A COST-UTILITY ANALYSIS COMPARING TRANSCATHETER AND SURGICAL PULMONARY VALVE REPLACEMENT AMONG INDONESIA PATIENTS WITH A HISTORY OF NEWBORN RIGHT VENTRICULAR OUTFLOW TRACT CORRECTION

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A Thesis Submitted in Partial Fulfillment of the Requirements
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การประเมินต้นทุนอรรถประโยชน์ของการเปลี่ยนลิ้นหัวใจพัลโมนารีโดยใช้สายสวนเทียบกับการผ่าตัดเปิดหน้าอกในผู้ป่วยชาวอินโดนีเซียที่มีประวัติการแก้ไขความผิดปกติบริเวณทางออกของหัวใจห้องล่างขวาเมื่อแรกเกิด

น.ส.แอนดี้ นูรูล แอนนิซ่า

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
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Thesis Title	A COST-UTILITY ANALYSIS COMPARING TRANSCATHETER AND SURGICAL PULMONARY VALVE REPLACEMENT AMONG INDONESIA PATIENTS WITH A HISTORY OF NEWBORN RIGHT VENTRICULAR OUTFLOW TRACT CORRECTION
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การประเมินต้นทุนอรรถประโยชน์ของการเปลี่ยนลิ้นหัวใจพัลโมนารีโดยใช้สายสวนเทียบกับการผ่าตัดเปิดหน้าอกในผู้ป่วยชาวอินโดนีเซียที่มีประวัติการแก้ไขความผิดปกติบริเวณทางออกของหัวใจห้องล่างขวาเมื่อแรกเกิด. (A COST-UTILITY ANALYSIS COMPARING TRANSCATHETER AND SURGICAL PULMONARY VALVE REPLACEMENT AMONG INDONESIA PATIENTS WITH A HISTORY OF NEWBORN RIGHT VENTRICULAR OUTFLOW TRACT CORRECTION) อ.ที่ปรึกษาหลัก : อ. ภก. ดร.โอสถ เนระพูสี

การเปลี่ยนลิ้นหัวใจพัลโมนารีเทียมผ่านสายสวน (TPVR) ใช้ครั้งแรก ปี 2000 TPVR แนะนำในผู้ป่วยที่มีประวัติการแก้ไขความผิดปกติบริเวณทางออกของหัวใจห้องล่างขวา(RVOT)เมื่อแรกเกิด ที่เคยรับการผ่าตัดมาก่อน การใช้ TPVR ทำให้นอนโรงพยาบาลสั้นกว่า ภาวะแทรกซ้อนน้อยกว่า และเป็นการรักษาที่รุกล้ำเข้าร่างกายน้อยกว่า แต่พบว่ามีราคาแพงกว่าวิธีการผ่าตัดเปลี่ยนลิ้นหัวใจแบบเปิด (SPVR) ซึ่งเป็นปัญหาการเข้าถึงในประเทศที่มีรายได้น้อย เนื่องจากยังไม่มีข้อมูลความคุ้มค่าในอินโดนีเซียและขาดข้อมูลประสิทธิผลการใช้เนื่องจากมีผู้ป่วยน้อย จึงเป็นความท้าทายในการหาวิธีการเข้าถึงที่เหมาะสม

วัตถุประสงค์ของงานวิจัยคือศึกษาความคุ้มค่าของต้นทุนอรรถประโยชน์ ต้นทุนรวม ปีสุขภาวะ (QALY) ปีชีวิต (LYs) และอัตราส่วนของต้นทุนเพิ่มต่อประสิทธิผล (ICER) การวิเคราะห์รวมค่าใช้จ่ายที่เกี่ยวข้องการรักษาในโรงพยาบาล, แบบผู้ป่วยใน , ผู้ป่วยนอก และภาวะแทรกซ้อน

แบบจำลอง MARKOV สร้างขึ้นเพื่อใช้ประเมินเปรียบเทียบการใช้ SPVR หรือ TPVR ในกลุ่มผู้ป่วยเด็กโรคหัวใจที่มีปัญหา RVOT และเคยผ่าตัดมาก่อน ติดตามไปตลอดอายุขัย การประเมินความคุ้มค่าใช้แนวทางปฏิบัติ HTA ของประเทศอินโดนีเซีย ข้อมูลคลินิกได้มาจากการวิเคราะห์อภิธาน 2 รายงานและบางส่วนจากหลักฐานที่ตีพิมพ์แล้ว ผลลัพธ์มีปรับด้วยอัตราลด 3% และราคาปรับด้วยดัชนีราคาผู้บริโภคแสดงในปี 2023 การวิเคราะห์ความไวใช้แบบค่าเดียวและแบบอาศัยความน่าจะเป็น

ต้นทุนรวมของ TPVR และ SPVR อยู่ที่ 71,033.15 USD และ 23,946.02 USD ขณะที่ QALY ทั้งหมดที่ได้คิดเป็น 14.23 และ 11.77 ปีสุขภาวะตามลำดับ พบว่า TPVR ยังไม่มีความคุ้มค่าเมื่อคิดจากอัตราส่วนต้นทุนเพิ่มต่อปีสุขภาวะ คือ 19,191.37 USD/QALY เทียบกับรายได้ประชาชาติที่ 3,900 USD การวิเคราะห์ความไวค่าเดียวพบว่าค่าอรรถประโยชน์ของ TPVR จะมีผลกระทบต่อ ICER ขณะที่ราคา TPVR จะเป็นปัจจัยที่สี่ ที่มีผล

ส่วนการวิเคราะห์ความไวแบบอาศัยความน่าจะเป็น พบว่าTPVRจะมีประสิทธิภาพมากกว่าแต่มีราคาแพงกว่าเช่นกัน

การลดราคาของ TPVR ลงอีก 60-70% จะทำให้ได้ราคาเหมาะสมในการจัดหาบรรลุตามแนวทางการประเมินความคุ้มค่า

สาขาวิชา	เภสัชศาสตร์สังคมและบริหาร	ลายมือชื่อนิสิต	....
ปีการศึกษา	2565	ลายมือชื่อ อ.ที่ปรึกษาหลัก	....

6478501833 : MAJOR SOCIAL AND ADMINISTRATIVE PHARMACY

KEYWORD: cost-effectiveness, transcatheter pulmonary valve replacement (TPVR), right ventricular outflow tract (RVOT), congenital heart disease (CHD), economic evaluation

Andi Nurul Annisa : A COST-UTILITY ANALYSIS COMPARING TRANSCATHETER AND SURGICAL PULMONARY VALVE REPLACEMENT AMONG INDONESIA PATIENTS WITH A HISTORY OF NEWBORN RIGHT VENTRICULAR OUTFLOW TRACT CORRECTION. Advisor: OSOT NERAPUSEE, Ph.D.

Transcatheter pulmonary valve replacement (TPVR) was launched since 2000. It indicated for cardiac patients who have the right ventricular outflow tract obstruction (RVOT) and a prior surgery history. TPVR have a shorter hospital stay, fewer complications, and a less-invasive method. However, TPVR is more expensive than surgical pulmonary valve replacement (SPVR). This raises access concerns for low income countries. There are no cost-effectiveness studies in Indonesia, and limited efficiency evidence due to rare disorder. It is a challenge in building the appropriate access strategies. Therefore, this study aims to investigate the cost-utility, resulted in total costs, quality-adjusted life-years (QALYs), life-years (LYs) and incremental cost-effectiveness ratio (ICER). The analysis included costs associated with hospitalization, inpatients and outpatients, and complication costs.

A Markov simulation was modelled to estimate a hypothetical cohort of cardiac surgery experienced paediatric patients who require RVOT remodelling via either SPVR or TPVR during lifelong care. The methodology follows Indonesian health technology assessment guideline, and clinical inputs were derived from two meta-analyses and slightly modified by published articles. We include 3% discount rate of outcome and the consumer price index adjusted price in 2023. Sensitivity analyses were conducted both deterministically and probabilistically.

Total costs between TPVR and SPVR were 71,033.15 USD and 23,946.02 USD, while QALYs gained accounted for 14.23 and 11.77 QALYs, respectively. Shown by ICER at 19,191.37 USD/QALY against one GDP of 3,900 USD, TPVR revealed that it was not cost-effective. For deterministic sensitivity analysis (DSA), utility index of initial TPVR has considerably impact while a price of TPVR is a fourth factor to ICER's. For probabilistic sensitivity analysis (PSA) confirm TPVR is more effective but more expensive. A 60-70% price reduction of TPVR will achieve the optimum price of TPVR provision.

Field of Study:	Social and Administrative Pharmacy	Student's Signature ....
Academic Year:	2022	Advisor's Signature ....

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Andi Nurul Annisa

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CHAPTER I INTRODUCTION

1.1. BACKGROUND AND RATIONALE

Congenital heart diseases (CHDs) present a range of abnormalities in the heart's structure and function of newborn that leads to detrimental effects either physical or functional forms[1, 2]. This condition acquires from a combination both genetic and environmental factors[2, 3]. This disease also has two types: acyanotic and cyanotic. Acyanotic heart disease means that the pumping blood flow has deformity although they have normal pulmonary circulation and oxygenation[3-5]. This condition is commonly as asymptomatic and rarely found because a murmur. This condition also includes left to right shunts, obstructive and miscellaneous lesions[4]. Another group is cyanotic which is normally detected as symptomatic. Thus, the classification of cyanotic CHDs depends on their pathophysiology such as pulmonary venous hypertension, increased and decreased pulmonary blood flow. In some case of cyanotic heart defects, right ventricular is considered due to its role in the pulmonary or the systemic circulation. This condition is normally found in adult congenital heart disease (ACHD) which can manifest to transposition complexes and pressure overload. Consequently, it will lead into RV dysfunction[6-9].

Right ventricular outflow tract (RVOT) dysfunction is attributed to several mechanism of cardiopulmonary diseases, including complex CHDs, valvular heart diseases, acute myocardial infarction, and pulmonary hypertension. It implies from the increasingly acute and chronic heart failure with preserved ejection fraction (HFpEF)[10]. This pathology often exists after intervention of surgeries which is associated with the right ventricle (RV) and pulmonary artery (PA). It also be found in patients who suffer from several types of CHDs with the commonest is tetralogy of Fallot (ToF), as resulted by conotruncal cardiovascular disease in cyanotic congenital heart defect (CHD)[6, 11].

Nowadays, the incidence rate of CHD in global is around 6-9 per 1,000 live births while in Asia continent accounts for 9.3 of 1,000 newborn. It means total patients in CHD will estimate approximately 40,000- 50,000 cases in Indonesia when total population is 274 million people and Indonesian fertility rate is 2.18%[12-15]. Although the survival rate was improved around 18.7% and the mortality rate was declined around 34.5% from 1990 to 2017, appropriate and innovative interventions must be performed in terms of improving quality of life and lowering disability[16]. In-depth understanding of congenital cardiopathies both diagnostic and management is also essential to increase survival rate since they need reintervention during their lifetime. Hence, surgical pulmonary valve replacement (SPVR) or transcatheter pulmonary valve replacement (TPVR) are expected to repair RVOT from the RV structural abnormalities.

The SPVR is an open-handed surgical which is known as a gold standard for the dysfunctional of RVOT. In the live births, the SPVR is a life-saving procedure and has a low mortality rate; however, this procedure demonstrates some drawback points for lifetime care. Firstly, the SPVR requires reoperation due to highly frequency of a failing RVOT conduit[17]. This condition, thus, potentially leads to derivation of cardiac functional status, proven by pulmonary regurgitation (PR), pulmonary stenosis (PS), aneurysmal degeneration, somatic growth, etc. Secondly, this technique requires more recovery time after replacement, shown by the longer of length of stay in hospital and the delay of improvement of RV function[18]. Thus, the SPVR is unfavourable unless it is performed to adults with CHDs and those required concomitant surgical procedures[17-19]. Likewise, the SPVR requires reintervention of an open-chest reconstruction over patients' lifetimes[20, 21]

The TPVR, whilst, is a less-invasive therapy for patients that has been reported as a safe and an effective method to repair the dysfunctional of RVOT, proven by less than 25% of patients required reintervention[20, 22]. The studies from systematic reviews reported that TPVR can shorten the length of stay in hospitals and reduce the procedure-related complications[23]. Likewise, TPVR has a high possibility to procedural success rate, an increased cardio capacity and sustained haemodynamic functions by improved the severity of PR and transpulmonary peak systolic gradient. Instead of its benefits, infective endocarditis has been frequently occurred in TPVR than SPVR that should be considered[24, 25].

As a consequence, TPVR currently indicates for off-label cases to treat RVOT, and on-label indications to patients who have symptoms of heart failure requiring pharmacotherapy, severe RV hypertension, and mean Doppler gradients across the PV of >50 mmHg also 30 mmHg respectively [20, 26]. Not to mention, the procedure of TPVR for RVOT should be conducted by a careful assessment of patient preferences and a multidisciplinary specialist team to achieve a high success rate. It obviously makes this intervention high cost compared to surgical treatment.

Regarding to a higher cost of TPVR outweigh SPVR, the economic evaluation should be conducted to deal with limited healthcare resources. Also, health economic evaluation for introduction new technology is required for providing effective decisions both healthcare professionals, stakeholders, and decision makers. Thus, health economic study will benefit in determining reimbursement rate to government, considered by actual cost from hospital system. Eventually, this study aims to investigate the cost-effectiveness of TPVR considering the SPVR as the comparator among Indonesian patients with a history of right ventricular outflow tract correction.

1.2. OBJECTIVE

To investigate the cost-effectiveness of using transcatheter pulmonary valve replacement compared with surgical pulmonary valve replacement Indonesian patients with a history of newborn right ventricular outflow tract replacement.

1.3. RESEARCH QUESTION

How do the results of TPVR versus SPVR among patients with pulmonary valve disease in right ventricular outflow tract obstruction in Indonesia reflect to lifetime costs and total life-years?

1.4. HYPOTHESIS

The TPVR may successfully perform a longer life-years (LYs) gained along with Indonesian patients with a history of right ventricular outflow tract restoration and potentially result a cost-effective comparing SPVR.

1.5. CONCEPTUAL FRAMEWORK

A conceptual framework of the research study is illustrated below:

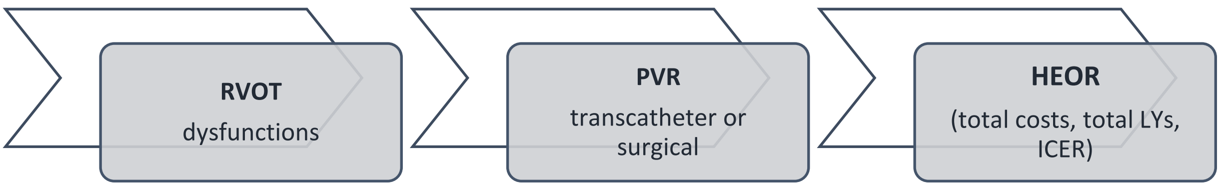

Figure 1. Conceptual framework of study

1.6. EXPECTED BENEFITS

The findings will be evidence supported for healthcare professional and policy makers to make effective decisions for the future use of transcatheter pulmonary valve replacement.

