finance, MOF (2022). Perlaksanaan Perolehan Kerajaan Selaras Peranan Dan Fungsi Kerajaan Caretaker (MOF.BPK(S)600-1/1/4(3). https://ppp.treasury.gov.my/

Ministry of Finance Malaysia, MOF. (2024). *About Eperolehan. https://www.eperolehan.gov.my/en/home*

Ministry of Health Malaysia, MOH. (2012). Buku DUNAS. Pharmacy Division, Ministry of Health Malaysia. Retrieved from https://pharmacy.moh.gov.my/sites/default/files/document-upload/buku-dunas.pdf

Ministry of Health Malaysia, MOH. (2020a). *Standard operating procedure (SOP) for joint procurement management of pharmaceuticals by the Ministry of Health Malaysia (MOH), Ministry of Higher Education (MOHE), and Ministry of Defence Malaysia (MOD): Revision dated 5 August 2020.* Ministry of Health Malaysia.

Ministry of Health Malaysia, MOH. (2024) Formulari Ubat Kementerian Kesihatan Malaysia. Ministry of Health Medicines Formulary (MOHMF). Retrieved [Date], from https://pharmacy.moh.gov.my/en/documents/ministry-health-medicines-formulary-mohmf.html

Morgan, S. G., Vogler, S., & Wagner, A. K. (2017). Payers' experiences with confidential pharmaceutical price discounts: A survey of public and statutory health systems in

North America, Europe, and Australasia. *Health Policy*, *121*(4), 354–362. https://doi.org/10.1016/j.healthpol.2017.02.002

Mulcahy, A. W., Schwam, D., & Lovejoy, S. L. (2024). International Prescription Drug Price Comparisons: Estimates Using 2022 Data. *Rand health quarterly*, *11*(3), 5.

Nemzoff, C., Chalkidou, K., & Over, M. (2019). *Aggregating Demand for Pharmaceuticals is Appealing, but Pooling Is Not a Panacea.*

Nguyen, N. X., Sheingold, S. H., Tarazi, W., & Bosworth, A. (2022). Effect of competition on generic drug prices. *Applied health economics and health policy*, *20*(2), 243-253.

OECD (2020), *OECD Economic Outlook, Volume 2020 Issue 2*, OECD Publishing, Paris, https://doi.org/10.1787/39a88ab1-en.

P. Fraser, J. (2020). Purchasing and Supply Management. https://dl.icdst.org/pdfs/files3/cbedc5d8840f943b1909426532dd3ed2.pdf

Patcharanarumol, W., Panichkriangkrai, W., Sommanuttaweechai, A., Hanson, K., Wanwong, Y., & Tangcharoensathien, V. (2018). Strategic purchasing and health system efficiency: A comparison of two financing schemes in Thailand. PLOS ONE, 13(4), e0195179. https://doi.org/10.1371/JOURNAL.PONE.0195179

Parmaksiz, K., Pisani, E., Bal, R., & Kok, M. O. (2022). *A systematic review of pooled procurement of medicines and vaccines: identifying elements of success. Globalization and Health, 18(1), 59. https://doi.org/10.1186/s12992-022-00847-z*

Parmaksiz, K., van de Bovenkamp, H., & Bal, R. (2023). *Does structural form matter? A comparative analysis of pooled procurement mechanisms for health commodities. Globalization and Health, 19(1), 1–15. https://doi.org/10.1186/S12992-023-00974-1/TABLES/2*

Pazirandeh, A. (2011). Sourcing in global health supply chains for developing countries: Literature review and a decision making framework. International Journal of Physical Distribution & Logistics Management, 41(4), 364-384. http://dx.doi.org/10.1108/09600031111131931

Pharmaceutical Services Programme (2022). *Medicine Prices Monitoring Survey in Malaysia 2020.* https://pharmacy.moh.gov.my/en/documents/medicine-prices-monitoring-survey-malaysia-2020.html

Pharmaceutical Services Programme. (2023a). *Laporan Eksekutif kajian penilaian Impak Harga Ubat-Ubatan Yang dibeli Secara Perolehan Bersama (pooled procurement) di Sektor Awam. Program Perkhidmatan Farmasi. https://pharmacy.moh.gov.my/ms/dokumen/laporan-eksekutif-kajian-penilaian-impak-harga-ubat-ubatan-dibeli-secara-perolehan-bersama-pooled.html*

Pharmaceutical Services Programme. (2023b). *Malaysian National Medicines Policy 4th-Term 2022-2026*.

Procurement Services South Africa. (2023). *Negotiation guidelines. https://www.procurement.sa.gov.au/documents2/guidelines2/Negotiation-Guideline.pdf*

Safaeian, L., Mahdanian, A. R., Salami, S., Pakmehr, F., & Mansourian, M. (2015). Seasonality and Physician-related Factors Associated with Antibiotic Prescribing: A Cross-sectional Study in Isfahan, Iran. *International journal of preventive medicine*, *6*, 1. https://doi.org/10.4103/2008-7802.151431

Seidman, G., & Atun, R. (2017). Do changes to supply chains and procurement processes yield cost savings and improve availability of pharmaceuticals, vaccines or health medicines? A systematic review of evidence from low-income and middle-income countries. *BMJ Global Health*, *2*(2), 243. https://doi.org/10.1136/BMJGH-2016-000243

Sharifnia, S. H. A., Mohammadzadeh, M., Arzani, G., Salamzadeh, J., Abolfazli, S. A., Zali, A., & Khoshdel, A. R. (2018). Main Factors Affecting Physicians' Prescribing Decisions: The Iranian Experience. *Iranian journal of pharmaceutical research : IJPR*, *17*(3), 1105–1115.

Shaw, S. J., & Hartman, A. L. (2010). The controversy over generic antiepileptic drugs. *The Journal of Pediatric Pharmacology and Therapeutics*, *15*(2), 81-93.

Shi, Jshi., Liu, R., Jiang, H., Wang, C., Xiao, Y., Liu, N., Wang, Z., & Shi, L. (2018). Moving towards a better path? A mixed-method examination of China's reforms to remedy medical corruption from pharmaceutical firms. *BMJ open*, *8*(2), e018513. https://doi.org/10.1136/bmjopen-2017-018513

Shrank, W. H., Liberman, J. N., Fischer, M. A., Girdish, C., Brennan, T. A., & Choudhry, N. K. (2011). Physician perceptions about generic drugs. *The Annals of pharmacotherapy*, *45*(1), 31–38. https://doi.org/10.1345/aph.1P389

Straka, R. J., Keohane, D. J., & Liu, L. Z. (2017). Potential clinical and economic impact of switching branded medications to generics. *American journal of therapeutics*, *24*(3), e278-e289.

Vogler, S.; Habimana, K.; Bauer, E.; Schneider, P.; Haasis, M. A. (2021). *Assessment of Centralised Procurement of Medicines in Portugal*. Gesundheit Österreich, Vienna

Vondeling, G. T., Cao, Q., Postma, M. J., & Rozenbaum, M. H. (2018). The Impact of Patent Expiry on Drug Prices: A Systematic Literature Review. *Applied Health Economics and Health Policy*, *16*(5), 653. https://doi.org/10.1007/S40258-018-0406-6

Wafula F, Agweyu A, Macintyre K. 2013. Regional and temporal trends in malaria commodity costs: an analysis of Global Fund data for 79 countries. Malaria Journal 12: 466.

