

DOI: 10.5455/msm.2023.35.65-72

Received: Feb 10 2023; Accepted: Mar 11, 2023

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ORIGINAL PAPER

Mater Sociomed. 2023 Mar; 35(1): 65-72

Acquisition of New Philips Affiniti 30 Vascular Color Doppler Ultrasound Device - Cost Benefit Analysis to Reduce Cardiosurgical Patients' Treatment

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ABSTRACT

Background: Cerebrovascular accidents (CVI) are considered the second most serious complication in cardiac surgery patients with a frequency of 10%. By preventing complications of surgical treatment, using a Color Doppler ultrasound (CDU) device, in the population of cardiac surgery patients, the unplanned costs of prolonged postoperative treatment would be reduced. **Objective:** To prove that the acquisition and use of the newly developed CDU device "Affinit 30" is completely economical, profitable and medically justified. **Methods:** Numerical parameters of the treatment of cardiovascular patients were analyzed (number of procedures, number of days in the intensive care unit, cost of additional consultative services of the clinic for radiology and neurology), and the calculated economic value of the potential investment, as well as the cost of preventing surgical complications, by purchasing and installing a new modern CDU device. **Results:** The profitability of the investment was assessed using the economic parameters Net Present Value (NPV) of the investment, Internal rate of return (IRR) and Profitability Index (PI). A mathematical calculation with the given parameters yields NPV = 948,850 KM and IRR of 273% when applied to the given parameters. The PI value is 12.6, which matches the previously calculated NPV and IRR values. **Conclusion:** The acquisition and use of the newly developed CDU device "Affinit 30" is economically profitable and medically justified.

This is shown by the calculated values of the economic parameters Net Present Value of the investment (NPV), Internal rate of return (IRR) and the Profitability Index (PI).

Keywords: Cost benefit analysis, Cerebrovascular accident, Color doppler ultrasonography.

1. BACKGROUND

Cerebrovascular Cerebrovascular accidents (CVI) are considered the second most serious complication in cardiac surgery patients with a frequency of 10% (1-3). They are often fatal and leave permanent disability. They extend the patient's treatment, both in the intensive care unit (ICU), on the ward, and after hospital treatment. This significantly increases the cost of treatment due to prolonged hospital stays, the need for additional resources, both material and human (4).

Permanent disability and long-term outpatient treatments are another segment of the significant financial burden on the health system. Prevention of cerebrovascular incidents is possible, among others, through preoperative examination of the neck arteries. In addition, it is possible to treat eventual atherosclerotic lesions, which are the most common causes of complications (5).

Color Doppler ultrasonography (CDU) device, which can be used in the preoperative evaluation of the neck arteries, to detect a possible lesion, and to prevent complications

with adequate measures (medications, stenting or surgical treatment), is a necessary instrument in everyday practice. The economic benefit of screening the carotid arteries of the general population, in which the prevalence of atherosclerotic disease is 2%, has been proven, with a reduction of CVI of 22% and a saving of 50,000 EUR per year in view of preventive optimal medical treatment (BMP-best medical treatment), improved quality of life and reduction of additional treatment costs, which are achieved by preventing CVI (5).

By preventing complications of surgical treatment, using the CDU device, in the population of cardiac surgery patients, which has a high percentage of significant atherosclerotic disease (AS) of the carotid arteries (Carotid arteries, CA; Internal Carotid artery, ICA) and over 6%, three times more than the general population, with adequate and timely preoperative therapy, the unplanned costs of prolonged treatment would be reduced, as well as avoiding the patient's permanent disability, with all the economic consequences that accompany it.

The effects of preoperative CDU examination in cardiac surgery patients, who have a significantly higher prevalence/incidence of atherosclerosis, are considerably greater than in the general population due to additional comorbidity, and according to the current SCORE scales for the operative risk of CVI, they range over 11.8%, depending on comorbidity (3). Current cost-effectiveness studies in patients with AS disease CA predict significantly higher savings after Color Doppler Ultrasound (CDU) evaluation and selection of optimal therapy. Thus, in a patient with surgical or invasive revascularization after CDU confirmed significant stenosis, the financial effect was 110,000 US dollars. In a patient who underwent medical treatment, the financial effect was 29,000 US dollars per year (6).