CHAPTER II LITERATURE REVIEW

2.1. CONGENITAL HEART DEFECTS

Congenital hearts disease (CHD) is the most frequently diagnosed in the birth defect. The incidence trend of CHD remained stable in globally and was relatively low in most high-income countries; however, a high rate has still found in low- and middle-income countries (LMICs), specifically located in Afrika and Asia[16]. In addition, one common type of CHD is the dysfunctional of right ventricular outflow tract (RVOT) which estimated to 4% of prevalence rate (around a 1-9% of prevalence range)[8, 27].

2.2. RIGHT VENTRICULAR OUTFLOW TRACT DYSFUNCTIONS & PULMONARY VALVE DISEASES

Right ventricular outflow tract (RVOT) obstruction occurs due to the increased right ventricular pressures. It can manifest to right-sided heart failure[10]. The aetiologies include congenital, iatrogenic and non-specific caused neither congenital nor iatrogenic[27]. This condition is frequently found to adults with congenital heart diseases (ACHD) due to initial repaired of the tetralogy of Fallot[8]. The clinical prognosis will progressively result to pulmonary stenosis or pulmonary regurgitation, or both which leads to haemodynamic impairment.

Pulmonary Stenosis (PS) is a characteristic from cyanotic congenital heart defect that requires treatment although it may have asymptomatic at the beginning of disease progression. The reason is to prevent the possibility of serious complications such as pulmonary regurgitation, permanent cardiac deformation, and heart failure[28]. Pulmonary stenosis (PS) is characterised by approximately 8-10% of all congenital heart defects, combined with other lesions[29, 30]

Pulmonary regurgitation (PR) is the most occurred after replacement of congenital heart disease, such as previous valvuloplasty for Pulmonary Stenosis (PS), Pulmonary Atresia, and repaired Tetralogy of Fallot (ToF). This condition is associated with volume overload. To identify which severity of PR, the classification includes none/trivial/trace, mild, moderate, and severe. It is useful to determine further clinical intervention whereas each severity probably manifests to a significant impact to enlargement or the dysfunctional of right ventricle. It also can generate to exercise intolerance, arrhythmias, and sudden cardiac death[31, 32].

As a result, evaluation, monitoring, and management of these diseases are critical to identify the prognosis of diseases. Advance in diagnostic test is required to achieve optimal goals for heart functional status and maintain clinical consequences for long-term care.

2.3. THE CLINICAL ASSESSMENT OF RIGHT VENTRICULAR OUTFLOW TRACT DYSFUNCTIONS & PULMONARY VALVE DISEASES

The lesions from pulmonary valve diseases should be assessed according to the grading of severity both qualitative and quantitative methods. Performing a comprehensive evaluation can be applied by utilizing variety of diagnostic measurements, including transthoracic echocardiography (TTE), Doppler Echocardiogram, Cardiac Magnetic Resonance Imagining (MRI) and Three-dimensional of Echocardiography[31].

2.3.1. Transthoracic Echocardiography (TTE)

2.3.2. Doppler Echocardiogram

2.3.3. Cardiac Magnetic Resonance Imagining (C-MRI)

2.3.4. Three-dimensional of Echocardiography

Table 1. The severity of Pulmonary Regurgitation (PR) Level, interpreted by various of diagnostic measurements.

	Parameters	A (At risk)		B (Progressive)		C (Asymptomatic)	D (Symptomatic)	References	First Author, Year
		None	Trace	Mild	Moderate	Severe			
Valve Anatomy and Morphology									
A.	Valve Anatomy					Distored or absent leaflets, annular dilatation		AHA/ACC Guidelines	Nishimura Rick A. *et al.* 2014[33]
B.	Pulmonic valve morphology			Normal	Normal/Abnormal	Abnormal		European Association of Echocardiography/ESC	Lancelloti, Patrizio, *et al.* 2010[34]
C.	RV Size			Normal	Normal/Dilated	Dilated		Department of Cardiothoracic Anaesthesia and Intensive Care, Freeman Hospital, NHS Trust	Prabhu, Mahesh. 2009[35]
D.	2D Visualisation of the cusps			Usually normal	Abnormal	Abnormal or may not be seen		British Society of Echocardiography's perspective	Zaidi, A. *et al.* 2020[31]
E.	2D Assessment of Chamber siza			RV is usually normal	RV is usually normal or with mild dilatation	RV is usually dilated		British Society of Echocardiography's perspective	Zaidi, A. *et al.* 2020[31]
Valve Hemodynamics									
ECHOCARDIOGRAPHY									
A.	Colour Doppler/ Jet length (At a Nyquist limit of 50-60 cm/s)								
1	Jet width in relation to pulmonary annulus or conduit (Colour Doppler/CD)			<20%	20-40%	>40%		American Society of Echocardiography collaboration with Japanese Society of Echocardiography	Zoghbi, William A. *et al.* 2019[36]
2	Colour flow PR jet width			Small, usually <10 mm in length with a narrow origin	Intermediate	Large, with a wide origin; may be brief in duration		European Association of Echocardiography/ESC	Lancelloti, Patrizio. *et al.* 2010[34]
3	Regurgitant jet width			Normal right ventricular dimensions with thin (less than 10	Normal or dilated right ventricle with intermediate regurgitant jet	Dilated right ventricle (except in acute PR) with large regurgitant jet width (greater than 50% of pulmonic valve annulus)		National Library of Medicine, National Institutes of Health.	Pendela, Venkata S and Rania Ayyad. 2021[37]

					mm in length)	width (less than 50% of pulmonic valve annulus)			
B.	Pulse wave Doppler/ Flow quantitation								
	1	Pulmonic vs Aortic flow			Normal or slightly increased	Intermediate	Greatly increased	European Association of Echocardiography/ESC	Lancelloti, Patrizio, et al. 2010[34]
	2	Site of diastolic flow reversal in PA/conduit (pulse wave Doppler/PWD)			Proximal half of the main PA/conduit	Distal main PA/conduit	Extends into PA branches	American Society of Echocardiography collaboration with Japanese Society of Echocardiography	Zoghbi, William A. *et al.* 2019[36]
C.	Continuous wave Doppler/ Jet deceleration rate								
	1	CW signal of PR jet (steep deceleration is not specific for severe PR)			Faint/Slow deceleration	Dense/Variable	Dense/steep deceleration, early termination of diastolic flow	European Association of Echocardiography/ESC	Lancelloti, Patrizio, *et al.* 2010[34]
	2	PR velocity wafeform density and contour (Continuous-wave Doppler/CWD)			Soft	Dense; early termination of diastolic flow possible (depending on RV compliance)	Dense; early termination of diastolic flow	American Society of Echocardiography collaboration with Japanese Society of Echocardiography	Zoghbi, William A. *et al.* 2019[36]
	3	Deceleration time of PR signal					<260 ms	British Society of Echocardiography's perspective	Zaidi, A. *et al.* 2020[31]
	4	PR pressure hal-time (Continuous-wave Doppler/CWD)					<100 ms	American Society of Echocardiography collaboration with Japanese Society of Echocardiography	Zoghbi, William A. *et al.* 2019[36]
	5	Pulmonary Regurgitation Fraction (PRF)			<20%	20-40%	>40%	American Society of Echocardiography collaboration with Japanese Society of Echocardiography	Zoghbi, William A. *et al.* 2019[36]
CARDIAC MAGNETIC RESONANCE IMAGINING (C-MRI/CMR)									

	1	Right ventricular end-systolic volume index (RVESVi)					> 80 ml/m2			Alkashkari W. et al. 2020[38]
	2	Right ventricular end-diastolic volume index (RVEDVi)				>140 ml/m2			EuroIntervention Journals	Boudjemline, Younes, et al. 2016[39]
							>160 ml/m2			Alkashkari W. et al. 2020[38]
	3	Right ventricular ejection fraction (RVEF)								
	4	Left ventricular end-systolic volume index (LVESVi)								
	5	Left ventricular end-diastolic volume index (LVEDVi)								
	6	Left ventricular ejection fraction (LVEF)								
Hemodynamic consequences							1. Paradoxical septal motion (volume overload pattern) 2. RV enlargement		AHA/ACC Guidelines	Nishimura, Rick A. *et al.* 2014[33]
Symptoms							None or variable and dependent on cause of PR and RV function		AHA/ACC Guidelines	Nishimura, Rick A. *et al.* 2014[33]

2.4. SURGICAL VS TRANSCATHETER PULMONARY VALVE REPLACEMENT

Surgical pulmonary valve replacement (SPVR) is favourable for adults who have undergone replacement of TOF and characterised by moderate or greater PR with other malformations which requires open-heart surgery[1]. This technique is a gold standard therapy to repair of PR in ToF although it is very invasive and requires more recovery time after procedure, shown by the longer of length of hospital stay (LoS)[11, 17].

Over the time, transcatheter pulmonary valve replacement (TPVR) comes as a less invasive therapy to patients who have had a previous RVOT conduit or valve replacement. It has been initially launched since 2000 by Dr. Bonhoeffer to treat a 12-year-old boy with pulmonary stenosis (PS) and insufficiency of a prosthetic conduit from the right ventricular to the pulmonary artery[40]. Therefore, the population of this condition is normally started from adolescents or young adults to consider long-term consequences.

According to meta-analysis, TPVR is more favourable in every clinical outcome. Firstly, early mortality was approximated by 0,2% of TPVR compared to SPVR cases. Another short-term outcome is procedure-relate complication which is significantly lowering to incidence rate. For midterm outcomes both mortality and reintervention are less found in TPVR compared to SPVR. However, endocarditis incidence was highly diagnosed into TPVR than SPVR[25]. Despite of endocarditis case, TPVR based on this systematic review has potential results to be value-based healthcare.

In Norway, along with 34 patients participated in the study whereas TPVR was attempted in 20 patients (median age: 8-36 years), and around 14 patients (median age: 9-53 years) received surgical repairment. The reported study has captured the most precise stage of micro-costing, including length of stay (LoS) and pre-operative, per-operative, post-operative phases. Although, the TPVR spent more expenses at the pre-intervention than open-heart surgery but the TPVR is more cost-saving, presented by the high post-treatment cost SPVR and the LoS's costs of TPVR were lower mean \$3885, compared to SPVR mean \$17,848[24]

In a multicentre trial from Europe to Canada reported that after long-term follow-up within a 5-year, TPVR showed not only ensuring better haemodynamic performance, proven by Echocardiographic and NYHA functional classes but also improving patients' quality of life, demonstrated by visual analogue scale (VAS) and EQ-5D utility index.

Although it reports only single study, the increased utility value from pre-implant (0.808) to one year post implanted (0.921) is promisingly recommended for further strategies[41].

2.5. CLINICAL OUTCOMES

2.5.1. Mortality rates

The incidence mortality after repaired is divided into two groups. First is periprocedural mortality or early mortality which accounts around 30 days after replacement. Second is mortality during follow-up period which occurs within lifetime follow-up. According to a meta-analysis result, TPVR is more favourable compared to SPVR. In the preprocedural mortality, the case finding in TPVR is less occurred which approximated 0,2%[25].

2.5.2. Significant pulmonary regurgitation

Pulmonary regurgitation is resulted in repaired congenital heart defects or specifically tetralogy of Fallot. It commonly occurs due to the dilatation of the valve conduits or patients who get pulmonary arterial dilatation as a manifestation from pulmonary hypertension (PH)[31]. It is also found in echocardiogram as a follow-up intervention to track both PS and PR. The prognosis of PR depends on the severity of PR grading. Therefore, the evaluation and management of PR require the interprofessional team.

2.6. ECONOMIC EVALUATION

Health economics have been grown popular since the implementation of universal health coverage due to making sure that every people have access to healthcare services without financial hardship. The topic of health economics includes all essential healthcare programmes such as promotion, prevention, treatment, rehabilitation, and palliative care. To assess those programmes and prevent them from inefficiency, economic evaluation in healthcare system is prominent role to achieve the efficiency of resources to the implementation of healthcare services. The purpose is to provide information in which intervention is the most cost-effective strategy meanwhile the allocation are limited[42]. It also can be beneficial to determine decision-making process either interventions or services to directly aiming for patients[43]. Therefore, economic evaluation explicitly compares between the outcomes and the included costs to provide decision makers for further recommendation both health policies and strategies. In this condition, the most cost-effective strategy will be called as dominant[42]. The result also presents as incremental cost effectiveness ratio (ICER).

2.7. TYPE OF ECONOMIC EVALUATION

In general, the economic evaluation is categorised into two groups. The first is partial economic study which independently measures either costs or outcomes of health technologies or policies without looking for their consequences. The second is full economic study which assesses two or more alternative strategies about. It is typically used to compare between new technology and standard intervention[44]. Furthermore, the type of economic evaluation also defines based on the outcomes measurement that study looks for, as explained in Table 2.

Table 2.Type of economic evaluation

Type of economic evaluation	Input (costs)	Output (consequences/outcomes)	Implementation
1. Cost-illness analysis[43, 45]	Identify total cost, costs by component, and unit costs and consider the myriad included factors	Monetary value	Comparing of net cost of implementation intervention with equivalent outcomes. It determines as the economic burden to society caused by illness.
2. Cost-minimalization analysis (CMA)[42]	Unit cost	The alternative technologies should be equivalent	Comparing costs and choosing the affordable intervention
3. Cost-benefit analysis (CBA)[42, 44]	Unit cost	Monetary units	Comparison between more alternative strategies where the outcomes and costs are presented in monetary units
4. Cost-effectiveness analysis (CEA)[42]	Unit cost	The alternative technologies are not equivalent, and it assesses in natural units.	Making decision for technical efficiency or the optimal strategies
5. Cost-utility analysis (CUA)[42, 43]	Unit cost, utility value	Humanistic: Quality-adjusted life years (QALYs)	Comparing the various of healthcare strategies which has similar area between each other, including mortality and morbidity.

2.8. VALUE-BASED HEALTHCARE RESEARCH

Over the years, the trend of healthcare system has changed from volume-based care to value-based healthcare since universal health coverage (UHC) has been globally promoted by World Health Organisation (WHO). Value-based healthcare is a programme for given incentive payments or reimbursement, or both, accounted by patient-centred outcomes. This aims to support delivering of healthcare services into ensuring quality care. Therefore, value-based healthcare is called as a long-term outcome of cost-effectiveness analysis (CEA)[46, 47].

Value in healthcare focusses on expanding health benefits and reducing health expenditures to achieve efficiency, equitability, and sustainability of high quality for patients. This is an innovative method to optimise clinical outcomes that matter to patients and raise patient satisfaction. Meanwhile, overall healthcare costs and burden can be promisingly reduced since this method puts payment based on performance and quality metrics instead of implementing fee of service or claim-based package system[47-49]. Therefore, value-based healthcare research comes to systematically evaluate those in the healthcare system.

Value-based healthcare research provides a form to guide and support researchers and any research collaboration to create system priorities[50, 51]. This method hereby requires both a well-established model and a collective commitment, including researchers, physician, patients, and providers. This team comes together to design and formulate how healthcare strategies will be provided and funded in the future to improve health service provision.