WHO Regional Office for South-East Asia. (2014). *Regional workshop on strengthening quantification and procurement of essential medicines*. https://iris.who.int/handle/10665/206213

Wong, Z. Y., Hassali, M. A., Alrasheedy, A. A., Saleem, F., Yahaya, A. H., & Aljadhey, H. (2014). Patients' beliefs about generic medicines in Malaysia. *Pharmacy practice*, *12*(4), 474. https://doi.org/10.4321/s1886-36552014000400006

World Health Organisation. (2020). *WHO guideline on country pharmaceutical pricing policies. World Health Organisation*.

World Health Organization (WHO). (2021). Global expenditure on health: Public spending on the rise? https://files.aho.afro.who.int/afahobckpcontainer/production/files/2_Global_expenditure_on_health_Public_spending_on_the_rise.pdf

World Health Organization, WHO. (2014). Regional workshop on strengthening quantification and procurement of essential medicines. In Regional workshop on strengthening quantification and procurement of essential medicines.

World Health Organization. (2016). WHO Drug Information 2016, vol. 30, 2 [full issue]. WHO Drug Information, 30 (2), 171 - 240. World Health Organization. https://iris.who.int/handle/10665/331024

Wirtz, V. J., Hogerzeil, H. V., Gray, A. L., Bigdeli, M., de Joncheere, C. P., Ewen, M. A., Gyansa-Lutterodt, M., Jing, S., Luiza, V. L., Mbindyo, R. M., Möller, H., Moucheraud, C., Pécoul, B., Rägo, L., Rashidian, A., Ross-Degnan, D., Stephens, P. N., Teerawattananon, Y., 't Hoen, E. F., Wagner, A. K., … Reich, M. R. (2017). Essential medicines for universal health coverage. *Lancet (London, England)*, *389*(10067), 403–476. https://doi.org/10.1016/S0140-6736(16)31599-9

Xiao Yue. (2019). *"4+7" drug procurement reform in China*. https://www.cgdev.org/sites/default/files/CGD-procurement-background-china-case.pdf

Yu, H., Zeng, A.Z., & Zhao, L. (2009). Single or dual sourcing: decision-making in the presence of supply chain disruption risks. Omega - The International Journal of Management Science, 37, 788–800. http://dx.doi.org/10.1016/j.omega.2008.05.006

Zhang, X., Zimmerman, A., Lai, H., Zhang, Y., Tang, Z., Tang, S., Ogbuoji, O., Zeng, W., Chang, J., & Kumar Mallineni, S. (2024). Differential effect of China's Zero Markup Medicine Policy on provider-induced demand in secondary and tertiary hospitals. *Frontiers in Public Health*, *12*, 1229722. https://doi.org/10.3389/FPUBH.2024.1229722

Zhu, Z., Wang, Q., Sun, Q., Lexchin, J., & Yang, L. (2023). Improving access to medicines and beyond: the national volume-based procurement policy in China. *BMJ Global Health*, *8*(7), e011535.

8.0 APPENDICES

Appendix I List of medicines procured through pooled procurement inter-ministries (Original list)

No.	Medicines name	Strength	Dosage form
1	Alendronate Sodium & Cholecalciferol	70mg + 5600IU	Tab/cap
2	Alfuzosin HCl	10mg	Tab/cap
3	Alprostadil	500mcg/ml	Injection
4	Ampicillin & Sulbactam	375mg	Tab/cap
5	Anagrelide Hydrochloride	0.5mg	Tab/cap
6	Anidulafungin	100mg	Injection
7	Atorvastatin	40mg	Tab/cap
8	Benzydamine HCl 0.15% w/v solution	1.5mg/ml	Oromucosal
9	Beractant Intrathracheal Suspension	200mg/8ml	Injection
10	Brimonidine Tartrate 0.15% Opthalmic	1.5mg/ml	Eye Drops
11	Budesonide & Formoterol	160mcg + 4.5mcg	Inhalation Aerosol
12	Bupivacaine 0.5% Heavy Injection	5mg/ml	Injection
13	Calcipotriol & Betamethasone	50mcg/g + 0.5mg/g	Ointment
14	Calcium Polystyrene Sulphonate	5g	Granules
15	Capecitabine	500mg	Tab/cap
16	Carbamazepine CR	200mg	Tab/cap
17	Carbamazepine CR	400mg	Tab/cap
18	Carboprost Tromethamine	250mcg	Injection
19	Celecoxib	200mg	Tab/cap
20	Deferasirox	360mg	Tab/cap
21	Deferasirox	90mg	Tab/cap
22	Dexmedetomidine HCl	100mcg/ml	Injection

No.	Medicines name	Strength	Dosage form
23	Dutasteride	0.5mg	Tab/cap
24	Dydrogesterone	10mg	Tab/cap
25	Enoxaparin Sodium	4000 IU (40mg)/0.4ml	Injection
26	Enoxaparin Sodium	6000 IU (60mg)/0.6ml	Injection
27	Eperisone HCL	50mg	Tab/cap
28	Ertapenem	1g	Injection
29	Erythropoietin Beta Human Recombinant	2000IU/0.3ml	Injection
30	Escitalopram	10mg	Tab/cap
31	Etoricoxib	90mg	Tab/cap
32	Ezetimibe	10mg	Tab/cap
33	Felodipine	10mg	Tab/cap
34	Felodipine	5mg	Tab/cap
35	Fentanyl Transdermal Patch	25mcg/h	Patch
36	Fludarabine Phosphate	50mg	Injection
37	Fluvoxamine	100mg	Tab/cap
38	Fluvoxamine	50mg	Tab/cap
39	Fondaparinux Sodium	2.5mg/0.5ml	Injection
40	Gefitinib	250mg	Tab/cap
41	Gemeprost	1mg	Pessary
42	Granisetron HCl	1mg	Tab/cap
43	Idarubicin	1mg/ml	Injection
44	Imatinib Mesylate	100mg	Tab/cap
45	Imatinib Mesylate	400mg	Tab/cap
46	Insulin Aspart & Protaminated Insulin Aspart	30%/70% 100 IU/ml	Prefilled Pen
47	Insulin Glargine	300IU/3ml	Prefilled Pen
48	Ipratropium Bromide & Salbutamol	0.5 + 2.5mg	Nebuliser

No.	Medicines name	Strength	Dosage form
49	Ipratropium Bromide Anhydrous & Fenoterol	20mcg + 50mcg	Inhalation Aerosol
50	Leuprolide Acetate	11.25mg	Injection
51	Leuprolide Acetate	3.75mg	Injection
52	Linezolid	2mg/ml	Injection
53	Magnesium Sulphate	50% w/v	Injection
54	Methotrexate	2.5mg	Tab/cap
55	Methylphenidate HCl	10mg	Tab/cap
56	Midazolam	5mg/ml (1ml)	Injection
57	Midazolam	5mg/ml (3ml)	Injection
58	Mometasone Furoate	50mcg	Nasal spray
59	Mycophenolate Mofetil	250mg	Tab/cap
60	Mycophenolate Mofetil	500mg	Tab/cap
61	Nilotinib	150mg	Tab/cap
62	Nilotinib	200mg	Tab/cap
63	Paliperidone	3mg	Tab/cap
64	Paliperidone	6mg	Tab/cap
65	Paliperidone	9mg	Tab/cap
66	Parecoxib Sodium	40mg	Injection
67	Quetiapine Fumarate	200mg	Tab/cap
68	Quetiapine Fumarate	300mg	Tab/cap
69	Quetiapine Fumarate	400mg	Tab/cap
70	Quetiapine Fumarate	50mg	Tab/cap
71	Raloxifene HCl	60mg	Tab/cap
72	Raltegravir	400mg	Tab/cap
73	Ranibizumab	10mg/ml	Injection
74	Rituximab	10mg/ml	Injection