Modern trends, CDU devices economic profitability, we will consider the purchase of such a device. We will analyze several basic numerical parameters of the treatment of cardiovascular patients (number of surgeries, number of days in the intensive care unit, additional consultation services of the clinic for radiology and neurology) in the Clinic for Cardiovascular Surgery, and calculate the economic value of potential investments, as well as the cost of preventing surgical complications, by purchasing and using the new modern CDU device.

We will prove that the acquisition and use of the newly developed CDU device "Affinity 30" is completely economical, feasible and medically justified. By observing the economic parameters and their calculations, it will be clearly shown that according to each of them the considered investment is acceptable. In addition, the investment will be profitable. According to our assumption, we expect a profitable investment, and I will check the Net Present Value (NPV), Internal Rate of Return (IRR) and Profitability Index (PI). So, from the perspective of financial evaluation techniques for investment projects, we expect that the considered purchase of an ultrasound machine will be an acceptable and beneficial project. Saving the patient's life and health, enhancing their quality of life, and providing medical services are all parts of

this investment that give it full meaning.

The assumption is that the acquisition of an innovative technologically modern CDU device would result in the expansion of the service portfolio of the Clinic for Cardiovascular Surgery. By increasing the number and quality of services by improving the sensitivity and accuracy of findings, shortening the period of pre-operative preparation and reducing the burden on patients and the health system by saving time and thereby improving the quality of the health service provided, it would affect the increase in satisfaction of employees and users of our services and have a positive impact on institutions' business.

Cost benefit analysis (CBA) is a method of choosing an economic analysis that will provide the opportunity to compare and evaluate the assumed options and choose the most cost-effective alternative in the financial and economic sense and thus support making the right decision regarding the purchase of a new CDU device.

After considering the new Affinity ultrasound CDU device with three ultrasound probes from the manufacturer Siemens, we will prove the profitability of the investment with savings that will be realized by examinations in the clinic, by clinic employees, which will reduce the outflow of funds to other consulting clinics, both in terms of making CDU findings, as well as during the treatment of CVI complications during the surgery and postoperative period.

CBA is planned to determine the Net present value of the investment (NPV), the Internal rate of return (IRR), and the Profitability Index (PI), which will determine whether purchase of an upgraded CDU device based on Affiniti 30 is an economically acceptable and profitable economic project.

2. OBJECTIVE

The article aims to prove the economic viability of purchasing a modern color Doppler ultrasound device "Affiniti 30". This will significantly reduce cardiac surgery costs, by preventing cerebrovascular incidents. Investing in equipment and additional training of medical personnel reduces the cost of treating a cardiovascular surgical patient. This is done through timely detection of the pathological substrate in the neck arteries and implementing effective and timely preventive therapeutic measures. The hypotheses are: a) The purchase of a new vascular color doppler ultrasound device Affinity 30 is economically profitable and contributes to the reduction of treatment costs for cardiac surgery patients; b) The purchase of a new vascular color doppler ultrasound device Affinity 30 is not economically profitable and does not contribute to the reduction of treatment costs for cardiac surgery patients.

3. MATERIAL AND METHODS

The defined mission is to improve service, reduce surgical complications, and reduce treatment costs and increase profitability in the treatment of cardiovascular patients.

The documentation and technical characteristics of

the Color Doppler ultrasound machine were reviewed, and it was assumed that the work process could be improved, and the requirements for improvement were defined: a) Better, more reliable and faster examination of the patient; b) Increasing the motivation of doctors for education and performing CDU examinations; c) Reduction of costs by reducing the search for services from other clinics (radiology); And D) Cost reduction by reducing the number of surgical complications.

During the analysis of the potential CDU device purchased, attention was paid to: 1. Quality and reliability of the search and the duration of the search with the updated device; 2. Search and savings costs; 3. Work process and automation degree; 4. Price; 5. Manufacturer's or supplier's service contract (length of warranty period, price and service conditions, technical support and automatic software renewal); 6. Availability of parts and consumables 7. Staff training for working on the updated device.