CHAPTER III METHODOLOGY

3.1. OVERALL MODEL SIMULATION

The economic modelling of this study is a Markov cohort simulation that was designed by using a Microsoft Excel® macro-enabled workbook to evaluate the incremental cost-effectiveness ratio (ICER). The economic modelling provides several following assumptions for all RVOT patients in 15 years old with the early age (2-4 years of age) had initial SPVR ($SPVR_0$), as shown in Figure 2. First assumption is patients undergoing 1^{st} repeated and 2^{nd} repeated SPVR within 15 years of interval. The second assumption illustrates patients who were eligible for initial TPVR ($TPVR_0$) after $SPVR_0$. These patients then continued with 1^{st} repeated and 2^{nd} repeated of TPVR within 10 years of interval due to the best used from the medical device. From all scenarios, patients got probability to still alive in each annual cycle and/or distributed to intervention and/or natural death. All patients after 45 years old of SPVR and TPVR will have a high mortality risk up to 10 times from natural death due the atrial and ventricular arrhythmias risk will get a higher after 45 years[1]. Likewise, the models simulate a hypothetical cohort of 1,000 patients with annual cycle length.

In cost inputs, the currency rate was converted from 2023 Indonesia Rupiah/IDR to 2023 US Dollars/USD (1USD= 14,824.75IDR)[52]. Each pricelist is adjusted to 2023 of consumer price index[53]. Thereafter, total costs were presented into actual costs of each component as mentioned to hospital rates. The model was not directly visualised further long-term complications occurred beyond one year post-implanted. However, each SPVR and TPVR have taken cost of system and IPD during intervention process. Also, intervention death and some complication risk such as pacemaker implantation, procedure-related complications and/or endocarditis treatment have incurred in total costs.

Furthermore, total actual costs and clinical parameters plugged into a hypothetical cohort simulation to obtain incremental cost-effective ratio (ICER) by dividing cost per quality-adjusted life-years (QALYs) gained. The ICER threshold that has been established for acceptable cost-effective in Indonesia is 1-time of GDP/capita in which 1 GDP is 3900 USD (57,816,525IDR)[54]. All outcomes of being interest beyond the annual rate of the model were discounted at 3% as recommended by Indonesian HTA guideline[55].

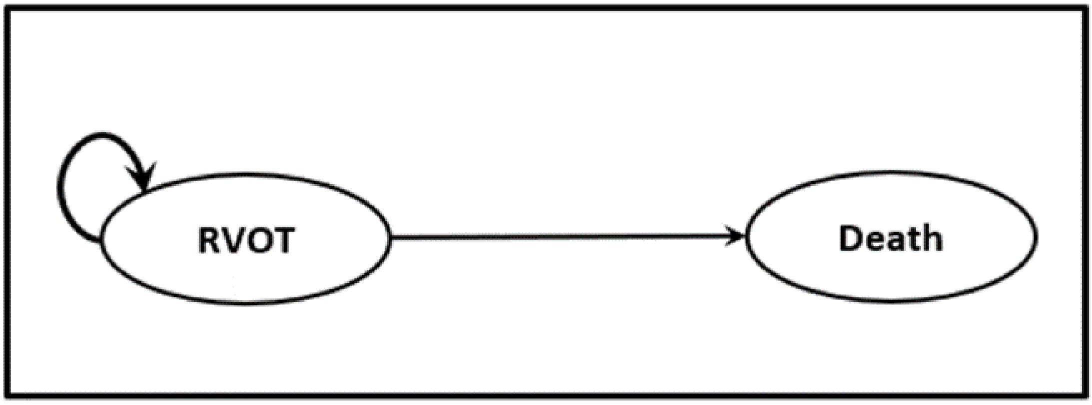

Figure 2. A Markov cohort simulation model for population who had a prior RVOT replacement.

3.2. COMPARATOR AND INTERVENTION

This study used SPVR as comparator meanwhile TPVR is the intervention. Since the brands of those interventions are varied in worldwide, the estimated charge of those medical devices used an available information of a market price.

3.3. MODEL INPUT PARAMETERS

3.3.1. Transition probabilities and clinical inputs

Two meta-analyses and two original articles were found to calculate mortality rates and annual complication risks for patients undergoing TPVR and SPVR procedures[23, 56-58]. These parameters thus extrapolated to over the time horizon of the analysis. Details of input parameters are reported in Table 3.

3.3.2. All incurred costs

All cost inputs were derived from hospital's website at National Cardiovascular Centre Harapan Kita Hospital, Jakarta, interview to clinical experts, and published available resources in Indonesia. Cost inputs were estimated by hospital rates as actual costs. The actual costs were grouped into 5 components, including costs of a routine visit, total costs of SPVR (system and inpatient), total costs of TPVR (system and inpatient), costs associated with procedure-related complications and costs of endocarditis treatment. Per each component has each cost items, as explained in Appendix 1. Also, the class 3 of treatment was selected to estimate a charge of service for inpatient department (IPD).

3.3.3. Utility values

Utilities were drawn and estimated linear extrapolation to extend utility data from clinical trials, located in Europe and Canada[41]. Details of utility index were described in Table 3.

3.4. Study Outcomes

The results were presented by total lifetime costs, total QALYs, total LYs, and ICER as the outcomes of interest in this study.

Table 3. Model input parameters

Input Parameters	Value (SE)	Distribution	References
Transition probabilities			
1st repeated SPVR goes to death	0.014 (0.002)	Beta	Ribeiro, *et al*[23]
2nd repeated SPVR goes to death	0.104 (0.005)	Beta	Dorobantu, *et al*[57]
Initial TPVR goes to death	0.001 (0.000)	Beta	Ribeiro, *et al*[23]
1st repeated TPVR goes to death	0.006 (0.000)	Beta	Zhou *et al*[56]
2nd repeated TPVR goes to death	0.089 (0.005)	Beta	McElhinney *et al*[59]
Direct medical costs			
OPD (outpatient department)	396.86 (78.52)	Gamma	Published resources[53, 60, 61]and expert opinions
Price of SPVR system	6,622.37 (916.06)	Gamma	Indonesian E-Catalogue[62]
SPVR IPD (inpatient department)	4,258.77 (731.08)	Gamma	Ribeiro, *et al*[23], Zhou *et al*[56], published resources[53, 60, 61]and expert opinions
Price of TPVR system	28,331.00 (1,445.46)	Gamma	Expert opinions
TPVR IPD (inpatient department	1,840.18 (394.13)	Gamma	Ribeiro, *et al*[23], Zhou *et al*[56], published resources[53, 60, 61]and expert opinions
Costs of procedure-related complications	3,617.49 (1,168.29)	Gamma	Ribeiro, *et al*[23], Zhou *et al*[56], published resources[53, 60, 61]and expert opinions
Costs of pacemaker implantation	522.08 (305.06)	Gamma	Ribeiro, *et al*[23], Zhou *et al*[56], published resources[53, 60, 61]and expert opinions

Costs of endocarditis treatment	941.35 (515.03)	Gamma	Ribeiro, *et al*[23], Zhou *et al*[56], published resources[53, 60, 61]and expert opinions
Utility values			
1st repeated SPVR	0.911 (0.023)	Beta	Modified by Hager, *et al*[63]
2nd repeated SPVR	0.819 (0.021)	Beta	Modified by Hager, *et al*[63]
Initial TPVR	0.921 (0.023)	Beta	Modified by Hager, *et al*[63]
1st repeated TPVR	0.829 (0.021)	Beta	Modified by Hager, *et al*[63]
2nd repeated TPVR	0.746 (0.019)	Beta	Modified by Hager, *et al*[63]
No intervention	0.300 (0.008)	Beta	Modified by Hager, *et al*[63]
Other parameters			
Annual risk of pacemaker implantation	0.035 (0.002)	Beta	Ribeiro, *et al*[23]
Annual risk of procedure-related complication at SPVR	0.160 (0.008)	Beta	Ribeiro, *et al*[23]
Annual risk of procedure-related complication at TPVR	0.049 (0.003)	Beta	Ribeiro, *et al*[23]
Annual risk of endocarditis treatment at SPVR	0.007 (0.000)	Beta	Ribeiro, *et al*[23]
Annual risk of endocarditis treatment at TPVR	0.024 (0.001)	Beta	Ribeiro, *et al*[23]
Discount rate outcomes and costs	0.030	N/A	Indonesian HTA Guideline[55]

3.5. STUDY ANALYSES

3.5.1. Baseline analysis

The baseline analysis was applied to estimate the expected lifetime costs and outcomes over a lifelong care. This demonstrated by dividing incremental cost with incremental life-year, and then presented it as an incremental cost-effectiveness ratio (ICER= USD/QALY). Hence, the ICER will be calculated by using formulation below:

$$\text{ICER} = \frac{\text{total costs of TPVR} - \text{total costs of SPVR}}{\text{total QALYs of TPVR} - \text{total QALYs of SPVR}}$$

A cost-effective decision will be considered to TPVR intervention when the estimated ICER is not higher than the threshold of 3900 USD/QALY, or approximately 1-time GDP.

3.5.2. Sensitivity analyses

Sensitivity analyses are depicted by two approaches. The first is using deterministic sensitivity analysis (DSA). It will test the robustness of the model results changed under uncertainty parameters and inform decision makers about the outcomes. It also aims to rank in order of importance parameters. In the absence of specific ranges, the values for utilities, clinical inputs and costs were varied by ± 5%, 10%, and 10%. The analysis was shown by a tornado diagram.

The second is probabilistic sensitivity analysis (PSA) which aims to address uncertainty between all parameters. PSA was calculated by using a Monte Carlo simulation. This simulation was run 1,000 iterations of parameters. The results were visualised by a cost-effectiveness plane (CEP) and a cost-effective acceptability curve (CEAC). CEP aims to evaluate a cost- effective under different willingness-to-pay (WTP) thresholds while CEAC quantifies the ratio of probability cost-effective.

3.5.3. Threshold analysis

Threshold analysis aims to estimate how ICER results are influenced to a varied price of TPVR system. A varied price of TPVR system will begin from price raising to price reduction against current price but it depends on ICER result in the baseline scenario.

CHAPTER IV RESULTS

4.1. Baseline analysis

The base case results are explained in Table 4. Total projected costs over a lifelong care were higher in TPVR (71,033.15 USD) compared to SPVR (23,946.02 USD). In terms of a higher of total costs, TPVR produced more quality-adjusted life-years (QALYS) gained and more life-years (LYs) gained compared to SPVR (14.23 versus 11.77 and 16.64 versus 13.27). These results interpreted that TPVR was more effective outweigh SPVR, but TPVR did not meet the Indonesian willingness-to-pay (WTP) threshold of 3,900 USD.

Table 4. The results of incremental cost, QALY, LY and ICER

	Cost (USD)	QALYs	LYs	ICER (USD/QALY)	ICER (USD/LY)
TPVR	71,033.15	14.23	16.64		
SPVR	23,946.02	11.77	13.27		
Incremental	47,087.13	2.45	3.38	**19,191.37**	**13,944.68**

4.2. Sensitivity analyses

4.2.1. Deterministic Sensitivity Analysis (DSA)

A tornado diagram informed that utilities had a significant factor on the ICER. It means that patients undergoing initial TPVR had a higher utility index than those who received 1st repeated SPVR for RVOT remodelling. However, a higher cost of TPVR system was a contributor to increase ICER across 19,191.37 USD/QALY of ICER's baseline.

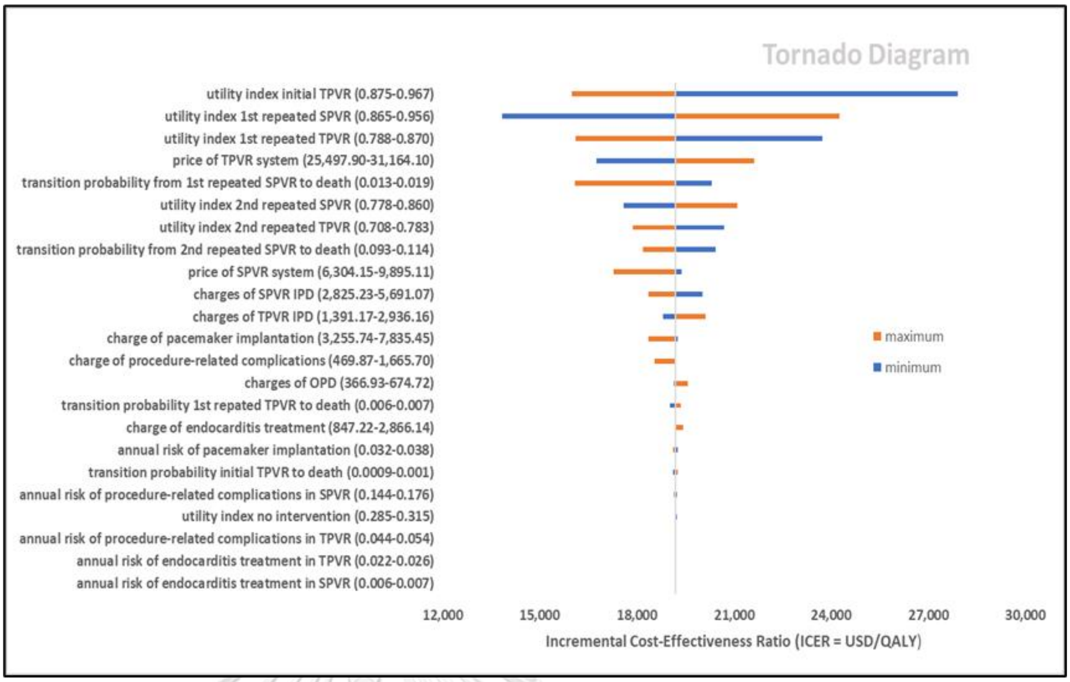

Figure 3. A tornado diagram from TPVR versus SPVR

4.2.2. Probabilistic Sensitivity Analysis (PSA)

The ICER scatter plot visualised on the results of cost-effectiveness plane (CEP) from 1,000 iterations of parameters (Figure 4). The visualisation had shown in the north-east quadrant in which TPVR yielded more QALYs gained but it was overpriced to reach out Indonesian WTP threshold. The cost-effectiveness acceptability curve (CEAC) illustrated the likelihood of those intervention options at various WTP values. Based on Figure 5, a better chance of being cost effective could be raised as well as the increased level of WTP threshold. As an example, a 100% of being cost-effective will be achievable when WTP Threshold increased up to 30,000 USD.