No.	Medicines name	Strength	Dosage form
75	Sodium Chloride	0.9% w/v in 3000ml	Irrigation
76	Sodium Valproate	200mg/5ml	Syrup
77	Sterile Water (500ml)	-	Irrigation
78	Tamsulosin HCl	400mcg	Tab/cap
70	Tenecteplase	10000U (50mg)	Injection
80	Terlipressin	1mg	Injection
81	Ursodeoxycholic Acid	250mg	Tab/cap
82	Valsartan	160mg	Tab/cap
83	Valsartan	80mg	Tab/cap
84	Warfarin Sodium	1mg	Tab/cap
85	Warfarin Sodium	2mg	Tab/cap

Appendix II List of medicines procured through pooled procurement inter-ministries (Additional medicines)

No.	Medicines name	Strength	Dosage form
1	Fentanyl Transdermal Patch	50mcg/h	Patch
2	Warfarin Sodium	3mg	Tab/cap
3	Warfarin Sodium	5mg	Tab/cap

Appendix III List of medicines of pooled procurement that unable to be procured

No.	Medicines name	Reason
1	Raloxifene HCL 60mg Tablet/Capsule	No offer after being advertised twice
2	Fludarabine Phosphate 50mg Injection	No offer after being advertised twice
3	Raltegravir 400mg Tablet/Capsule	Listed as APPL medicines
4	Sterile Water for Irrigation 500ml	Listed as APPL medicines
5	Tenecteplase 10,000U (50mg) Injection	Provider withdrawal
6	Nilotinib 150mg Capsule	Complexity of offer
7	Nilotinib 200mg Capsule	Complexity of offer

APPL: Approved Medicine Purchase List

Appendix IV List of medicines that are not included in pooled procurement due to LOA

No.	Medicines name	Strength	Dosage form
1.	Imatinib Mesylate	100mg	Tab/cap
2.	Imatinib Mesylate	400mg	Tab/cap

Appendix V List of medicines with two brands

No.	Medicines name	Brand	Strength	Dosage form
1.	Benzydamine Hydrochloride	Difflam	0.15% w/v	Solution
		Easiflam		
2.	Mycophenolate Mofetil	Cellcept	250mg	Tab/cap
		Mycofit		
3.	Mycophenolate Mofetil	Cellcept	500mg	Tab/cap
		Mycofit		

Appendix VI Data collection form

Bil	Nama Generik	Kekuatan	Bentuk dosej	Perolehan semasa/selepas *pooled procurement* (15.5.2020 - 14.5.2022)															
				Jenama produk	No MAL Unit ID	Jenis produk	Pembekal	Jenis pengilang	Rujukan tarikh mula	Rujukan tarikh akhir	Jenis perolehan	Pek	Kuantiti per pek	Harga per pek	Harga per unit	Unit	Tarikh mula perolehan (LP/Kontrak)	Tarikh tamat perolehan (LP/Kontrak)	Tarikh lanjutan (KONTRAK SAHAJA)
1	Abacavir Sulphate & Lamivudine	600 + 300mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
1	Abacavir Sulphate & Lamivudine	600 + 300mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
2	Abiraterone Acetate	250mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
2	Abiraterone Acetate	250mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
2	Abiraterone Acetate	250mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
2	Abiraterone Acetate	250mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
3	Acarbose	50mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
3	Acarbose	50mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
4	Acetylsalicylate Acid & Glycine	100 + 45mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
4	Acetylsalicylate Acid & Glycine	100 + 45mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
5	Adalimumab	40mg	Prefilled Pen		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
5	Adalimumab	40mg	Prefilled Pen		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
6	Aflibercept	40mg/ml	Injection		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
6	Aflibercept	40mg/ml	Injection		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
7	Alteplase	50mg	Injection		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
7	Alteplase	50mg	Injection		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
8	Amisulpride	100mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
8	Amisulpride	100mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
9	Amisulpride	400mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
9	Amisulpride	400mg	Tab/cap		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
10	Amoxicillin & Clavulanate	1g & 200mg	Injection		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
10	Amoxicillin & Clavulanate	1g & 200mg	Injection		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
10	Amoxicillin & Clavulanate	1g & 200mg	Injection		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
10	Amoxicillin & Clavulanate	1g & 200mg	Injection		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
11	Amoxicillin Trihydrate	125mg/5ml	Syrup		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
11	Amoxicillin Trihydrate	125mg/5ml	Syrup		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				
11	Amoxicillin Trihydrate	125mg/5ml	Syrup		#N/A	#N/A	#N/A	#N/A	15/5/2020	14/5/2022					#DIV/0!				

KutipanData(Kontrak KKM)(AFTER) | KutipanData(KontrakKKM)(BEFORE) | Senarai Ubat | Ubat Tiada dalam S

Appendix VII Estimated savings based on price tiers of pooled procurement medicines

Price tier of pooled procurement medicines	Overall estimated savings			Estimated savings			Estimated dissavings		
	No medicines of 3 facilities (n)	Value (RM)	Percentage (%)	No medicines of 3 facilities (n)	Value (RM)	Percentage (%)	No medicines of 3 facilities (n)	Value (RM)	Percentage (%)
Tier 1	4-23	98,394,604.55	54.78	4-21	99,772,407.35	53.44	1-4	1,377,802.80	19.47
Tier 2	1-18	27,659,170.33	15.40	2-16	29,265,345.53	15.68	1-7	1,606,175.20	22.70
Tier 3	3-22	41,591,274.90	23.15	3-18	43,863,966.62	23.49	1-7	2,272,691.72	32.12
Tier 4	2-11	7,928,088.08	4.41	2-9	9,554,871.58	5.12	1-6	1,626,783.50	22.99
Tier 5	2-8	4,050,625.30	2.26	2-7	4,242,356.90	2.27	1	191,731.60	2.71
Overall	**9-82**	**179,623,763.15**	**100.00**	**9-62**	**186,698,947.96**	**100.00**	**2-20**	**7,075,184.82**	**100.00**

Appendix VIII Estimated savings based on price tiers of pooled procurement medicines, according to ministries