The plan is to purchase a CDU device that would support the stated requirements for providing safer, faster and more efficient diagnostic preoperative processing/diagnostics inside the clinic and which, in the next five-year period, through reduction of surgery and postoperative complications, reduction of treatment costs, and reduction of seeking services from other clinics, enable higher revenues (reduced costs) for the Clinic for Cardiovascular Surgery. The implementation of the plan began with the selection of the right equipment that suits our working environment. It also included the motivation for education and search, and in accordance with the planned investment costs. A team was formed to implement the CBA

The total number of cardiac surgery patients at the Clinic for Cardiovascular Surgery over five years was analyzed. Based on the professional literature, the potential frequency of CVI in that group of cardiac surgery patients was estimated. In addition, the cost of prolonged treatment of patients with CVI in the Intensive Care Unit, and the cost of consultation-consultative examinations by the Neurology and Radiology clinic was evaluated.

An assessment of the projected costs and benefits was conducted with the CBA. The analysis factors are Benefits with monetary values (savings on consultations at another clinic and additional tests, reduction/increase in complications and reduction/increase in treatment costs). Only the expected benefits and costs of the proposed options were considered.

In this case, Phillips' "Affiniti 30" Color Doppler ultrasound machine was selected, with a specification from "Medicom" Bijeljina. Two additional costs that were considered unique investment costs are the acquisition of the probe and the annual regular service. During the analysis, a conservative approach of 5 years of the investment cycle was chosen. This is the framework within which the investment justification will be analyzed.

Salary costs did not burden the investment profitability calculation because the device does not require special technicians or personnel. The device is used by medical staff as part of the basic activity, and no additional costs

are created. In the analysis, the costs of education for 15 doctors, spread over two years, were calculated. For the analysis of the investment's justification, these costs were calculated as a whole.

Analyzing the economic parameters Net Present Value of the investment (NPV), Internal Rate of Return (IRR) and Profitability Index (PI) and their calculation, it was checked for each considered investment, its acceptability and profitability.

This study is retrospective in nature.

3.1. COST-BENEFIT ANALYSIS (CBA), project – new Color Doppler ultrasound device

Option 1

Continuing working without appropriate diagnostics disables the prevention of complications and requires additional consultations with a radiology clinic, a prolonged stay in intensive care, and consulting with a neurologist.

Option 2

To acquire an advanced technologically modern Color Doppler ultrasound device, user friendly. This will encourage doctors to educate and perform Color Doppler ultrasound examinations and prevent complications and avoid additional costs associated with this procedure.

4. RESULTS

4.1. Determining and measuring costs and benefits

CBA includes a comprehensive assessment of projected benefits and costs for both alternatives. The analysis factors are: a) Benefits that have monetary values (savings on consultations at another clinic and additional tests, increase in the number of complications and increase in treatment costs); b) Costs that cannot be expressed monetarily (patient satisfaction, physician motivation and satisfaction). Only the expected benefits and costs of the proposed options will be considered in the analysis.

As an example, /case report, the "Affiniti 30" Color Doppler device from Phillips was selected based on the specifications from the provider "Medicom" Bijeljina dated 10.6.2022. Total purchase value 75,675.32 KM including VAT (64,679.76 KM without VAT).

Acquisition of the probe and annual maintenance of the probe are both unique investment costs. The probe costs 6,182.32 KM including VAT. This price according to the manufacturer's specification and use experience should not change during the device's projected useful life. The annual service cost of the "Affinity 30" ultrasound machine is 400.00 KM including VAT, according to the service provider's specifications.

According to the manufacturer's specification, the device's basic useful life is 10 years (although in practice it has been established that it is possible to expect functionality significantly beyond that period, but with limited or non-existent software upgrades and upgrades to new technologies). Accounting practices align the useful life of 5 to 8 years with the applicable allowable rates under the straight-line method. Taking everything into account during the analysis, we chose a conservative approach of 5 years of the investment cycle. This is

Year	2018	2019	2020	2021	2022	X
Number of surgeries	287	330	358	360	350*	337
Number of high-risk patients (3%)**	8,61	18,9	10,74	10,8	10,5	10
Frequency of CVI in cardio-surgical procedures 10%	28,7	33	35,8	36	35	34

Table 1. Average number of surgical procedures and complications. Source: Invoicing service of CCUS, and the protocol of the Clinic for cardiovascular surgery; * Estimate for the current year; ** Number of high-risk patients in the general population; * High-risk patients and cardiac surgery patient populations**