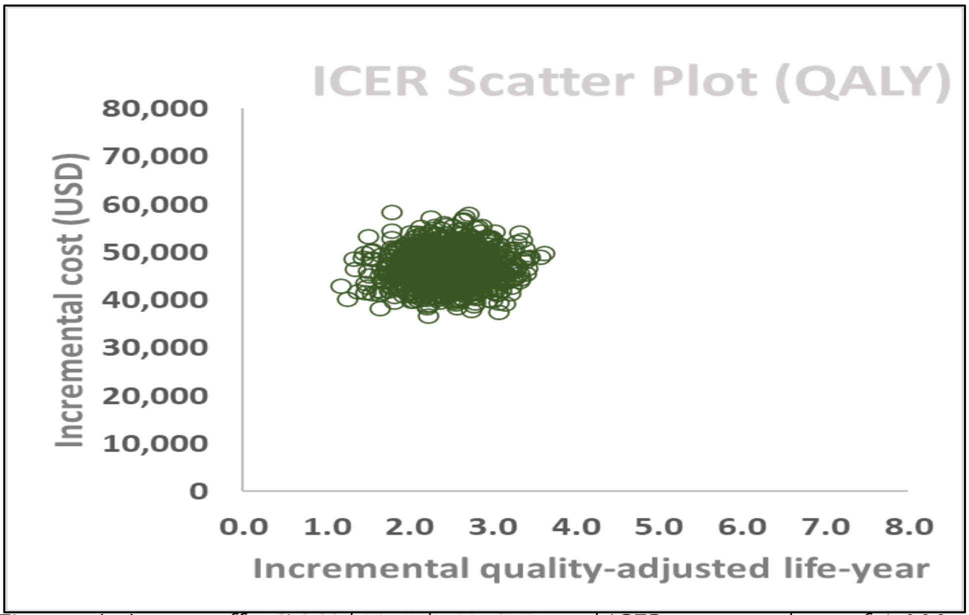

Figure 4. A cost-effective plane demonstrated ICER scatter plots of 1,000 iterations for TPVR versus SPVR.

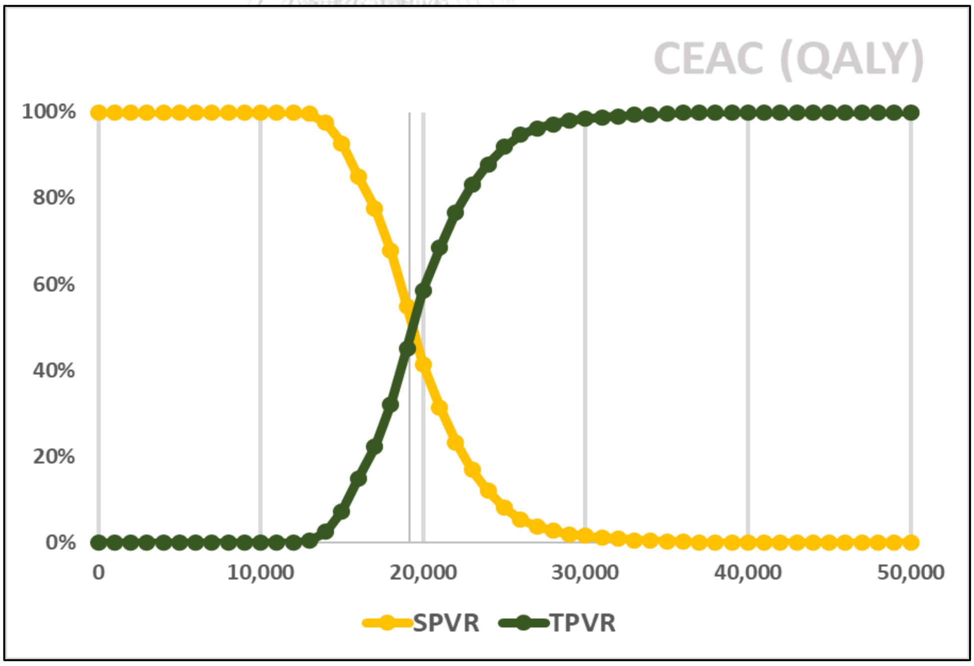

Figure 5. A cost-effectiveness acceptability curve performed probability of being cost-effective for TPVR versus SPVR.

4.3. Threshold analysis

For determining an optimum price of TPVR system in being a cost-effective, the estimated price should be around 10,000 to 12,500 USD or the cost reduction should be approximately 60-70% lower against a current price of TPVR system.

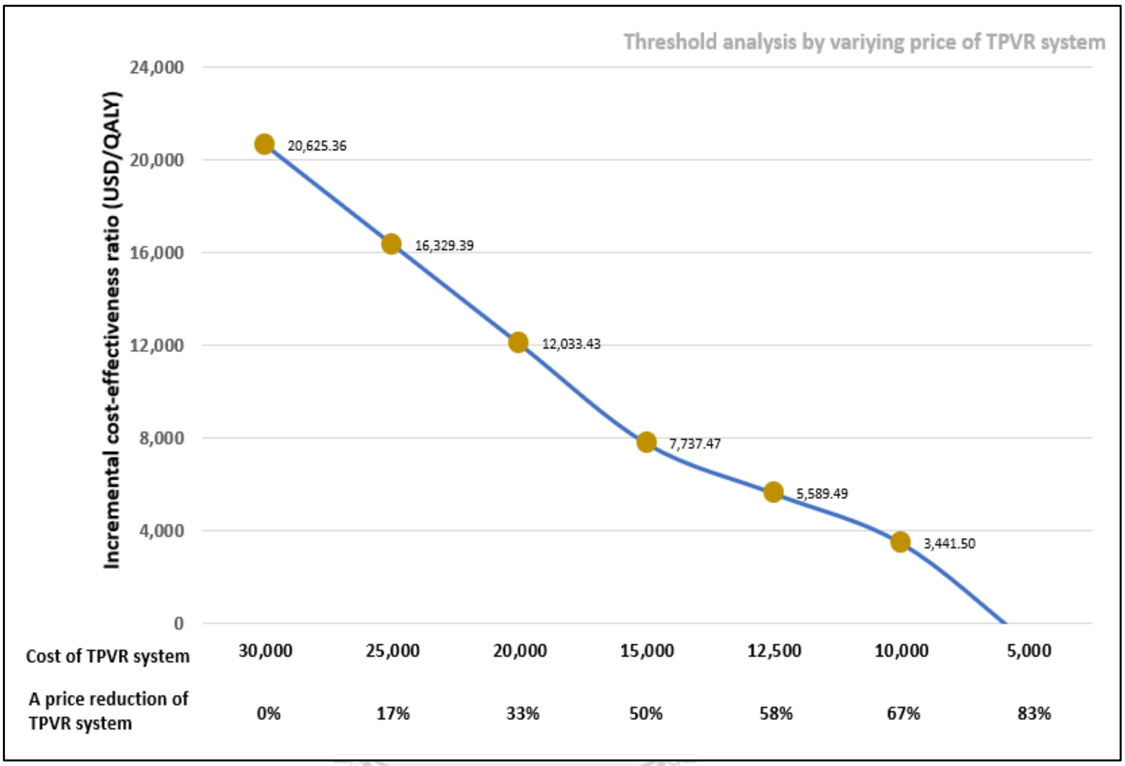

Figure 6. A threshold varying price of TPVR system analysis

CHAPTER V DISCUSSIONS AND CONCLUSIONS

5.1. Discussion

To the best of our knowledge, the health economic evaluation of TPVR versus SPVR from this work is the first study in the Indonesian setting. In terms of following assumptions along with the results, this study provides insight into the value for money for implementation of TPVR in Indonesia. An incremental cost-effectiveness result (ICER) of 19,191.37 USD/QALY (284,507,191.15 IDR/QALY) is thus projected for over lifetime.

From a revealed result against one GDP, TPVR was not categorised into cost-effective intervention in paediatric patients with a history of RVOT restoration at a celling ratio of 3900 USD/QALY but it has more effective compared to SPVR, as illustrated in Figure 4. Although the level of WTP lifted the celling ratio up to three times of GDP (11,700 USD/QALY) as presented in Figure 5, TPVR had not a probability of being cost-effective. A threshold of WTP should be increased to 30,000 USD/QALY for chasing a-100% of being cost-effective which is only achievable in nations with its status of advanced income economies. Alternatively, negotiating a fair price of TPVR should be considered between those parties, including, government, manufacturers, health charities or those who have been invested in innovation, research, and development sectors.

Another consideration in negotiating and determining a fair price is not only based on their positive outcomes in overall clinical studies of TPVR. A different trend of costing analyses in many advance high-income countries towards their results should be paid attention in determining price negotiation. Starting from the health economic studies were initially reported from Atlanta, United States[64] and London, United Kingdom[65] in 2011. In Atlanta, total projected costs within 5 years between TPVR and SPVR were $72,837 and $52,209 respectively. A higher price of 24,000 USD in Melody valve played a role for total costs in which this price was almost three times for SPVR's valve system. In London, the estimated total costs both TPVR and SPVR over a period of 25 years were expected to £8,734 and £5,791. As such Atlanta's study, a higher cost was resulted from Melody valve.

Similar studies from Virginia (2013) and Yale (2015) in United States published that TPVR offered promisingly less of overall costs due to the shorter hospital stay and the lower complication costs[66, 67]. A study from Oslo, Norway in 2017 reported that TPVR has potentially become cost-saving, presented by a lower cost of several hospital charges such as medical disposables, diagnostics, drugs, blood products, etc. Although medical device of TPVR is a main contributor to increase total costs, SPVR treatment still holds more expensive specifically when paediatric patients growing up to adults with congenital heart failure due to acquired complications have followed[24]. Other studies also released that total costs TPVR was associated with a higher of hospital costs in the database of Paediatric Health Information System (PHIS, 2016) and Utah (2018), United States[68, 69]. The Nationwide Readmissions Database (NRD, 2019) from 35 states in United States[70], oppositely presented that TPVR was lower overall charges compared to SPVR. A reported study in 2018 published that the projected total costs within a 5-year period were higher charges for TPVR over SPVR in California, United States [71]. In 2020, a published study from Georgia, United States showed that TPVR increased hospital costs over SPVR[72].

As displayed in the tornado diagram, utility index of initial TPVR plays a higher impact on reducing the ICER while TPVR system is a major cost-driving factor of raising the ICER towards total charges in the healthcare services. Regardless of TPVR system's price, a shorter hospitalisation, and a better haemodynamic functional status, measured by echocardiography and cardiac MRI, are most favourable outcomes that should be taken in into consideration[23, 56].

As depicted on threshold varying cost of TPVR system, the price reduction should be ranged to 60-70% or 10,000 to 12,500 USD. Thus, a probability of being cost-effective can be achieved it based on this scenario. In addition to this, the estimated cost reduction may assist stakeholders to calculate budget allocation for TPVR system. For example, around 4% of CHD patients as a prevalence rate require RVOT replacement or CHD patients were estimated to 1,911 with RVOT[27]. If the TPVR price allocates to 10,000 USD, budget impact is allocated to roughly 19,2 million USD. Alternatively, the estimated budget should be around 23,9 million USD if an optimum price of TPVR will be chased to 12,500 USD.

In this study, several factors made the analyses were strength. Firstly, two meta-analyses were used to depict the clinical outcomes and mortality of TPVR versus SPVR. Secondly, Indonesia-specific cost inputs were plugged in the analysis. It thereby could be utilised to the Indonesian National Insurance Scheme. Thirdly, this study was followed in accordance with Indonesian HTA Guideline. Furthermore, this study provides insight into the value for money of TPVR in Indonesia. Moreover, this study considered the updated of existing evidence related to clinical outcomes and cost implications of TPVR versus SPVR. It therefore benefits health professionals, stakeholders, policy decision makers, for further decision making.

5.2. Conclusion

TPVR does not offer a cost-effective treatment in consideration with SPVR as a comparator during a period of lifetime. It is shown by a huge uplift of ICER (19,191.37 USD/QALY) against one GDP (3900 USD/LY) as the Indonesian WTP. It also might be predominantly posed by the price of TPVR's system. Of these, around 60-70% of cost reduction could be alternative strategy to support TPVR provision as a cost-effective intervention. Despite of outlined results, this study is the first health economics evaluation providing evidence about cost-utility of TPVR in comparison with SPVR using actual costs.

5.3. Limitation

The limitations include three points. Firstly, the extrapolation of long-term complication charges such as concomitant procedures were not included to assessment due to scarce resources of disease's case and this model does not apply to patients with a high complexity of RVOT. Secondly, total costs were not incurred direct non-medical costs from patients such as, transportation, accommodation, food, and other additional charges during patients' treatment because this study used payer perspective. Thirdly, utility index was acquired from clinical trials for Europe and Canada population as a proxy for quality-of-life.

5.4. Recommendation – from this study

Further real-world studies from Indonesia are needed to confirm our current results.

5.5. Recommendation – lessons learned for Indonesia.

Further investigation on longitudinal care of patients and out-of-pocket expenditure data are required to increase collective impact by providing the best available evidence. It will definitely play an important role in estimating the national status of CHDs with a previous RVOT replacement and their budget impact in Indonesia systematically. Eventually, special efforts should be considered for promoting more cooperation in reducing costs and increasing access while bringing hope for patients and their families. Likewise, it will drive to enhancement of clinical practice and effective healthcare policies.