Price tier of pooled procurement medicines	Overall estimated savings			Estimated savings			Estimated dissavings		
	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)
Ministry of Health (MOH)									
Tier 1	23	45,907,719.70	40.28	19	47,203,819.30	39.20	4	1,296,099.60	20.08
Tier 2	18	24,181,313.68	21.22	16	25,537,553.68	21.21	2	1,356,240.00	21.01
Tier 3	22	34,277,499.18	30.08	15	36,317,550.18	30.16	7	2,040,051.00	31.60
Tier 4	11	5,985,060.00	5.25	5	7,563,145.00	6.28	6	1,578,085.00	24.44
Tier 5	8	3,611,150.00	3.17	7	3,796,330.00	3.15	1	185,180.00	2.87
Overall	**82**	**113,962,742.56**	**100.00**	**62**	**120,418,398.16**	**100.00**	**20**	**6,455,655.60**	**100.00**
Ministry of Defence (MOD)									
Tier 1	20	3,127,205.27	46.66	18	3,208,476.47	47.11	2	81,271.20	74.78
Tier 2	11	1,215,374.78	18.14	7	1,227,838.18	18.03	4	12,463.40	11.47
Tier 3	19	2,063,688.79	30.79	18	2,064,312.79	30.31	1	624.00	0.57
Tier 4	10	274,804.65	4.10	9	287,839.65	4.23	1	13,035.00	11.99
Tier 5	5	20,546.90	0.31	3	21,833.50	0.32	2	1,286.60	1.18

Price tier of pooled procurement medicines	Overall estimated savings			Estimated savings			Estimated dissavings		
	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)
Overall	**65**	**6,701,620.38**	**100.00**	**55**	**6,810,300.58**	**100.00**	**10**	**108,680.20**	**100.00**
Ministry of Higher Education (MOHE)									
Tier 1	4-21	49,359,679.58	83.72	4-21	49,360,111.58	83.00	1	432.00	0.08
Tier 2	1-15	2,262,481.87	3.84	2-11	2,499,953.67	4.20	1-7	237,471.80	46.49
Tier 3	3-17	5,250,086.93	8.90	3-12	5,482,103.65	9.22	1-6	232,016.72	45.42
Tier 4	2-8	1,668,223.43	2.83	2-8	1,703,886.93	2.87	1	35,663.50	6.98
Tier 5	2-7	418,928.40	0.71	2-6	424,193.40	0.71	1	5,265.00	1.03
Overall	**9-68**	**58,959,400.21**	**100.00**	**9-55**	**59,470,249.23**	**100.00**	**2-13**	**510,849.02**	**100.00**

MOH = Ministry of Health; MOD = Ministry of Defence; MOHE = Ministry of Higher Education

Appendix IX Estimated savings based on price tiers of pooled procurement medicines, according to UTHs

Price tier of pooled procurement medicines	Overall estimated savings			Estimated savings			Estimated dissavings		
	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines	Value (RM)	Percentage (%)
Canselor Tuanku Muhriz Hospital (HCTM)									
Tier 1	15	46,124,173.97	93.7	15	46,124,173.97	93.4	-	-	0.0
Tier 2	14	540,615.65	1.1	11	620,633.65	1.3	3	80,018.00	54.4
Tier 3	17	1,484,257.58	3.0	11	1,516,932.25	3.1	6	32,674.67	22.2
Tier 4	6	928,945.10	1.9	5	963,458.60	2.0	1	34,513.50	23.4
Tier 5	4	132,205.10	0.3	4	132,205.10	0.3	-	-	0.0
Overall HCTM	**56**	**49,210,197.40**	**100.00**	**46**	**49,357,403.57**	**100.0**	**10**	**147,206.17**	**100.00**
University of Science Malaysia Specialist Hospital (HPUSM)									
Tier 1	21	2,438,772.00	44.9	21	2,438,772.00	42.2	-	-	0.0
Tier 2	15	757,712.92	14.0	8	913,913.92	15.8	7	156,201.00	43.9
Tier 3	17	1,675,177.80	30.9	12	1,869,658.30	32.3	5	194,480.50	54.6
Tier 4	8	348,126.78	6.4	8	348,126.78	6.0	-	-	0.0
Tier 5	7	209,745.90	3.9	6	215,010.90	3.7	1	5,265.00	1.5
Overall HPUSM	**68**	**5,429,535.39**	**100.0**	**55**	**5,785,481.90**	**100.0**	**13**	**355,946.50**	**100.0**

Price tier of pooled procurement medicines	Overall estimated savings			Estimated savings			Estimated dissavings		
	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines	Value (RM)	Percentage (%)
University Malaya Medical Center (UMMC)									
Tier 1	5	260,420.54	10.2	5	260,420.54	10.2	-	-	-
Tier 2	3	773,280.00	30.4	3	773,280.00	30.4	-	-	-
Tier 3	3	1,289,100.00	50.6	3	1,289,100.00	50.6	-	-	-
Tier 4	2	223,471.25	8.8	2	223,471.25	8.8	-	-	-
Tier 5	-	-	0.0	-	-	0.0	-	-	-
Overall UMMC	**13**	**2,546,271.79**	**100.0**	**13**	**2,546,271.79**	**100.0**	**-**	**-**	**-**
Sultan Ahmad Shah Medical Centre (SASMEC)									
Tier 1	8	153,539.00	14.9	7	153,971.00	14.9	1	432.00	6.9
Tier 2	5	167,241.70	16.2	5	167,241.70	16.1	-	-	0.0
Tier 3	6	510,265.85	49.6	4	514,920.40	49.7	2	4,654.55	74.6
Tier 4	7	157,051.40	15.3	6	158,201.40	15.3	1	1,150.00	18.4
Tier 5	2	41,407.50	4.0	2	41,407.50	4.0	-	-	0.0
Overall SASMEC	**28**	**1,029,505.45**	**100.0**	**24**	**1,035,742.00**	**100.0**	**4**	**6236.5**	**100.0**

Price tier of pooled procurement medicines	Overall estimated savings			Estimated savings			Estimated dissavings		
	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines (n)	Value (RM)	Percentage (%)	No. of medicines	Value (RM)	Percentage (%)
Al Sultan Abdullah Hospital (HASA)									
Tier 1	6	242,834.47	50.1	6	242,834.47	49.9	-	-	0.0
Tier 2	1	-1,252.80	-0.3	-	-	0.0	1	1,252.80	85.8
Tier 3	8	197,361.70	40.7	7	197,568.70	40.6	1	207.00	14.2
Tier 4	5	10,628.90	2.2	5	10,628.90	2.2	-	-	0.0
Tier 5	3	35,569.90	7.3	3	35,569.90	7.3	-	-	0.0
Overall HASA	**23**	**485,142.17**	**100.0**	**21**	**486,601.97**	**100.0**	**2**	**1459.8**	**100.0**
Sultan Abdul Aziz Shah Hospital (HSAAS)									
Tier 1	4	139,939.60	54.1	4	139,939.60	54.1	-	-	-
Tier 2	2	24,884.40	9.6	2	24,884.40	9.6	-	-	-
Tier 3	3	93,924.00	36.3	3	93,924.00	36.3	-	-	-
Tier 4	-	-	0.0	-	-	0.0	-	-	-
Tier 5	-	-	0.0	-	-	0.0	-	-	-
Overall HSAAS	**9**	**258,748.00**	**100.0**	**9**	**258,748.00**	**100.0**	**-**	**-**	**-**

Appendix X Top 5 medicines with the highest estimated savings according to ministry