	Without consultation	With consultation	1 st week	2 nd week	3 rd week
Average cost of surgery	15,000				
Average price of ICU /24h		244	1,708	3,416	5,124
Price of CDU on radiology		60*			
CTA prices		350**			
Net refund with complication without consultation			13,292	11,584	9,876
Net refund with complication and consultation			12,882	11,174	9,466
Loss without complication					
Loss with complication			1,708	3,416	5,124
Loss with complication and consultation (neurologist)			2,118	3,826	Σ 5,534

Table 2. Overview of relevant costs. Source: Author's calculations *- prices for consultation of CDU findings at the Radiology Clinic **- price of CTA scan in radiology clinic. The total value of CDU and CTA findings is 410 KM

the framework within which the investment justification will be analyzed.

A few more items need to be clarified regarding the cost structure. Salary costs do not burden the investment profitability calculation because the use of the device does not require special technicians or other personnel. The device is used by medical staff as part of the basic activity, and no additional costs are created. At the same time, it is necessary that the mentioned personnel undergo adequate training, whose gross unit costs are 2,000.00 KM per participant, one time. Given that the department consists of 15 doctors, the total costs amount to 30,000.00 KM gross. These costs would be distributed in accordance with the training dynamics over two years. It is possible, in different ways, to reduce this item. However, choosing a conservative approach, for the analysis of the investment justification, we decided to calculate these costs as a whole.

On the other hand, the existing costs, which could be completely eliminated by purchasing and using the described CDU device, would in the analysis actually represent direct profits. This refers to the inflow of investments that are considered. These costs are of course aligned with the described medical practice and standards, and the material expression and overview of

these opportunity costs is as follows:

Based on reimbursement from the Canton Sarajevo Health Insurance Fund, the surgical procedure costs 15,000.00 KM. Table 1 provides an overview of the dynamics and trends for this type of surgery at the University Clinical Center of Sarajevo (KCUS).

What is particularly relevant for our calculation are the average values in Table 1. Namely, on an annual basis, the five-year average of performed surgical procedures of this type amounts to 337 surgeries per year. Based on the previously presented statistical indicators, which were confirmed in KCUS practice, 3% in the average population (that is, 10 patients per year) can get CVI, and 10% of patients (34 patients per year) are likely to get CVI as a surgical complication in the population of operated patients. On the other hand, the additional costs charged by KCUS, which are not covered by the Institute, represent a direct cost to the clinic. These costs are summarized in Table 2.

When the values from Tables 1 and 2 are taken together, for the purposes of assessing the profitability of the considered investment, the following proposition presented in Table 3 can be set, with the important note that the maximum length of stay in intensive care of 21 days was taken for the calculation. CDU and CTA findings total 410 KM. This is calculated as an additional loss in case of consultation and search. The total maximum potential cost per

	Number of surgeries	Loss per surgery	Total annual loss
Planned surgeries	337	-	-
Cases without complication	10	5,124	50,124
Cases with complication and consultation	34	5,534	188,156
Σ			238,280

Table 3. Overview of existing inputs and losses per each surgery. Source: Author's calculations

patient for a CVI complication is 5534 KM.

When the number of patients at risk of CVI is multiplied by the potential additional cost, the total annual loss is obtained from patients from the general population (3%, 10 patients) and high-risk patients with AS disease of the carotid arteries (10%, 34 patients). The combined (total) savings on an annual basis amount to 238,280 KM and are presented together with the annual costs of starting and maintaining the investment in Table 4, which provides a summary overview of the investment costs in the considered period.

Choosing an adequate discount rate is an extremely difficult task. Namely, central banks around the world decided to gradually raise reference interest rates after almost two decades of historically low interest rates, and practically continuous expansionary monetary policy in

Year	Buying a CDU device	Probe cost	Cost of service	Education of doctors	Total
1 st	75,675.32	6,182.32	400	15,000	97,257.64
2 nd			6,182.32	15,000	15,400.00
3 rd			6,182.32		400.00
4 th			6,182.32		400.00
5 th			6,182.32		400.00
Σ					113,857.64

Table 4. Overview of the costs of the considered investment. Source: Author's calculations

	Outflows	Inflows	Cash flow	Year
0	(81,857.64)		(81,858)	(81,858)
1 st	(15,400.00)	238,280	222,880	214,308
2 nd	(15,400.00)	238,280	222,880	206,065
3 rd	(400)	238,280	237,880	211,474
4 th	(400)	238,280	237,880	203,341
5 th	(400)	238,280	237,880	195,520

Table 5. Overview of cash flows of the proposed investment

the years before the Global Financial Crisis, in its wake and after it, and of course pandemic interventions by monetary authorities.