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Appendix 1. Cost input data

		Qty	Unit	Cost per unit USD ($)			References (cost per unit)	Frequency	Period	References (frequency)	Total costs USD ($)			
				baseline	minimum	maximum					baseline	minimum	maximum	SE
A	**Cost items for outpatient department (a routine visit)**										**396.86**	**366.93**	**674.72**	**78.52**
1	hospital card	1	card	2.02	1.69	2.02	https://jdih.kemenkeu.go.i	1	lifetime	interview	2.02	1.69	2.02	0.09
2	administrative charge of OPD	1	visit	1.01	1.01	1.69	https://jdih.kemenkeu.go.i	2	semester	interview	2.02	2.02	3.37	0.34
3	consultation charge to sub-cardiologist	1	person	23.61	23.61	26.98	https://jdih.kemenkeu.go.i	2	semester	interview	47.22	47.22	53.96	1.72
4	consultation charge to cardiologist	1	person	13.49	13.49	22.26	https://jdih.kemenkeu.go.i	2	semester	interview	26.98	26.98	44.52	4.47
5	radiology service charge	1	service	6.75	6.75	89.04	https://jdih.kemenkeu.go.i	2	semester	interview	13.49	13.49	178.08	41.99
6	fluoroscopy*	1	test	21.37	19.24	23.51	https://www.kemhan.go.i	2	semester	interview	42.75	38.47	47.02	2.18
7	electrocardiogram (ECG)	1	test	6.85	6.17	7.54	http://farmalkes.kemkes.g	2	semester	interview	13.71	12.34	15.08	0.70
8	echocardiography colour and doppler transthoracic	1	test	60.71	54.64	66.78	https://www.pjnhk.go.id/	2	semester	interview	121.42	109.28	133.56	6.19
9	consultation of rehabilitation programme	1	person	10.12	9.11	11.13	https://www.pjnhk.go.id/	1	year	interview	10.12	9.11	11.13	0.52
10	rehabilitation programme	1	package	97.81	88.03	107.59	https://www.pjnhk.go.id/	1	year	interview	97.81	88.03	107.59	4.99
11	pharmacy													
	a) bisoprolol 1 x 5 mg	30	tablet/month	0.01	0.01	0.15	https://e-katalog.lkpp.go.i	12	months	interview	3.96	3.96	54.18	12.81
	b) aspirin 1 x 75 mg	30	tablet/month	0.01	0.01	0.04	https://e-katalog.lkpp.go.i	12	months	interview	5.25	5.25	13.06	1.99
	c) pharmacist service charge	1	visit	5.06	4.55	5.57	https://www.pjnhk.go.id/	2	semester	interview	10.12	9.11	11.13	0.52
12	other charges										-	-	-	
B	**Cost items for SPVR valve system**										**6,622.37**	**6,304.15**	**9,895.11**	**916.06**
1	pulmonary valve conduit	1	valve	3,182.18	2,863.96	3,500.40	https://e-katalog.lkpp.go.	1	intervention/year	interview	3,182.18	2,863.96	3,500.40	162.36
2	any included procedure	1	procedure	3,440.19	3,440.19	6,394.71	http://farmalkes.kemkes.	1	intervention/year	interview	3,440.19	3,440.19	6,394.71	753.70
C	**Cost items for SPVR inpatient department**										**4,258.77**	**2,825.23**	**5,691.07**	**731.08**
1	administrative charge of inpatient	1	visit	1.69	1.01	1.69	https://jdih.kemenkeu.go.i	1	year	interview	1.69	1.01	1.69	0.17
2	intensive care unit (ICU) bed along with physician's visit	1	procedure	175.38	157.84	192.92	https://www.pjnhk.go.id/	2	days	SRMA (https://www.an	350.76	315.69	385.84	17.90
3	hospital bed (3rd class)	1	procedure	26.98	24.28	29.68	https://www.pjnhk.go.id/	6	days	SRMA (https://www.an	161.89	145.70	178.08	8.26
4	radiology service	1	service	89.04	6.75	89.04	https://jdih.kemenkeu.go.i	8	days	interview; SRMA (https:	712.32	53.96	712.32	167.95
5	chest X-ray or diagnostic rontgen	1	test/day	20.24	20.24	202.36	https://jdih.kemenkeu.go.i	2	days	interview	40.47	40.47	404.73	92.92
6	electrocardiogram (ECG)	1	test/day	6.85	6.17	7.54	http://farmalkes.kemkes.g	6	days	interview	41.12	37.01	45.23	2.10
7	multi sliced computed tomography scan (MSCT-Scan) cardiac	1	test	263.07	236.77	289.38	https://www.pjnhk.go.id/	1	pre intervention	interview	263.07	236.77	289.38	13.42
8	echocardiography colour and doppler transthoracic	1	test/day	60.71	54.64	66.78	https://www.pjnhk.go.id/	8	days	interview; SRMA (https:	485.67	437.11	534.24	24.78
9	MRI	1	test	168.64	168.64	944.37	http://farmalkes.kemkes.g	1	pre intervention	interview	168.64	168.64	944.37	197.89
10	trans esophageal echo (TEE) with anaesthetic	1	test	526.15	473.53	578.76	https://www.pjnhk.go.id/	1	pre intervention	interview	526.15	473.53	578.76	26.84
11	sub-cardiologist	1	person	23.61	23.61	26.98	https://jdih.kemenkeu.go.i	8	days	interview; SRMA (https:	188.87	188.87	215.86	6.88
12	cardiologist	1	person	20.24	13.49	22.26	https://jdih.kemenkeu.go.i	8	days	interview; SRMA (https:	161.89	107.93	178.08	17.90
13	surgeon	1	person	20.24	13.49	22.26	https://jdih.kemenkeu.go.i	8	days	interview; SRMA (https:	161.89	107.93	178.08	17.90
14	assistant surgeon	1	person	7.42	5.73	7.42	https://jdih.kemenkeu.go.i	8	days	interview; SRMA (https:	59.36	45.87	59.36	3.44
15	general medical doctor	1	person	11.13	6.75	11.13	https://jdih.kemenkeu.go.i	8	days	interview; SRMA (https:	89.04	53.96	89.04	8.95
16	clinical pathology (full blood count, urea, electrolytes, etc.)	1	test	134.91	2.02	134.91	https://jdih.kemenkeu.go.i	1	procedure	interview	134.91	2.02	134.91	33.90
17	clotting	1	procedure	0.67	0.61	0.74	interview	1	procedure	interview	0.67	0.61	0.74	0.03
18	crossmatch	1	procedure	2.02	1.82	2.23	interview	1	procedure	interview	2.02	1.82	2.23	0.10
19	anaesthesic	1	procedure	337.27	303.55	371.00	interview	1	procedure	interview	337.27	303.55	371.00	17.21
20	blood transfusion or blood bank	1	procedure	269.82	12.14	269.82	http://farmalkes.kemkes.g	1	procedure	interview; SRMA (https:	269.82	12.14	269.82	65.73
21	pharmacy													
	a) furosemid injection	1	vial	0.17	0.12	0.27	https://e-katalog.lkpp.go.i	8	days	interview	1.35	1.00	2.14	0.29
	b) furosemid tab	30	tablet/month	0.01	0.01	0.02	https://e-katalog.lkpp.go.i	1	month	interview	0.45	0.40	0.49	0.02
	c) IV Fluids	1	procedure	0.57	0.52	0.63	interview;https://e-katalog	8	days	interview	4.59	4.13	5.05	0.23
	d) captopril tab	30	tablet/month	0.02	0.01	0.04	interview	1	month	interview	0.58	0.20	1.20	0.25
	e) bisoprolol 1 x 5 mg	30	tablet/month	0.01	0.01	0.15	https://e-katalog.lkpp.go.i	1	month	interview	0.33	0.33	4.51	1.07
	f) aspirin 1 x 75 mg	30	tablet/month	0.01	0.01	0.04	https://e-katalog.lkpp.go.i	1	month	interview	0.44	0.44	1.09	0.17
	g) medication disposables	1	package	26.51	23.86	29.16	interview;https://e-katalog	2	days	interview	53.02	47.72	58.32	2.71
	h) pharmacist service charge	1	visit	5.06	4.55	5.57	https://www.pjnhk.go.id/	8	days	interview; SRMA (https:	40.47	36.43	44.52	2.06
22	other charges													
D	**Cost items for TPVR medical device system**										**28,331.00**	**25,497.90**	**31,164.10**	**1,445.46**
1	Venus P-Valve	1	device	26,981.91	24,283.71	29,680.10	interview	1	intervention/year	interview	26,981.91	24,283.71	29,680.10	1,376.63
2	any included procedure	1	procedure	1,349.10	1,214.19	1,484.00	interview	1	intervention/year	interview	1,349.10	1,214.19	1,484.00	68.83
E	**Cost items for TPVR inpatient department**										**1,840.18**	**1,391.17**	**2,936.16**	**394.13**
1	administrative charge of inpatient	1	visit	1.69	1.01	1.69	https://jdih.kemenkeu.go.i	1	year	interview	1.69	1.01	1.69	0.17
2	intensive care unit (ICU) bed along with physician's visit	1	procedure	175.38	157.84	192.92	https://www.pjnhk.go.id/	1	day	SRMA (https://www.an	175.38	157.84	192.92	8.95
3	hospital bed (3rd class)	1	procedure	26.98	24.28	29.68	https://www.pjnhk.go.id/	1	day	SRMA (https://www.an	26.98	24.28	29.68	1.38
4	radiology service	1	service	89.04	6.75	89.04	https://jdih.kemenkeu.go.i	2	days	interview; SRMA (https:	178.08	13.49	178.08	41.99
5	chest X-ray or diagnostic rontgen	1	test/day	20.24	20.24	202.36	https://jdih.kemenkeu.go.i	1	day	interview	20.24	20.24	202.36	46.46
6	electrocardiogram (ECG)	1	test/day	6.85	6.17	7.54	http://farmalkes.kemkes.g	2	days	interview	13.71	12.34	15.08	0.70
7	multi sliced computed tomography scan (MSCT-Scan) cardiac	1	test	263.07	236.77	289.38	https://www.pjnhk.go.id/	1	pre intervention	interview	263.07	236.77	289.38	13.42
8	echocardiography colour and doppler transthoracic	1	test/day	60.71	54.64	66.78	https://www.pjnhk.go.id/	2	days	interview; SRMA (https:	121.42	109.28	133.56	6.19
9	MRI	1	test	168.64	168.64	944.37	http://farmalkes.kemkes.g	1	pre intervention	interview	168.64	168.64	944.37	197.89
10	trans esophageal echo (TEE) with anaesthetic	1	test	526.15	473.53	578.76	https://www.pjnhk.go.id/	1	pre intervention	interview	526.15	473.53	578.76	26.84
11	sub-cardiologist	1	person	23.61	23.61	26.98	https://jdih.kemenkeu.go.i	2	days	interview; SRMA (https:	47.22	47.22	53.96	1.72
12	cardiologist	1	person	20.24	13.49	22.26	https://jdih.kemenkeu.go.i	2	days	interview; SRMA (https:	40.47	26.98	44.52	4.47
13	surgeon	1	person	20.24	13.49	22.26	https://jdih.kemenkeu.go.i	1	procedure	interview	20.24	13.49	22.26	2.24
14	assistant surgeon	1	person	7.42	5.73	7.42	https://jdih.kemenkeu.go.i	1	procedure	interview	7.42	5.73	7.42	0.43
15	general medical doctor	1	person	11.13	6.75	11.13	https://jdih.kemenkeu.go.i	2	days	interview; SRMA (https:	22.26	13.49	22.26	2.24
16	clinical pathology (full blood count, urea, electrolytes, etc.)	1	test	134.91	2.02	134.91	https://jdih.kemenkeu.go.i	1	procedure	interview	134.91	2.02	134.91	33.90
17	clotting	1	procedure	0.67	0.61	0.74	interview	1	procedure	interview	0.67	0.61	0.74	0.03
18	crossmatch	1	procedure	2.02	1.82	2.23	interview	1	procedure	interview	2.02	1.82	2.23	0.10
19	anaesthesic	0	procedure	337.27	303.55	371.00	interview	0	not applicable, include d	interview	-	-	-	-
20	blood transfusion or blood bank	0	procedure	269.82	12.14	269.82	http://farmalkes.kemkes.g	0	not applicable, only occu	interview; SRMA (https:	-	-	-	-
21	pharmacy													
	a) furosemid injection	1	vial	0.17	0.12	0.27	https://e-katalog.lkpp.go.i	1	day at ICU	interview	0.17	0.12	0.27	0.04
	b) furosemid tab	30	tablet/month	0.01	0.01	0.02	https://e-katalog.lkpp.go.i	1	month	interview	0.45	0.40	0.49	0.02
	c) IV Fluids	1	procedure	0.57	0.52	0.63	interview;https://e-katalog	2	days	interview	1.15	1.03	1.26	0.06
	d) captopril tablet	30	tablet/month	0.02	0.01	0.04	interview	1	month	interview	0.58	0.20	1.20	0.25
	e) bisoprolol 1 x 5 mg	30	tablet/month	0.01	0.01	0.15	https://e-katalog.lkpp.go.i	1	month	interview	0.33	0.33	4.51	1.07
	f) aspirin 1 x 75 mg	30	tablet/month	0.01	0.01	0.04	https://e-katalog.lkpp.go.i	1	month	interview	0.44	0.44	1.09	0.17
	g) heparin	1	vial	3.37	3.03	3.71	https://e-katalog.lkpp.go.i	1	day at ICU	interview	3.37	3.03	3.71	0.17
	h) medication disposables	1	package	26.51	23.86	29.16	interview;https://e-katalog	2	days	interview	53.02	47.72	58.32	2.71
	i) pharmacist service charge	1	visit	5.06	4.55	5.57	https://www.pjnhk.go.id/	2	days	interview; SRMA (https:	10.12	9.11	11.13	0.52
22	other charges													
F	**Cost items for each complication**										5,080.92	4,572.83	12,367.29	1,988.38
1	pacemaker implantation	1	case	3,617.49	3,255.74	7,835.45	http://farmalkes.kemkes.g	1	year	interview	3,617.49	3,255.74	7,835.45	1,168.29
2	malfunction or any complication post-procedure	1	case	522.08	469.87	1,665.70	http://farmalkes.kemkes.g	1	year	interview	522.08	469.87	1,665.70	305.06
3	acute and sub-acute endocarditis treatment	1	case	941.35	847.22	2,866.14	http://farmalkes.kemkes.g	1	year	interview	941.35	847.22	2,866.14	515.03

Appendix 2. Published resources of direct medical costs from Indonesia's regulatory

LAMPIRAN I
PERATURAN MENTERI KEUANGAN REPUBLIK INDONI
NOMOR 1/PMK.05/2023
TENTANG
TARIF LAYANAN BADAN LAYANAN UMUM RUMAH S
JANTUNG DAN PEMBULUH DARAH HARAPAN I
JAKARTA PADA KEMENTERIAN KESEHATAN

TARIF LAYANAN BERDASARKAN KELAS BADAN LAYANAN UMUM RUMAH SAKIT JANTUNG DAN PEMBULUH DARAH HARAPAN KITA JAKARTA PADA KEMENTERIAN KESEHATAN

TARIF KELAS II

No.	Jenis Layanan	Satuan	Tarif (Rp)
A.	Rawat Inap		
	1. Kamar	Per Hari	500.000,00 600.000
	2. *Visite* Ruang Perawatan		
	a. Dokter Spesialis	Per Tindakan	200.000,00 300.000
	b. Dokter Subspesialis	Per Tindakan	250.000,00 350.000
B.	Tindakan Medis Operatif		
	1. Bedah Dewasa		
	a. Operasi Kecil	Per Tindakan	5.000.000,00 60.000.000
	b. Operasi Sedang	Per Tindakan	51.000.000,00 94.800.000
	c. Operasi Besar	Per Tindakan	100.000.000,00 234.000.000
	d. Operasi Khusus I	Per Tindakan	200.000.000,00 288.000.000
	e. Operasi Khusus II	Per Tindakan	250.000.000,00 432.000.000
	f. Operasi Khusus III	Per Tindakan	370.000.000,00 456.000.000
	2. Bedah Anak (*Pediatric*)		
	a. Operasi Kecil	Per Tindakan	23.000.000,00 48.000.000
	b. Operasi Sedang	Per Tindakan	40.000.000,00 93.600.000
	c. Operasi Besar	Per Tindakan	80.000.000,00 151.200.000
	d. Operasi Khusus I	Per Tindakan	130.000.000,00 222.000.000
	e. Operasi Khusus II	Per Tindakan	207.000.000,00 s.d. 309.600.000,00
	f. Operasi Khusus III	Per Tindakan	262.000.000,00 s.d. 314.400.000,00

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No.	Jenis Layanan	Satuan	Tarif (Rp)
	3. Tindakan Medik Non-operatif Diagnostik Invasif (DI)		
	a. Kecil	Per Tindakan	10.000.000,00 12.000.000
	b. Sedang	Per Tindakan	14.000.000,00 16.800.000
	c. Besar	Per Tindakan	15.000.000,00 18.000.000
	d. Khusus I	Per Tindakan	20.000.000,00 22.000.000
	e. Khusus II	Per Tindakan	21.000.000,00 38.400.000
	f. Khusus III	Per Tindakan	35.000.000,00 162.000.000
	4. Intervensi NonBedah		
	a. Kecil	Per Tindakan	11.000.000,00 25.200.000
	b. Sedang	Per Tindakan	37.000.000,00 44.400.000
	c. Besar	Per Tindakan	40.000.000,00 48.000.000
	d. Khusus	Per Tindakan	42.000.000,00 116.400.000

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SRI MULYANI INDRAWATI

Salinan sesuai dengan aslinya
Kepala Biro Umum
u.b.
Kepala Bagian Administrasi Kementerian