	Innovator					Generic			
	Generic name	Brand name	Estimated savings (RM)	Estimated savings (%)		Generic name	Brand name	Estimated savings (RM)	Estimated savings (%)
Ministry of Health (MOH)									
1	Deferasirox 360mg Tab/cap	Exjade Film-Coated 360mg	6,463,800.00	5.37	1	Celecoxib 200mg	Hovid-Celecoxib Capsule	19,536,750.00	16.22
2	Bupivacaine 0.5% Heavy Injection 5mg/ml	Marcain Spinal 0.5% Heavy, 4ml	4,432,385.00	3.68	2	Capecitabine 500mg	Intacape	15,340,800.00	12.74
3	Ampicillin & Sulbactam 375mg Tablet	Unasyn Tablet	2,382,050.00	1.98	3	Gefitinib 250mg	Gefitinib Intega Film-Coated	11,121,000.00	9.24
4	Anidulafungin 100mg	Eraxis	2,218,500.00	1.84	4	Dexmedetomidine HCl 100mcg/ml	Precedex	6,931,600.00	5.76
5	Carbamazepine CR 400mg	Tegretol CR 400mg	1,689,400.00	1.40	5	Ezetimibe 10mg	Accord Ezetimibe 10	6,258,000.00	5.20
Ministry of Defence (MOD)									
1	Parecoxib Sodium 40mg	Dynastat Injection 40mg	653,600.00	9.60	1	Escitalopram 10mg	Eslo 10	1,374,444.00	20.18
2	Etoricoxib 90mg	Arcoxia	653,280.00	9.59	2	Atorvastatin 40mg	Storvas C	760,571.25	11.17
3	Erythropoietin Beta Human Recombinant 2000IU/0.3ml	Recormon Pre-Filled Syringe 2000IU/0.3ml (1)	309,013.25	4.54	3	Mometasone Furoate 50mcg Aqueous Nasal Spray	Elonide Nasal Spray 50mcg/dose	460,992.88	6.77
4	Insulin Aspart 30% & Protaminated Insulin Aspart 70% 100IU/ml	NovoMix 30 FlexPen 100U/ML Suspension for injection	180,576.00	2.65	4	Ezetimibe 10mg	Accord Ezetimibe 10	392,592.20	5.76
5	Budesonide & Formoterol 160mcg + 4.5mcg	Symbicort Turbuhaler 160/4.5mcg/Dose	156,024.60	2.29	5	Gefitinib 250mg	Gefitinib Intega Film-Coated	213,703.20	3.14

Innovator					Generic				
	Generic name	Brand name	Estimated savings (RM)	Estimated savings (%)		Generic name	Brand name	Estimated savings (RM)	Estimated savings (%)
Ministry of Higher Education (MOHE)									
1	Deferasirox 360mg	Exjade Film-Coated 360mg	1,116,425.85	1.88	1	Mycophenolate Mofetil 500mg	Mycofit Tablets	39,462,500.00	66.36
2	Tamsulosin HCl 400mcg	Harnal OCAS	464,700.00	0.78	2	Mycophenolate Mofetil 250mg	Mycofit Capsule	5,180,000.00	8.71
3	Alendronate Sodium & Cholecalciferol 70mg + 5600IU	Fosamax Plus Tablet	203,742.00	0.34	3	Gefitinib 250mg	Gefitinib Intega Film-Coated	1,187,240.00	2.00
4	Deferasirox 90mg	Exjade Film-Coated 90mg	170,533.60	0.29	4	Insulin Glargine 300IU/3ml (Prefilled Pen) 300IU/3ml	Basalog One Insulin Glargine Injection (rDNA origin) 100iu/ml	823,500.00	1.38
5	Budesonide & Formoterol 160mcg + 4.5mcg	Symbicort Turbuhaler 160/4.5mcg/Dose	153,595.00	0.26	5	Capecitabine 500mg	Intacape	710,640.00	1.19

Appendix XI Top 5 medicines with the highest estimated savings according to UTHs

Innovator					Generic				
	Generic name	Brand name	Estimated savings (RM)	Estimated savings (%)		Generic name	Brand name	Estimated savings (RM)	Estimated savings (%)
Tuanku Muhriz Cansellor Hospital (HCTM)									
1	Deferasirox 360mg	Exjade Film-Coated 360mg	930,414.60	17.61	1	Capecitabine 500mg	Intacape	477,572.00	0.88
2	Tamsulosin HCl 400mcg	Harnal OCAS	464,700.00	8.79	2	Gefitinib 250mg	Gefitinib Intega Film-Coated	437,712.00	0.81
3	Alendronate Sodium & Cholecalciferol 70mg + 5600IU	Fosamax Plus Tablet	203,742.00	3.86	3	Insulin Glargine 300IU/3ml (Prefilled Pen)300IU/3ml	Basalog One Insulin Glargine Injection (rDNA origin) 100iu/ml	367,400.00	0.68
4	Deferasirox 90mg	Exjade Film-Coated 90mg	170,533.60	3.23	4	Atorvastatin 40mg	Storvas C	221,760.00	0.41
5	Valsartan 80mg	Diovan Film-Coated 80mg	89,900.00	1.70	5	Alfuzosin HCl 10mg	Alfutor ER	211,680.00	0.39
University of Science Malaysia Specialist Hospital (HPUSM)									
1	Budesonide & Formoterol 160mcg + 4.5mcg	Symbicort Turbuhaler 160/4.5mcg/Dose	153,595.00	2.91	1	Insulin Glargine 300IU/3ml (Prefilled Pen) 300IU/3ml	Basalog One Insulin Glargine Injection (rDNA origin) 100iu/ml	823,500.00	1.52
2	Felodipine 10mg	Plendil ER 10mg	145,920.00	2.76	2	Capecitabine 500mg	Intacape	627,935.00	1.16
3	Carbamazepine CR 400mg	Tegretol CR 400mg	139,738.50	2.64	3	Ipratropium Bromide 0.5mg & Salbutamol 2.5mg Per UDV 0.5mg + 2.5mg	Combineb	621,600.00	1.15
4	Deferasirox 360mg	Exjade Film-Coated 360mg	139,581.00	2.64	4	Dexmedetomidine HCl 100mcg/ml	Precedex	487,872.00	0.90
5	Valsartan 160mg	Diovan Film-Coated 160mg	129,735.00	2.45	5	Ezetimibe 10mg	Accord Ezetimibe 10	432,450.00	0.80