Also, the period of negative interest rates on deposit facilities of central banks around the world significantly hinders the comparison of comparable options, which is the de facto situation in BiH as well after the decision of the CBBH to debit the accounts of commercial banks in BiH in this way, and they consequently pass the burden on to their clients (the majority of banks in Bosnia and Herzegovina limit themselves to the so-called "large clients", or those who have an average account value of 1,000,000.00 or more).

Nevertheless, bearing in mind that the purchase of the device is financed from own funds, and considering the rates on leasing for comparable equipment, interest on loans of a similar type, and the possibility of placement on the financial market (primarily observing the issues of the FBiH Government), we believe that the discount factor of 4% is an adequate choice.

As a technique for evaluating the profitability of the considered investment, we chose the method of calculating the Net Present Value of the investment (NPV). The net present value of a given investment is actually the present value of the net cash flows of the investment. This is minus the initial investment cost.

Where:

CF_n – value of net cash flows for the period n,

IC – Initial investment cost,

k – discount rate.

The project acceptance criterion is that if the NPV is equal to or greater than zero, the project is acceptable. An investment with higher NPV is, of course, more desirable.

Table 5 provides an overview of the investment's cash flows. From these data, the Net present value, with the given and calculated parameters, amounts to NPV = 948,850 KM.

A complementary indicator that should make it easier to make an investment decision is the Internal Rate of Return (IRR). The internal rate of return is actually a discount factor that equates the present value of the expected net cash flow (CF) with the initial investment costs (IC).

In other words, IRR is the rate that discounts the future cash flows of the considered investment to equalize them with the present value of the initial cost (IC) in the first period. The usual acceptance criteria for IRR is to compare the IRR with the required rate of return, where the IRR must be higher than the required rate of return. Due to the specificity of the project itself, which does not have an imperative of profitability, although it is immediately concluded from Tables 4 and 5 that it is a project with a high rate of profitability, which every subsequent calculation only confirms in exact terms.

In order to avoid the IRR interpolation procedure, the calculation was performed with an appropriate function in Excel 2010. In the case under consideration, the IRR is an impressive 273%. This indicates that the project is absolutely acceptable according to these criteria.

Finally, as the last technique when making an investment decision, we will calculate the value of the profitability index (PI), for example, the ratio of benefits and costs of the project. In other words, it is the ratio of the present value of net cash flows to the initial investment cost: As for the acceptance criteria, it is evident that the PI must be at least equal to 1. The higher its value is, the more profitable the project is. In our case, the PI is 12.6, which is a very high value and in accordance with the previously calculated NPV and IRR values.

After considering each of the calculated indicators individually, it is clear that the investment qualifies for acceptance on the basis of each. What's more, it is an extremely profitable investment, as the extremely high IRR and PI values suggest.

Therefore, from the perspective of financial techniques for evaluating investment projects, the considered purchase of an ultrasound machine is an acceptable and extremely profitable project.

5. DISCUSSION

The incidence of perioperative CVI has decreased after cardiac surgery over the last two decades (2). However, it is still one of the most serious complications for cardiac surgery patients. CVI is associated with 21 to 23% intra-hospital mortality (7, 8), and up to 43% (3). Combined AS

and carotid artery disease is currently present in approximately 8% of patients undergoing cardiac surgery (range 2-22% depending on the definition of stenosis, diagnostic method, and frequency of screening) (2). Several large studies from before 2002 estimated CVI incidence at about 3% (7, 9, 2), while more recent large studies, conducted on almost 1.5 million patients who underwent isolated CABG surgery between 2000-2009, estimate that risk at around 1.2% (10). That number in a patient with valvular disease (aortic or mitral valve) and with diseases of the ascending aorta is somewhat higher, and also in a patient with CABG, according to some recent studies, and ranges from 3.0% to 8%, regardless of the type of surgery. (11).

CVI as a complication of cardiac surgery prolongs the length of the patient's stay in the ICU, the duration of hospital treatment, the need for care at home, increases hospital costs and has a significant impact on the quality of life of surviving patients (4).