MAS SOEHARTO
NIP 19690922 199001 1 001

LAMPIRAN II
PERATURAN MENTERI KEUANGAN REPUBLIK INDONESIA
NOMOR 1/PMK.05/2023
TENTANG
TARIF LAYANAN BADAN LAYANAN UMUM RUMAH SAKIT JANTUNG DAN PEMBULUH DARAH HARAPAN KITA JAKARTA PADA KEMENTERIAN KESEHATAN

TARIF LAYANAN TIDAK BERDASARKAN KELAS BADAN LAYANAN UMUM RUMAH SAKIT JANTUNG DAN PEMBULUH DARAH HARAPAN KITA JAKARTA PADA KEMENTERIAN KESEHATAN

No.	Jenis Layanan	Satuan	Tarif (Rp)
A.	Administrasi		
	1. Kartu Pendaftaran Pasien	Per Kartu	25.000,00 s.d. 30.000,00
	2. Administrasi Poli	Per Kunjungan	15.000,00 s.d. 25.000,00
B.	Konsultasi, *Visite*, dan Pemeriksaan		
	1. Dokter Subspesialis	Per Tindakan	350.000,00 s.d. 400.000,00
	2. Dokter Spesialis	Per Tindakan	200.000,00 s.d. 330.000,00
	3. Dokter Umum	Per Tindakan	100.000,00 s.d. 165.000,00
	4. Penunjang Kesehatan	Per Tindakan	85.000,00 s.d. 110.000,00
	5. *Visite* Ruang Intensif	Per Tindakan	300.000,00 s.d. 605.000,00
	6. Jasa Konsultasi untuk Konferensi Bedah	Per Tindakan	300.000,00 s.d. 660.000,00
C.	Tindakan Poliklinik		
	1. Tindakan Kecil	Per Tindakan	80.000,00 s.d. 600.000,00
	2. Tindakan Sedang	Per Tindakan	600.000,00 s.d. 6.360.000,00
D.	Ruang Rawat *High Care* dan Intensif	Per Hari	1.300.000,00 s.d. 4.200.000,00
E.	Ruang Instalasi Gawat Darurat	Per Hari	500.000,00 s.d. 1.500.000,00
F.	Tindakan Ruang Perawatan		
	1. Tindakan Kecil	Per Tindakan	100.000,00 s.d. 3.000.000,00
	2. Tindakan Sedang	Per Tindakan	3.500.000,00 s.d. 7.000.000,00

Appendix 2. Published resources of direct medical costs from Indonesia's regulatory

No.	Jenis Layanan	Satuan	Tarif (Rp)
	3. Tindakan Besar	Per Tindakan	8.000.000,00 s.d. 42.000.000,00
	4. Tindakan Khusus	Per Tindakan	140.000.000,00 s.d. 200.000.000,00
G.	Penunjang Medis		
	1. Diagnostik Non-invasif dan Pencitraan		
	a. Tindakan Kecil	Per Tindakan	620.000,00 s.d. 1.000.000,00
	b. Tindakan Sedang	Per Tindakan	1.100.000,00 s.d. 4.800.000,00
	c. Tindakan Besar	Per Tindakan	4.900.000,00 s.d. 15.000.000,00
	2. *Vascular*		
	a. Tindakan Kecil	Per Tindakan	800.000,00 s.d. 1.100.000,00
	b. Tindakan Sedang	Per Tindakan	1.200.000,00 s.d. 4.900.000,00
	c. Tindakan Besar	Per Tindakan	5.000.000,00 s.d. 15.000.000,00
	3. Poliklinik Gigi		
	a. Pemeriksaan	Per Pemeriksaan	150.000,00 s.d. 250.000,00
	b. Tindakan Kecil	Per Tindakan	100.000,00 s.d. 200.000,00
	c. Tindakan Sedang	Per Tindakan	230.000,00 s.d. 500.000,00
	d. Tindakan Besar	Per Tindakan	550.000,00 s.d. 1.000.000,00
	4. Radiodiagnostik		
	a. Radiologi Diagnostik	Per Tindakan	300.000,00 s.d. 3.000.000,00
	b. Radiologi Nuklir	Per Tindakan	3.000.000,00 s.d. 6.000.000,00
	c. MRI (*Magnetic Resonance Imaging*)	Per Tindakan	2.500.000,00 s.d. 14.000.000,00
	d. MSCT (*Multislice Computerized Tomography*)	Per Tindakan	2.500.000,00 s.d. 15.000.000,00
	e. Jasa *Ekspertise* Radiologi	Per Tindakan	100.000,00 s.d. 1.320.000,00
	5. Rehabilitasi Medik		
	a. Layanan *Homecare*	Per Tindakan	300.000,00 s.d. 10.000.000,00
	b. Rehab Psikososial	Per Pemeriksaan	100.000,00 s.d. 210.000,00
	c. Tindakan Kecil	Per Tindakan	150.000,00 s.d. 700.000,00

No.	Jenis Layanan	Satuan	Tarif (Rp)
	d. Tindakan Sedang	Per Tindakan	700.000,00 s.d. 1.500.000,00
	e. Tindakan Besar	Per Tindakan	1.500.000,00 s.d. 10.000.000,00
	6. Laboratorium		
	a. Patologi Klinik	Per Tindakan	30.000,00 s.d. 2.000.000,00
	b. Bank Darah	Per Tindakan	180.000,00 s.d. 4.000.000,00
	c. Patologi Anatomi	Per Tindakan	290.000,00 s.d. 1.000.000,00
	d. Mikrobiologi	Per Tindakan	40.000,00 s.d. 1.500.000,00
	7. Invasif *Non-Fluoroscopy*	Per Tindakan	1.500.000,00 s.d. 6.500.000,00

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u.b.
Kepala Bagian Administrasi Kementerian

MAS SOEHARTO
NIP 19690922 199001 1 001

TARIF INA-CBG
RUMAH SAKIT JANTUNG DAN PEMBULUH DARAH HARAPAN KITA
RAWAT INAP

NO	KODE INA-CBG	DESKRIPSI KODE INA-CBG	TARIF KELAS 3	TARIF KELAS 2	TARIF KELAS 1
238	I-1-04-I	PROSEDUR KATUP JANTUNG TANPA KATETERISASI JANTUNG (RINGAN)	72.663.600	84.653.000	96.642.500
239	I-1-04-II	PROSEDUR KATUP JANTUNG TANPA KATETERISASI JANTUNG (SEDANG)	90.674.000	105.635.200	120.596.400
240	I-1-04-III	PROSEDUR KATUP JANTUNG TANPA KATETERISASI JANTUNG (BERAT)	136.842.000	159.421.000	181.999.900
232	I-1-02-I	PROSEDUR KATUP JANTUNG DENGAN KATETERISASI (RINGAN)	73.392.500	85.502.300	97.612.000
233	I-1-02-II	PROSEDUR KATUP JANTUNG DENGAN KATETERISASI (SEDANG)	91.445.600	106.534.100	121.622.600
234	I-1-02-III	PROSEDUR KATUP JANTUNG DENGAN KATETERISASI (BERAT)	137.982.300	160.749.300	183.516.400
259	I-1-14-I	PEMASANGAN PACEMAKER JANTUNG PERMANEN (RINGAN)	53.628.400	62.477.000	71.325.700
260	I-1-14-II	PEMASANGAN PACEMAKER JANTUNG PERMANEN (SEDANG)	66.652.100	77.649.800	88.647.400
261	I-1-14-III	PEMASANGAN PACEMAKER JANTUNG PERMANEN (BERAT)	87.337.300	101.747.900	116.158.600
283	I-4-11-I	ENDOKARDITIS AKUT DAN SUBAKUT (RINGAN)	13.955.300	16.257.900	18.560.500
284	I-4-11-II	ENDOKARDITIS AKUT DAN SUBAKUT (SEDANG)	17.269.800	20.119.300	22.968.800
285	I-4-11-III	ENDOKARDITIS AKUT DAN SUBAKUT (BERAT)	31.947.200	37.218.500	42.489.800
319	I-4-23-I	MALFUNGSI, REAKSI DAN KOMPLIKASI DARI ALAT ATAU PROSEDUR KARDIOVASKULER (RINGAN)	7.739.700	9.016.700	10.293.800
320	I-4-23-II	MALFUNGSI, REAKSI DAN KOMPLIKASI DARI ALAT ATAU PROSEDUR KARDIOVASKULER (SEDANG)	9.502.100	11.070.000	12.637.900
321	I-4-23-III	MALFUNGSI, REAKSI DAN KOMPLIKASI DARI ALAT ATAU PROSEDUR KARDIOVASKULER (BERAT)	18.566.600	21.630.100	24.693.600

TARIF INA-CBG
RUMAH SAKIT JANTUNG DAN PEMBULUH DARAH HARAPAN KITA
RAWAT JALAN

NO	KODE INA-CBG	DESKRIPSI KODE INA-CBG	TARIF INA-CBG
194	Q-5-14-0	RONGENT (PLAIN FILM)	199.400
195	Q-5-15-0	ELEKTROKARDIOGRAM (ECG)	101.600
278	Z-3-19-0	CT SCAN LAIN-LAIN	2.959.000
280	Z-3-21-0	IMAGING KONTRAS PEMBULUH DARAH	1.972.600
84	I-3-12-0	PROSEDUR KECIL LAIN-LAIN PADA JANTUNG	3.159.500
85	I-3-13-0	PROSEDUR EKOKARDIOGRAFI	863.500

Appendix 3. Published resources of direct medical costs from hospital's website


pjnhk.go.id/pelayanan/rawat-inap-anak

Contact Center: 1500 034 (WA) : 0811 911 5045 Emergency Call: (021) 568

Dokter | Rujukan Nasional | Diklat | Litbang | SP4N Lapor | Pengaduan | Inform

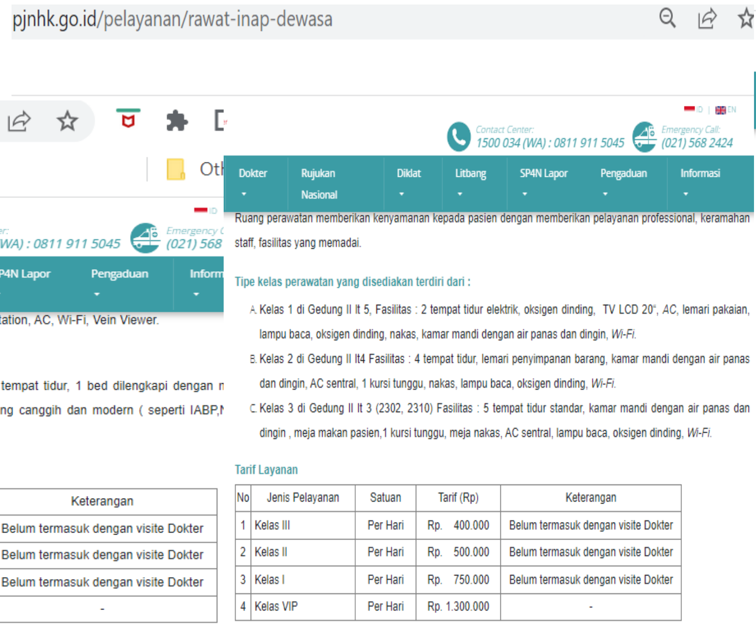
bed site monitor yang terhubung dengan sentral monitor di nurse station, AC, Wi-Fi, Vein Viewer.

3. Intensif Anak

Fasilitas : berada di perawatan 2 lantai 8, dengan kapasitas 18 tempat tidur, 1 bed dilengkapi dengan m invasive dan non invasive, peralatan medis dengan tehnologi yang canggih dan modern (seperti IABP,N ventilator, ECMO, Echo, dll.

4. Tarif Rawat Inap

No	Jenis Pelayanan	Satuan	Tarif (Rp)	Keterangan
1	Kelas III	Per Hari	Rp. 400.000	Belum termasuk dengan visite Dokter
2	Kelas II	Per Hari	Rp. 500.000	Belum termasuk dengan visite Dokter
3	Kelas I	Per Hari	Rp. 750.000	Belum termasuk dengan visite Dokter
4	Kelas VIP	Per Hari	Rp. 1.300.000	-


pjnhk.go.id/pelayanan/rawat-inap-dewasa

Contact Center: 1500 034 (WA) : 0811 911 5045 Emergency Call: (021) 568 2424

Dokter | Rujukan Nasional | Diklat | Litbang | SP4N Lapor | Pengaduan | Informasi

Ruang perawatan memberikan kenyamanan kepada pasien dengan memberikan pelayanan professional, keramahan staff, fasilitas yang memadai.

Tipe kelas perawatan yang disediakan terdiri dari :

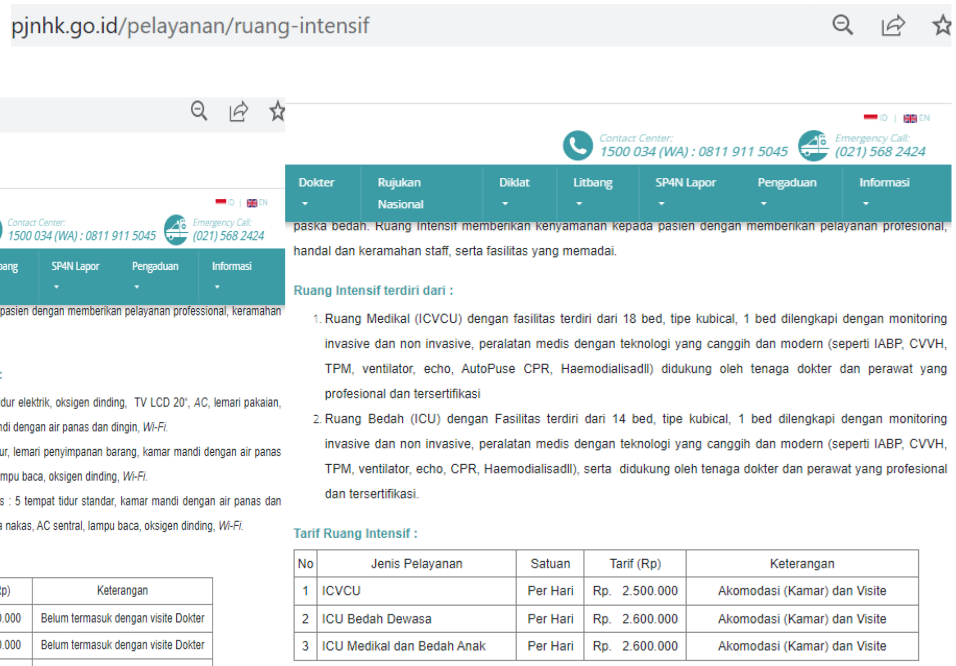
A. Kelas 1 di Gedung II lt 5, Fasilitas : 2 tempat tidur elektrik, oksigen dinding, TV LCD 20", AC, lemari pakaian, lampu baca, oksigen dinding, nakas, kamar mandi dengan air panas dan dingin, *Wi-Fi.*

B. Kelas 2 di Gedung II lt4 Fasilitas : 4 tempat tidur, lemari penyimpanan barang, kamar mandi dengan air panas dan dingin, AC sentral, 1 kursi tunggu, nakas, lampu baca, oksigen dinding, *Wi-Fi.*

C. Kelas 3 di Gedung II lt 3 (2302, 2310) Fasilitas : 5 tempat tidur standar, kamar mandi dengan air panas dan dingin , meja makan pasien,1 kursi tunggu, meja nakas, AC sentral, lampu baca, oksigen dinding, *Wi-Fi.*

Tarif Layanan

No	Jenis Pelayanan	Satuan	Tarif (Rp)	Keterangan
1	Kelas III	Per Hari	Rp. 400.000	Belum termasuk dengan visite Dokter
2	Kelas II	Per Hari	Rp. 500.000	Belum termasuk dengan visite Dokter
3	Kelas I	Per Hari	Rp. 750.000	Belum termasuk dengan visite Dokter
4	Kelas VIP	Per Hari	Rp. 1.300.000	-


pjnhk.go.id/pelayanan/ruang-intensif

Contact Center: 1500 034 (WA) : 0811 911 5045 Emergency Call: (021) 568 2424

Dokter | Rujukan Nasional | Diklat | Litbang | SP4N Lapor | Pengaduan | Informasi

paska bedah. Ruang Intensif memberikan kenyamanan kepada pasien dengan memberikan pelayanan profesional, handal dan keramahan staff, serta fasilitas yang memadai.