Innovator					Generic				
	Generic name	Brand name	Estimated savings (RM)	Estimated savings (%)		Generic name	Brand name	Estimated savings (RM)	Estimated savings (%)
University of Malaya Medical Centre (UMMC)									
1	Deferasirox 360mg	Exjade Film-Coated 360mg	186,011.25	3.52	1	Gefitinib 250mg	Gefitinib Intega Film-Coated	1,187,240.00	2.19
2	Felodipine 10mg	Plendil ER 10mg	63,125.00	1.19	2	Capecitabine 500mg	Intacape	710,640.00	1.31
3	Fondaparinux Sodium 2.5mg/0.5ml	Arixtra 2.5mg/0.5ml Solution for Injection	53,950.00	1.02	3	Calcium Polystyrene Sulphonate 5gm	Resincalcio Oral Powder	111,252.00	0.21
4	Deferasirox 90mg	Exjade Film-Coated 90mg	47,910.00	0.91	4	Benzydamine HCl 0.15% w/v solution 1.5mg/ml	Easiflam Mouthwash	38,340.00	0.07
5	Budesonide & Formoterol 160mcg + 4.5mcg	Symbicort Turbuhaler 160/4.5mcg/Dose	37,460.00	0.71	5	Atorvastatin 40mg	Storvas C	21,825.00	0.04
Sultan Ahmad Shah Medical Centre (SASMEC)									
1	Linezolid 2mg/ml	Zyvox 600mg/300ml Infusion Bags	127,880.00	2.42	1	Dexmedetomidine HCl 100mcg/ml	Precedex	311,275.00	0.57
2	Ampicillin & Sulbactam 375mg	Unasyn Tablet	116,350.00	2.20	2	Atorvastatin40mg	Storvas C	41,670.00	0.08
3	Enoxaparin Sodium 6000 IU (60mg)/0.6ml	Clexane 6000/0.6ml	91,012.50	1.72	3	Alfuzosin HCl 10mg	Alfutor ER	36,605.00	0.07
4	Enoxaparin Sodium 4000 IU (40mg)/0.4ml	Clexane 4000/0.4ml	74,862.90	1.42	4	Midazolam 5mg/ml Injection (3ml)	Domi Injection 15mg	26,926.25	0.05
5	Tamsulosin HCl 400mcg	Harnal OCAS	61,704.00	1.17	5	Mometasone Furoate 50mcg Aqueous Nasal Spray	Elonide Nasal Spray 50mcg/dose	13,700.00	0.03

Innovator					Generic				
	Generic name	Brand name	Estimated savings (RM)	Estimated savings (%)		Generic name	Brand name	Estimated savings (RM)	Estimated savings (%)
Al-Sultan Abdullah Hospital (HASA)									
1	Erythropoietin Beta Human Recombinant 2000IU 2000IU/0.3ml	Recormon Pre-Filled Syringe 2000IU/0.3ml	56,907.00	1.08	1	Celecoxib 200mg	Hovid-Celecoxib Capsule	62,400.00	0.12
2	Valsartan 80mg	Diovan Film-Coated 80mg	47,070.40	0.89	2	Dexmedetomidine HCl 100mcg/ml	Precedex	61,896.00	0.11
3	Beractant Intratracheal Suspension (200mg Phospholipids in 8ml Vial) 200mg/8ml	Survanta Intratracheal Suspension	35,089.50	0.66	3	Calcium Polystyrene Sulphonate 5gm	Resincalcio Oral Powder	46,741.69	0.09
4	Bupivacaine 0.5% Heavy Injection 5mg/ml	Marcain Spinal 0.5% Heavy, 4ml	28,106.00	0.53	4	Atorvastatin 40mg	Storvas C	44,525.00	0.08
5	Enoxaparin Sodium 6000 IU (60mg)/0.6ml	Clexane 6000/0.6ml	26,287.20	0.50	5	Escitalopram 10mg	Eslo 10	22,336.38	0.04
Sultan Abdul Aziz Shah Hospital (HSAAS)									
1	Fondaparinux Sodium 2.5mg/0.5ml	Arixtra 2.5mg/0.5ml Solution for Injection	28,200.00	0.53	1	Mycophenolate Mofetil 500mg	Mycofit Tablet	57,591.80	0.11
2	Felodipine5mg	Plendil ER 5mg	17,776.00	0.34	2	Mycophenolate Mofetil 250mg	Mycofit Capsule	57,311.80	0.11
3	Mycophenolate Mofetil 250mg	Cellcept Capsule	12,442.20	0.24	3	Sodium Chloride 0.9% w/v For Irrigation 3000ml	Rins NS	46,224.00	0.09
4	Mycophenolate Mofetil 500mg	Cellcept Tablet	12,442.20	0.24	4	Magnesium Sulphate 49.3% w/v 50% w/v	Injecsol MgSO4	19,500.00	0.04
5	Felodipine10mg	Plendil ER 10mg	7,260.00	0.14	5	-	-	-	-

Appendix XII Price reduction (per unit) according to the change of medicines category by ministry

Change of medicine category		Overall estimated savings					Estimated savings					Estimated dissavings				
		No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)	No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)	No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)
Ministry of Health (MOH)																
Same brand	**Innovator**	55	0.13	-0.001 - 1.23	0.010	0.78	41	0.33	0.06 – 2.10	0.001	2.91	14	-0.71	-2.83 - -0.20	0.001	-2.28
	Generic	14	0.07	-0.03 - 0.34	0.529	16.71	9	0.22	0.13 – 0.58	0.012	40.85	5	-0.65	-4.17 - -0.03	0.043	-5.96
Different brand	**Innovator to generic**	8	5.15	0.90 - 7.17	0.012	48.35	8	5.15	0.90 – 7.17	0.012	48.35	-	-	-	-	-
	Generic to other generic	5	0.09	0.05 - 0.09	0.078	22.55	4	0.09	0.08 – 0.25	>0.05	25.70	1	-0.04	-	-	-2.87
	Generic to Innovator	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Overall MOH		**82**	**0.13**	**0.00 - 1.28**	**0.001**	**2.91**	**62**	**0.34**	**0.08 – 3.63**	**0.001**	**5.44**	**20**	**-0.50**	**-3.52 – -0.11**	**0.001**	**-3.21**
Ministry of Defence (MOD)																
Same brand	**Innovator**	42	1.53	0.01 - 9.55	0.001	9.78	33	2.64	0.66 – 14.87	0.001	11.19	9	-0.08	-1.95 – -0.02	0.008	-2.24
	Generic	7	0.36	0.33 - 0.58	0.018	48.22	7	0.36	0.33 – 0.58	0.018	48.22	-	-	-	-	-
Different brand	**Innovator to generic**	10	9.48	3.81- 52.39	0.005	80.59	10	9.48	3.81 – 52.39	0.005	80.59	-	-	-	-	-
	Generic to other generic	6	5.65	1.95 - 12.26	0.046	69.38	5	5.90	5.40 – 14.38	0.043	73.97	1	-0.12	-	-	- 27.91

Change of medicine category		Overall estimated savings					Estimated savings					Estimated dissavings				
		No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)	No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)	No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)
	Generic to Innovator	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Overall MOD		**65**	**2.15**	**0.34 - 10.47**	**0.001**	**27.47**	**55**	**3.34**	**0.66 – 14.62**	**0.001**	**44.00**	**10**	**-0.10**	**-1.56 – -0.03**	**0.001**	**-2.30**
Ministry of Higher Education (MOHE)																
Same brand	**Innovator**	5-43	1.09	0.05 - 10.50	0.001	9.41	5-33	2.86	0.42 – 12.27	0.001	15.61	2-10	-0.40	-0.64 - -0.15	0.001	-3.01
	Generic	1-13	0.25	0.10 - 2.01	0.001	35.48	1-12	0.46	0.21 – 2.28	0.001	39.04	1-2	-0.59	-1.81 - -0.10	>0.05	-2.88
Different brand	**Innovator to generic**	1-5	6.11	2.60 - 11.05	0.001	69.93	1-5	6.11	2.60 – 11.05	0.001	69.93	-	-	-	-	-
	Generic to other generic	2-6	0.78	0.29 - 2.13	0.001	46.29	2-6	0.78	0.29 – 2.13	0.001	46.29	-	-	-	-	-
	Generic to Innovator	1-2	-1.28	-1.75 - 0.33	0.225	-108.47	1	0.43	0.38 – 0.48	>0.05	52.95	1-2	-1.75	-2.63 - -1.52	>0.05	-246.48
Overall MOHE		**9-68**	**1.03**	**0.15 - 6.62**	**0.001**	**23.76**	**9-55**	**2.05**	**0.33 – 9.72**	**0.001**	**31.47**	**2-13**	**-0.45**	**-1.06 – -0.15**	**0.001**	**-3.67**