Ruang Intensif terdiri dari :

1. Ruang Medikal (ICVCU) dengan fasilitas terdiri dari 18 bed, tipe kubical, 1 bed dilengkapi dengan monitoring invasive dan non invasive, peralatan medis dengan teknologi yang canggih dan modern (seperti IABP, CVVH, TPM, ventilator, echo, AutoPuse CPR, Haemodialisadll) didukung oleh tenaga dokter dan perawat yang profesional dan tersertifikasi
2. Ruang Bedah (ICU) dengan Fasilitas terdiri dari 14 bed, tipe kubical, 1 bed dilengkapi dengan monitoring invasive dan non invasive, peralatan medis dengan teknologi yang canggih dan modern (seperti IABP, CVVH, TPM, ventilator, echo, CPR, Haemodialisadll), serta didukung oleh tenaga dokter dan perawat yang profesional dan tersertifikasi.

Tarif Ruang Intensif :

No	Jenis Pelayanan	Satuan	Tarif (Rp)	Keterangan
1	ICVCU	Per Hari	Rp. 2.500.000	Akomodasi (Kamar) dan Visite
2	ICU Bedah Dewasa	Per Hari	Rp. 2.600.000	Akomodasi (Kamar) dan Visite
3	ICU Medikal dan Bedah Anak	Per Hari	Rp. 2.600.000	Akomodasi (Kamar) dan Visite

Appendix 3. Published resources of direct medical costs from hospital's website

pjnhk.go.id/pelayanan/rehabilitasi-medis

PUSAT JANTUNG Nasional | National Cardiovascular Center Harapan Kita

Contact Center: 1500 034 (WA) : 0811 911 5045

Profil | Pelayanan | Dokter | Rujukan Nasional | Diklat | Litbang | SP4N Lapor | Pengaduan

Tarif Layanan :

No	Jenis Pelayanan	Satuan	Tarif (Rp)	Keterangan
1	Rehab Fase I	Per Pemeriksaan	Rp. 110.000	-
2	Rehab Fase II	Per Pemeriksaan	Rp. 100.000	-
3	Rehab Fase III (pagi)	Per Pemeriksaan	Rp. 80.000	-
4	Rehab Fase III (siang)	Per Pemeriksaan	Rp. 40.000	-
5	Konsultasi Program Rehabilitasi	Per Pemeriksaan	Rp. 150.000	-
6	Ergocycle Test	Per Pemeriksaan	Rp. 500.000	-
7	Treadmill Test	Per Pemeriksaan	Rp. 450.000	-
8	Treadmill Analyzer	Per Pemeriksaan	Rp. 600.000	-
9	Paket Rehab Fase II Baru / Bulan	Per Pemeriksaan	Rp. 1.450.000	-
10	Konsultasi Psikologi	Per Pemeriksaan	Rp. 130.000	-
11	Konsultasi Stop Merokok	Per Pemeriksaan	Rp. 130.000	-
12	Telemetri / Six Minute Walk	Per Pemeriksaan	Rp. 150.000	-

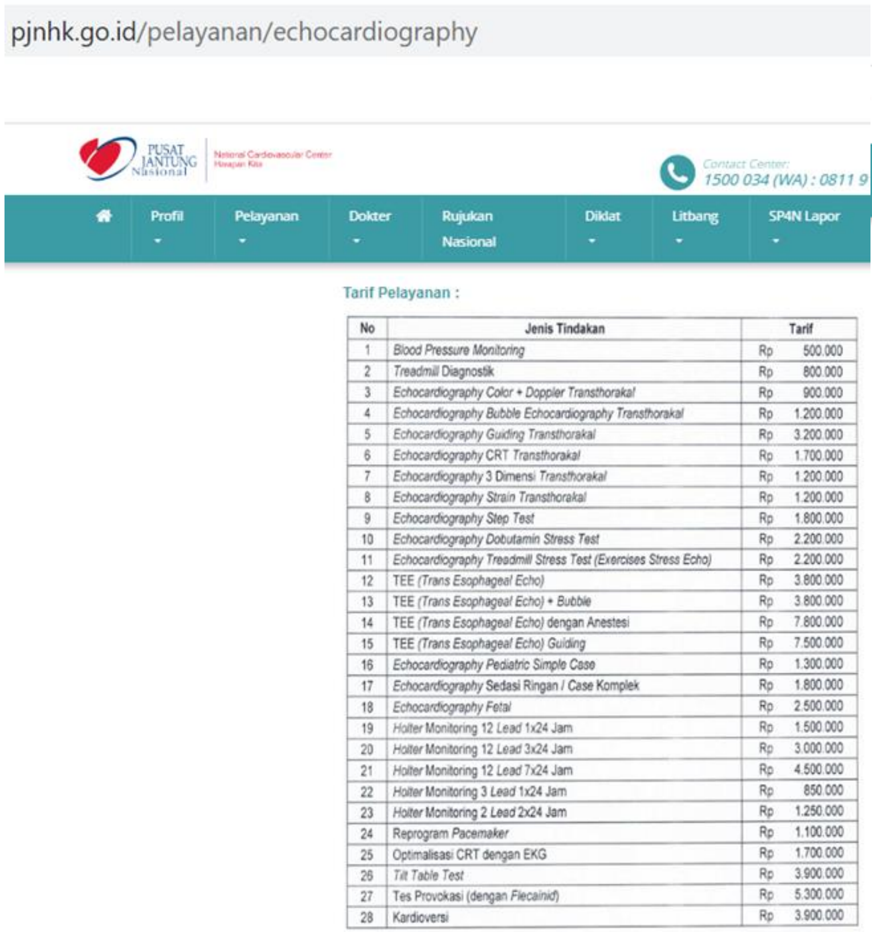
pjnhk.go.id/pelayanan/poliklinik-umum

Contact Center: 1500 034 (WA) : 0811 911 5045

Dokter | Rujukan Nasional | Diklat | Litbang | SP4N Lapor | Pengaduan | Info

No	Jenis Pelayanan	Satuan	Tarif (Rp)	Keterangan
1.	Konsultasi Dokter Spesialis Jantung	Per Konsultasi	150.000	-
2.	Konsultasi Dokter Spesialis Aritmia	Per Konsultasi	150.000	-
3.	Konsultasi Dokter Spesialis Bedah Jantung	Per Konsultasi	150.000	-
4.	Konsultasi Dokter Spesialis Anestesi	Per Konsultasi	150.000	-
5.	Konsultasi Dokter Neurologi / Syaraf	Per Konsultasi	130.000	-
6.	Konsultasi Dokter Pulmonologi / Paru	Per Konsultasi	130.000	-
7.	Konsultasi Dokter Internis / Penyakit Dalam	Per Konsultasi	130.000	-
8.	Konsultasi Dokter Klinik Gizi	Per Konsultasi	130.000	-
9.	Dokter Umum	Per Konsultasi	100.000	-
10.	Ahli Gizi	Per Konsultasi	75.000	-
11.	Keperawatan	Per Konsultasi	75.000	-
12.	Farmasi	Per Konsultasi	75.000	-

Appendix 3. Published resources of direct medical costs from hospital's website



pjnhk.go.id/pelayanan/echocardiography

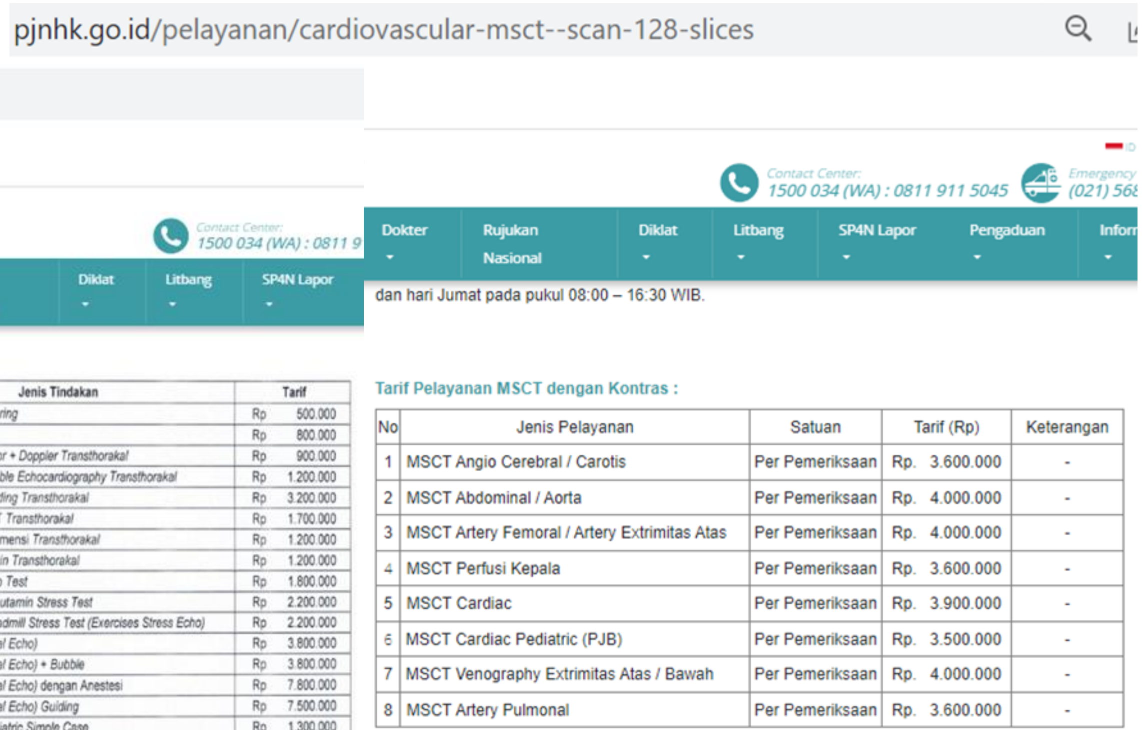
PUSAT JANTUNG Nasional | National Cardiovascular Center

Contact Center: 1500 034 (WA) : 0811 9

Profil | Pelayanan | Dokter | Rujukan Nasional | Diklat | Litbang | SP4N Lapor

Tarif Pelayanan :

No	Jenis Tindakan	Tarif
1	*Blood Pressure Monitoring*	Rp 500.000
2	*Treadmill Diagnostik*	Rp 800.000
3	*Echocardiography Color + Doppler Transthorakal*	Rp 900.000
4	*Echocardiography Bubble Echocardiography Transthorakal*	Rp 1.200.000
5	*Echocardiography Guiding Transthorakal*	Rp 3.200.000
6	*Echocardiography* CRT *Transthorakal*	Rp 1.700.000
7	*Echocardiography* 3 Dimensi *Transthorakal*	Rp 1.200.000
8	*Echocardiography Strain Transthorakal*	Rp 1.200.000
9	*Echocardiography Step Test*	Rp 1.800.000
10	*Echocardiography Dobutamin Stress Test*	Rp 2.200.000
11	*Echocardiography Treadmill Stress Test (Exercises Stress Echo)*	Rp 2.200.000
12	TEE *(Trans Esophageal Echo)*	Rp 3.800.000
13	TEE *(Trans Esophageal Echo) + Bubble*	Rp 3.800.000
14	TEE *(Trans Esophageal Echo)* dengan Anestesi	Rp 7.800.000
15	TEE *(Trans Esophageal Echo) Guiding*	Rp 7.500.000
16	*Echocardiography Pediatric Simple Case*	Rp 1.300.000
17	*Echocardiography* Sedasi Ringan / *Case* Komplek	Rp 1.800.000
18	*Echocardiography Fetal*	Rp 2.500.000
19	*Holter Monitoring* 12 *Lead* 1x24 Jam	Rp 1.500.000
20	*Holter Monitoring* 12 *Lead* 3x24 Jam	Rp 3.000.000
21	*Holter Monitoring* 12 *Lead* 7x24 Jam	Rp 4.500.000
22	*Holter Monitoring* 3 *Lead* 1x24 Jam	Rp 850.000
23	*Holter Monitoring* 2 *Lead* 2x24 Jam	Rp 1.250.000
24	Reprogram *Pacemaker*	Rp 1.100.000
25	Optimalisasi CRT dengan EKG	Rp 1.700.000
26	*Tilt Table Test*	Rp 3.900.000
27	Tes Provokasi (dengan *Flecainid*)	Rp 5.300.000
28	Kardioversi	Rp 3.900.000



pjnhk.go.id/pelayanan/cardiovascular-msct--scan-128-slices

Contact Center: 1500 034 (WA) : 0811 911 5045 | Emergency (021) 568

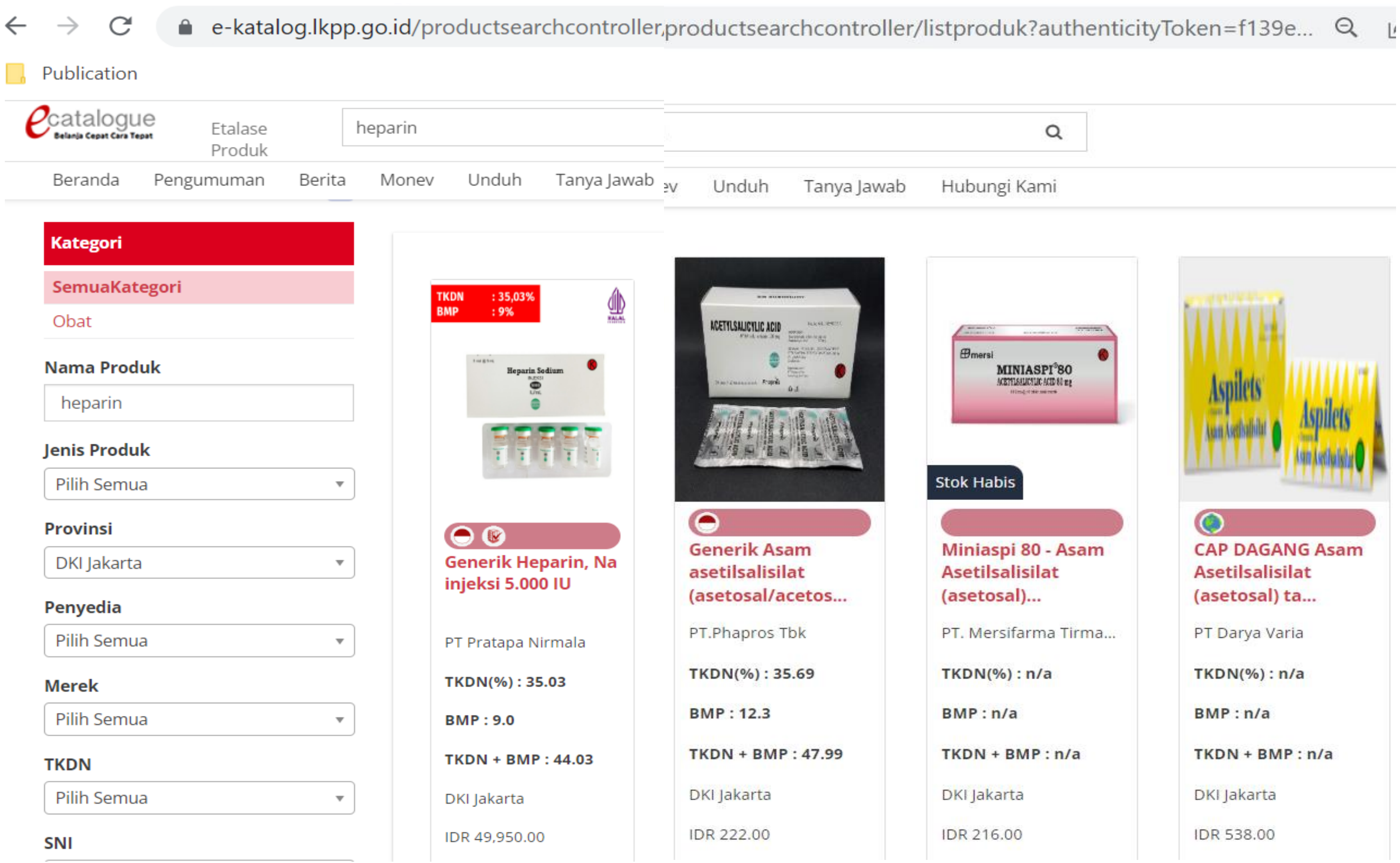
Dokter | Rujukan Nasional | Diklat | Litbang | SP4N Lapor | Pengaduan | Infor

dan hari Jumat pada pukul 08:00 – 16:30 WIB.

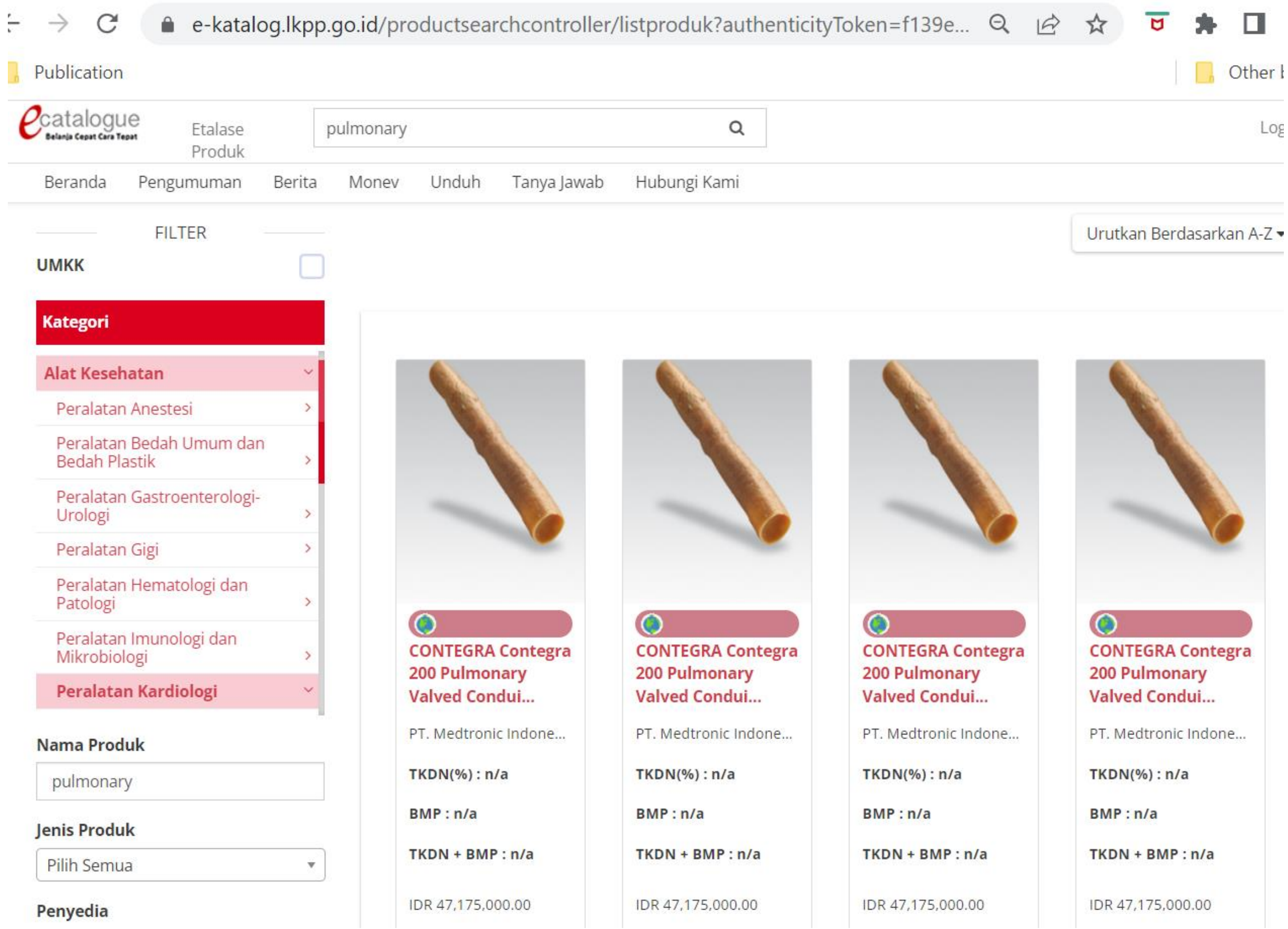
Tarif Pelayanan MSCT dengan Kontras :

No	Jenis Pelayanan	Satuan	Tarif (Rp)	Keterangan
1	MSCT Angio Cerebral / Carotis	Per Pemeriksaan	Rp. 3.600.000	-
2	MSCT Abdominal / Aorta	Per Pemeriksaan	Rp. 4.000.000	-
3	MSCT Artery Femoral / Artery Extrimitas Atas	Per Pemeriksaan	Rp. 4.000.000	-
4	MSCT Perfusi Kepala	Per Pemeriksaan	Rp. 3.600.000	-
5	MSCT Cardiac	Per Pemeriksaan	Rp. 3.900.000	-
6	MSCT Cardiac Pediatric (PJB)	Per Pemeriksaan	Rp. 3.500.000	-
7	MSCT Venography Extrimitas Atas / Bawah	Per Pemeriksaan	Rp. 4.000.000	-
8	MSCT Artery Pulmonal	Per Pemeriksaan	Rp. 3.600.000	-

Appendix 4. Published resources of direct medical costs from Indonesia's e-catalogue website



Appendix 4. Published resources of direct medical costs from Indonesia's e-catalogue website



Appendix 5. Published resources of probability of dying between ages from the World Health Organisation (WHO) website

World Health Organization | Health Topics | Countries | Newsroom | Emergencies | Data | About WHO

GHO Home | Indicators | Countries | Data API | Map Gallery | Publications | Data Search

Last updated: 2020-12-06

Indicator	nqx - probability of dying between ages x and x+n													
Period	2019			2015			2010			2005			2000	
Location	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male
Indonesia														
<1 year	0.021	0.023	0.019	0.022	0.024	0.019	0.03	0.033	0.027	0.036	0.039	0.033	0.043	0.047
1-4 years	0.004	0.004	0.003	0.005	0.005	0.004	0.006	0.007	0.006	0.008	0.009	0.008	0.012	0.012
5-9 years	0.003	0.003	0.003	0.004	0.004	0.003	0.004	0.004	0.004	0.005	0.005	0.005	0.006	0.006
10-14 years	0.002	0.002	0.002	0.002	0.003	0.002	0.003	0.003	0.002	0.003	0.003	0.003	0.004	0.004
15-19 years	0.004	0.005	0.003	0.004	0.005	0.003	0.004	0.005	0.003	0.005	0.006	0.004	0.006	0.006
20-24 years	0.005	0.007	0.003	0.006	0.007	0.004	0.006	0.008	0.005	0.007	0.009	0.006	0.008	0.009
25-29 years	0.005	0.007	0.004	0.006	0.007	0.005	0.007	0.008	0.006	0.008	0.01	0.007	0.01	0.011
30-34 years	0.007	0.008	0.005	0.007	0.009	0.006	0.009	0.01	0.008	0.01	0.011	0.009	0.012	0.013
35-39 years	0.009	0.01	0.008	0.01	0.012	0.009	0.012	0.013	0.011	0.013	0.015	0.012	0.015	0.016
40-44 years	0.014	0.016	0.013	0.016	0.017	0.014	0.018	0.019	0.016	0.02	0.021	0.018	0.021	0.023
45-49 years	0.023	0.025	0.02	0.024	0.027	0.022	0.026	0.03	0.023	0.028	0.031	0.025	0.03	0.032
50-54 years	0.036	0.042	0.031	0.039	0.044	0.033	0.042	0.048	0.036	0.044	0.049	0.038	0.045	0.05
55-59 years	0.057	0.067	0.046	0.06	0.07	0.049	0.064	0.073	0.053	0.065	0.073	0.056	0.065	0.072
60-64 years	0.089	0.11	0.071	0.094	0.11	0.076	0.098	0.11	0.082	0.1	0.11	0.087	0.1	0.11
65-69 years	0.14	0.16	0.11	0.14	0.17	0.12	0.15	0.17	0.12	0.15	0.16	0.13	0.14	0.16
70-74 years	0.21	0.24	0.18	0.21	0.24	0.19	0.22	0.25	0.2	0.22	0.24	0.2	0.22	0.24
75-79 years	0.31	0.34	0.28	0.31	0.35	0.29	0.32	0.35	0.3	0.32	0.34	0.3	0.31	0.33
80-84 years	0.44	0.48	0.42	0.45	0.49	0.43	0.46	0.49	0.45	0.46	0.48	0.45	0.46	0.48
85+ years	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Appendix 6. Equations in the MS Excel for economic modelling

table description related to the equations in a Markov model

A.	**Health and death distribution**		**Equation in the MS Excel**
	1. SPVR		
	Starting population	:	H21
	probability of natural death	:	B21
	healthy population in RVOT	:	H21*(1-B21-tpS1_D)
	natural death	:	H21*B21
	intervention death	:	H21*tpS1_D
	cumulative death	:	J22+L22
	for 45 years of age	:	probability of natural death increased 10 times
	2. TPVR		
	Starting population	:	H21
	probability of natural death	:	B21
	healthy population in RVOT	:	H21*(1-B21-tpT0_D)
	natural death	:	H21*B21
	intervention death	:	(H21*tpT0_D)
	cumulative death	:	J22+L22
	for 45 years of age	:	probability of natural death increased 10 times
B.	**Total costs**		
	1. SPVR		
	total population per each cycle	:	H22
	OPD	:	(H22*c_R_opd)/(1+dr)^@cycle
	IPD and SYSTEM (with intervention)	:	(H21*(c_SPVR_ipd+c_SPVR_sys))/(1+dr)^@cycle
	IPD and SYSTEM (without intervention)	:	(H22*(c_SPVR_ipd+c_SPVR_sys))*0/(1+dr)^@cycle

	complication for pacemaker implantation	:	(H21*(prob_PI*c_PI))/(1+dr)^@cycle
	complication for procedure-related replacement	:	(H21*(prob_PC_SPVR*c_PC))/(1+dr)^@cycle
	complication for endocarditis treatment	:	(H21*(prob_ET_SPVR*c_ET))/(1+dr)^@cycle
	total costs	:	R22+T22+V22+X22+Z22
	2. TPVR		
	total population per each cycle	:	H22
	OPD	:	(H22*c_R_opd)/(1+dr)^@cycle
	IPD and SYSTEM (with intervention)	:	(H21*(c_TPVR_ipd+c_TPVR_sys))/(1+dr)^@cycle
	IPD and SYSTEM (without intervention)	:	(H22*(c_TPVR_ipd+c_TPVR_sys))*0/(1+dr)^@cycle
	complication for procedure-related replacement	:	(H21*(prob_PC_TPVR*c_PC))/(1+dr)^@cycle
	complication for endocarditis treatment	:	(H21*(prob_ET_TPVR*c_ET))/(1+dr)^@cycle
	total costs	:	R22+T22+V22+X22
C.	**Total LYs**		
	1. SPVR		
	total population in cycle	:	H22
	LY per year	:	H22/(1+dr)^@cycle
	2. TPVR		
	total population in cycle	:	H22
	LY per year	:	H22/(1+dr)^@cycle
D.	**Total QALYs**		
	1. SPVR		
	total population per each cycle	:	H22
	utility index per each interval	:	uv_S1; uv_S2
	QALY per year	:	(H22*uv_S1)/(1+dr)^@cycle
	2. TPVR		

total population per each cycle	:	H22
utility index per each interval	:	uv_T0; uv_T1; uv_T2
QALY per year	:	(H22*uv_T0)/(1+dr)^@cycle

VITA

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PUBLICATION	1. Setiawan D, Annisa AN, Lianawati, Hutubessy RCW, Ting Yeung KH. 2023. The Cost Analysis of Human Papillomavirus Vaccination Program in Indonesia. available on pubmed.ncbi.nlm.nih.gov/36934486/ 2. International Pharmaceutical Federation-Early Career Pharmaceutical Group (FIP-ECPG). Cardiovascular Diseases: A handbook for Pharmacists. 2022. available on https://www.fip.org/file/5251 3. Annisa A, Utaminingrum W, Genatrika E. 2019. Dermal Sensitization Test of Gel Mask Containing Combination of Green Tea Waste Extract and Rice Washing Water. available on http://ejournal2.litbang.kemkes.go.id/index.php/jki/article/view/491 4. Nugraha. Irfan, Andi Nurul Annisa, Ari Tri Wibowo, and Anjar Mahardian Kusuma. 2018. Chemopreventive activity of kola (Cola accuminata) seed ethanol extract in mice induced by cyclophosphamide. available on https://iopscience.iop.org/article/10.1088/1757-899X/288/1/012008
AWARD RECEIVED	1. The Graduate Scholarship Programme for ASEAN or Non-ASEAN Countries, Chulalongkorn University, Thailand. 2022-2023 2. The Best Graduate of The Pharmacist Professional Degree, Universitas Muhammadiyah Purwokerto, Indonesia. 2019 3. Merits Scholarship for Undergraduate (PPA DIKTI) Indonesia, The Indonesian Ministry of Research, Technology and Higher Education, Indonesia. 2017