Wilcoxon signed-rank test. Statistical analysis was observed as p-value less than 0.05; IQR = Inter Quartile Range

Appendix XIII Price reduction (per unit) according to the change of medicines category by UTHs

Change of medicine category		Overall estimated savings					Estimated savings					Estimated dissavings				
		No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)	No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)	No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)
Canselor Tuanku Muhriz Hospital (HCTM)																
Same brand	Innovator	36	0.40	0.001 - 3.97	0.001	3.25	28	0.94	0.31 - 6.34	0.001	5.61	8	-0.44	-0.78 - -0.21	0.012	-3.17
	Generic	9	0.49	0.22 - 1.35	0.015	41.51	8	0.62	0.22 - 1.59	0.012	41.63	1	-0.13	-	-	-0.48
Different brand	Innovator to generic	5	6.86	4.10 - 13.36	0.043	66.67	5	6.86	4.10 - 13.36	0.043	66.67	-	-	-	-	-
	Generic to other generic	5	1.10	0.45 - 2.07	0.043	38.14	5	1.10	0.45 - 2.07	0.043	38.14	-	-	-	-	-
	Generic to Innovator	1	1.28	-	-	-108.47	-	-	-	-	-	1	-1.28	-	-	-108.47
Overall HCTM		**56**	**0.56**	**0.03 - 4.18**	**0.001**	**11.35**	**46**	**1.07**	**0.29 - 6.35**	**0.001**	**29.48**	**10**	**-0.44**	**-0.97 - -0.16**	**0.005**	**-3.17**
University of Science Malaysia Specialist Hospital (HPUSM)																
Same brand	Innovator	43	0.63	0.004 - 6.11	0.001	5.91	33	1.80	0.42 - 14.13	0.001	15.23	10	-0.32	-0.46 - -0.18	0.005	-2.23
	Generic	13	0.42	0.19 - 1.58	0.016	38.03	12	0.50	0.20 - 1.72	0.002	38.14	1	-4.08	-	-	-39.28
Different brand	Innovator to generic	4	9.73	6.11 - 12.42	0.068	59.47	4	9.73	6.11 - 12.42	0.068	59.47	-	-	-	-	-
	Generic to other generic	6	0.26	0.16 - 0.33	0.028	43.03	6	0.26	0.16 - 0.33	0.028	43.03	-	-	-	-	-
	Generic to Innovator	2	-2.63	-3.06 - -2.19	0.180	-246.48	-	-	-	-	-	2	-2.63	-3.06 - -2.19	0.180	-246.48
Overall HPUSM		**68**	**0.58**	**0.05 - 5.89**	**0.001**	**18.11**	**55**	**1.25**	**0.29 - 8.72**	**0.001**	**26.28**	**13**	**-0.45**	**-1.75 - -0.25**	**0.001**	**-3.67**

Change of medicine category		Overall estimated savings					Estimated savings					Estimated dissavings				
		No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)	No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)	No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)
University Malaya Medical Center (UMMC)																
Same brand	**Innovator**	7	2.13	1.25 - 7.51	0.018	21.07	7	2.13	1.25 - 7.51	0.018	21.07	-	-	-	-	-
	Generic	2	1.43	0.74 - 2.13	0.180	35.32	2	1.43	0.74 - 2.13	0.180	35.32	-	-	-	-	-
Different brand	**Innovator to generic**	3	7.10	3.92 - 53.02	0.109	61.21	3	7.10	3.92 - 53.02	0.109	61.21	-	-	-	-	-
	Generic to other generic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Generic to Innovator	1	0.53	-	-	58.75	1	0.53	-	-	58.75	-	-	-	-	-
Overall UMMC		**13**	**2.13**	**0.53 - 7.10**	**0.001**	**47.45**	**13**	**2.13**	**0.53 - 7.10**	**0.001**	**47.45**	**-**	**-**	**-**	**-**	**-**
Sultan Ahmad Shah Medical Centre (SASMEC)																
Same brand	**Innovator**	16	11.31	0.21 - 31.60	0.004	18.48	14	18.47	0.96 - 31.85	0.001	25.44	2	-6.21	-8.85 - -3.56	0.180	-6.29
	Generic	7	0.22	0.03 - 0.23	0.236	42.15	5	0.23	0.22 - 0.23	0.042	42.53	2	-0.54	-0.80 - -0.27	0.180	-2.88
Different brand	**Innovator to generic**	1	2.44	-	-	89.71	1	2.44	-	-	89.71	-	-	-	-	-
	Generic to other generic	3	1.45	1.41 - 2.80	0.109	50.84	3	1.45	1.41 - 2.80	0.109	50.84	-	-	-	-	-
	Generic to Innovator	1	0.33	-	-	47.15	1	0.33	-	-	47.15	-	-	-	-	-
Overall SASMEC		**28**	**1.26**	**0.19 - 25.43**	**0.001**	**32.85**	**24**	**1.94**	**0.24 - 28.34**	**0.001**	**33.89**	**4**	**-0.99**	**-3.67 - -0.69**	**0.068**	**-3.79**

Change of medicine category		Overall estimated savings					Estimated savings					Estimated dissavings				
		No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)	No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)	No of medicines (n)	Median Price Reduction (RM)	IQR (RM)	p-value	Median Price Reduction percentage (%)
Al Sultan Abdullah Hospital (HASA)																
Same brand	**Innovator**	17	3.60	0.42 - 12.22	0.001	9.80	15	5.57	2.11 - 12.25	0.001	10.99	2	-0.12	-0.13 - -0.10	0.180	-3.86
	Generic	2	2.71	1.39 - 4.03	0.180	29.82	2	2.71	1.39 - 4.03	0.180	29.82	-	-	-	-	-
Different brand	**Innovator to generic**	2	2.59	2.33 - 2.84	0.180	79.12	2	2.59	2.33 - 2.84	0.180	79.12	-	-	-	-	-
	Generic to other generic	2	25.98	13.19 - 38.78	0.180	70.02	2	25.98	13.19 - 38.78	0.180	70.02	-	-	-	-	-
	Generic to Innovator	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Overall HASA		**23**	**3.42**	**0.40 - 12.20**	**0.001**	**18.93**	**21**	**3.60**	**1.24 - 12.22**	**0.001**	**27.02**	**2**	**-0.12**	**-0.13 - -0.10**	**0.180**	**-3.86**
Sultan Abdul Aziz Shah Hospital (HSAAS)																
Same brand	**Innovator**	5	2.07	0.48 - 4.15	0.043	45.74	5	2.07	0.48 - 4.15	0.043	45.74	-	-	-	-	-
	Generic	1	3.25	-	-	23.90	1	3.25	-	-	23.90	-	-	-	-	-
Different brand	**Innovator to generic**	3	5.35	4.72 - 6.79	0.109	90.29	3	5.35	4.72 - 6.79	0.109	90.29	-	-	-	-	-
	Generic to other generic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Generic to Innovator	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Overall HSAAS		**9**	**4.09**	**2.07 - 4.70**	**0.008**	**45.74**	**9**	**4.09**	**2.07 - 4.70**	**0.008**	**45.74**	**-**	**-**	**-**	**-**	**-**

Wilcoxon signed-rank test. Statistical analysis was observed as p-value less than 0.05; IQR = Inter Quartile Range

Appendix XIV Procurement Price Ratio (PR) >1 for innovator medicines

No.	Generic name	Australia	Thailand	South Korea	South Africa
1	Alprostadil 500mcg/ml	-	2.59	-	1.88
2	Ampicillin & Sulbactam 375mg	-	-	1.06	-
3	Anagrelide Hydrochloride 0.5mg	-	-	1.05	-
4	Anidulafungin 100mg	-	-	-	-
5	Brimonidine Tartrate 0.15% Opthalmic 1.5mg/ml	-	-	1.43	-
6	Calcipotriol & Betamethasone 50mcg/gm + 0.5mg/gm	1.7	-	-	-
7	Carbamazepine CR 200mg	2.11	-	-	-
8	Carbamazepine CR 400mg	2.09	-	-	-
9	Deferasirox 360mg	-	-	1.3	-
10	Deferasirox 90mg	-	-	1.3	-
11	Dutasteride 0.5mg	1.57	1.25	1.75	-
12	Dydrogesterone 10mg	-	1.17	-	-
13	Enoxaparin Sodium 4000 IU (40mg)/0.4ml	1.52	-	1.01	1.01
14	Enoxaparin Sodium 6000 IU (60mg)/0.6ml	1.08	-	1.11	-
15	Eperisone HCl 50mg	-	-	1.8	-
16	Etoricoxib 90mg	-	-	-	-
17	Idarubicin 1mg/ml	-	1.25	-	1.42
18	Insulin Aspart 30% & Protaminated Insulin Aspart 70% 100iu/Ml 30%/70%	1.23	1.08	-	-
19	Linezolid 2mg/ml	-	-	1.19	-
20	Methylphenidate HCl 10mg	4.06	3.33	-	-
21	Mycophenolate Mofetil 250mg	2.25	-	-	-
22	Mycophenolate Mofetil 500mg	2.25	-	-	-

No.	Generic name	Australia	Thailand	South Korea	South Africa
23	Paliperidone 3mg	2.9	1.6	3.27	-
24	Paliperidone 6mg	1.44	-	2.19	-
25	Paliperidone 9mg	1.15	-	2.14	-
26	Parecoxib Sodium 40mg	-	1.17	-	-
27	Quetiapine Fumarate 200mg	3.9	-	2.25	-
28	Quetiapine Fumarate 300mg	4.76	-	2.68	1.26
29	Quetiapine Fumarate 400mg	4.23	-	2.63	1.29
30	Quetiapine Fumarate 50mg	-	-	-	1.39
31	Rituximab 10mg/ml	-	4.46	4.37	3.67

Appendix XV Procurement Price Ratio (PR) ≤1 for innovator medicines

No.	Generic name	Australia	Taiwan	Thailand	South Korea	South Africa
1	Ampicillin & Sulbactam 375mg	-	-	0.47	-	-
2	Anagrelide Hydrochloride 0.5mg	-	0.36	0.56	-	0.59
3	Anidulafungin 100mg	-	-	-	0.52	0.77
4	Benzydamine HCl 0.15% w/v solution 1.5mg/ml	0.18	-	0.48	-	-
5	Beractant Intrathracheal Suspension (200mg Phospholipids in 8ml Vial) 200mg/8ml	-	0.73	0.68	-	0.64
6	Budesonide & Formoterol 160mcg + 4.5mcg	0.86	0.51	0.96	0.70	0.94
7	Calcium Polystyrene Sulphonate 5gm	-	-	0.42	-	-
8	Capecitabine 500mg	-	-	0.88	-	-
9	Carbamazepine CR 200mg	-	-	-	0.84	0.45
10	Carbamazepine CR 400mg	-	-	-	-	0.46

No.	Generic name	Australia	Taiwan	Thailand	South Korea	South Africa
11	Dexmedetomidine HCl 100mcg/ml	-	0.37	0.32	-	0.49
12	Dutasteride 0.5mg	-	-	-	-	0.70
13	Dydrogesterone 10mg	-	-	-	-	0.83
14	Enoxaparin Sodium 4000 IU (40mg)/0.4ml	-	-	0.84	-	-
15	Enoxaparin Sodium6000 IU (60mg)/0.6ml	-	-	0.86	-	0.87
16	Eperisone HCL 50mg	-	-	0.83	-	-
17	Ertapenem 1g	-	0.88	0.99	0.84	0.84
18	Erythropoietin Beta Human Recombinant 2000IU/0.3ml	-	0.42	0.22	-	0.36
19	Etoricoxib 90mg	-	-	0.55	-	0.59
20	Felodipine 10mg	0.24	-	-	-	-
21	Felodipine 5mg	0.29	-	-	-	-
22	Fluvoxamine 100mg	0.70	-	-	-	0.20
23	Fluvoxamine 50mg	0.39	0.44	-	-	-
24	Fondaparinux Sodium 2.5mg/0.5ml	0.53	0.59	0.98	0.77	0.77
25	Insulin Aspart 30% & Protaminated Insulin Aspart 70% 100iu/Ml 30%/70%	-	0.65	-	0.56	0.67
26	Ipratropium Bromide Anhydrous 20mcg And Fenoterol 50mcg/Dose 20mcg + 50mcg	-	0.42	-	-	-
27	Linezolid 2mg/ml	-	-	0.81	-	-
28	Methylphenidate HCl 10mg	-	-	-	-	0.71
29	Mycophenolate Mofetil 250mg	-	0.42	0.92	0.86	0.43
30	Paliperidone 3mg	-	-	-	-	0.75
31	Paliperidone 6mg	-	0.75	0.90	-	0.75

No.	Generic name	Australia	Taiwan	Thailand	South Korea	South Africa
32	Paliperidone 9mg	-	0.87	0.91	-	-
33	Quetiapine Fumarate 200mg	-	-	-	-	0.98
34	Quetiapine Fumarate 300mg	-	-	0.78	-	-
35	Quetiapine Fumarate 400mg	-	-	0.61	-	-
36	Sodium Valproate 200mg/5ml	-	-	-	-	0.61
37	Tamsulosin HCl 400mcg	-	-	0.33	-	-
38	Ursodeoxycholic Acid 250mg	0.81	-	-	-	0.94
39	Valsartan 160mg	0.60	0.56	-	0.16	0.18
40	Valsartan 80mg	0.45	0.39	-	0.17	0.11
41	Warfarin Sodium 3mg	-	0.82	0.59	-	-

Appendix XVI Procurement Price Ratio (PR) ≤1 for generic medicines

No.	Generic name	Australia	Taiwan	Thailand	South Korea	South Africa
1	Calcium Polystyrene Sulphonate 5gm	-	-	0.42	-	-
2	Capecitabine 500mg	-	-	0.88	-	-
3	Dexmedetomidine HCl 100mcg/ml	-	0.37	0.32	-	0.49
4	Warfarin Sodium 3mg	-	0.82	0.59	-	-

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IMPACT OF POOLED PROCUREMENT ON MEDICINES PRICING IN THE PUBLIC SECTOR

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