However, despite the reduction in the frequency of CVI after heart surgery, which is the result of better preoperative preparation, intraoperative monitoring of cerebral perfusion and prevention of the development of CIV, diagnostics and more potent therapy in the postoperative period, the frequency of CVI is not negligible and cannot be expected eradication. Namely, precisely because of medicine's development, patients' life expectancy has been extended into the eighth or ninth decade. There is an increasing and almost predominant number of old patients who undergo heart surgery. Age is one of the established risk factors for postoperative CVI. In a study from 1986. Gardner et al showed that CVI rates increase with age. Patients younger than 45 years have a frequency of 0.2%, which increases to 3.5% for patients in their 60s, and 8.0% for patients older than 75 years. While the study by Brenes et al. From 1992 (12). Shows that this rate is 0.9% for those under 65 but 8.9% for those over 75. Other risk factors for CVI are aortic calcification, renal insufficiency, previous CVI, smoking, age, peripheral vascular disease, and diabetes. (8, 13).

It is worthwhile to mention that many studies have established a relationship between the degree of carotid artery stenosis and the frequency of CVI in cardiac surgery patients. Thus, in 1987, Brenner and his co-workers showed that CVI or TIA occurs with a frequency of 9.2% in patients with asymptomatic carotid artery stenosis (defined as 50% or more stenosis on angiographic findings), and in patients without stenosis, CVI frequency is 1.9%. In Faggioli et al. (1990) (14), that number is higher, i.e., 15% frequency of CVI for stenoses over 75% and age over 60 years, while in identically matched patients that number was 0.6%. The same study confirmed that thrombendarterectomy (TEA) of the carotid artery, as a surgical method of treatment in patients with significant stenosis, significantly reduces the frequency of CVI. Thus, not a single patient who underwent TEA preoperatively had CVI, while 14.3% of patients who did not undergo TEA developed CVI. A significant increase in the frequency of CVI with a higher degree of ICA stenosis was also found (12), with a 109% higher frequency of CVI

in patients with stenosis over 80%.

All these data are in support of the idea that persistent and detailed, and at every stage of the patient's preparation for cardiac surgery, an examination could be carried out, the condition determined, and preventative action taken, which is the only way to prevent complications, shorten treatment, and thereby reduce costs and achieve savings, as soon as the justification for investing in the CDU apparatus and diagnostics is determined. Numerous studies prove this, linking the preoperative condition of the neck arteries and the frequency of CVI, resulting in complicated and prolonged treatment.

Pandya et al. (2015), (15) analyzing the Cost Effectiveness in the study of cerebrovascular reserve (CVR), as a guide for the treatment of asymptomatic patients, found that CVR testing can be a cost-effective tool for identifying asymptomatic patients with carotid artery stenosis who would benefit the most from surgical revascularization, for example, TEA of the carotid arteries. On that occasion, it was determined that the incremental cost-effectiveness ratio for a CVR-based strategy (patients who were screened and indicated for surgical revascularization) compared to a medication-related strategy was \$23,000 per QALY, and for urgent revascularization compared to a CVR-related strategy alone and medical treatment, the ratio was \$760,000 per QALY. Data indicates that preventive screening diagnostics and timely, adequate therapy are highly profitable. In the study by Pandya et al., CDU screening was used to determine the type of therapy was determined. This resulted in significant savings based on avoiding treatment costs and improved quality of life (15).

Incremental cost-effectiveness ratio (ICER) is a summary measure that presents the economic value of an intervention in comparison to another alternative. It is the major output parameter or result of an economic evaluation. The ICER is calculated by dividing the difference in total cost (incremental cost) with the difference in cost between the selected measures per health outcome (incremental effect) to obtain the ratio "additional cost per additional unit of health effect"—for significantly more expensive therapy or diagnostics than alternatives. In the United Kingdom (UK), QALY (The quality adjusted life year), which is a generic measure of the burden of disease, including the quality and quantity of life lived or years of life, is the most commonly used measure of health effect, which allows the ICER to be compared with various diseases. At the stage of awarding the award, the ICR is most useful when an innovative method or intervention is used, which costs extra, but has a beneficial health effect, i.e., it generates an improved health effect (Incremental Cost-Effectiveness Ratio (ICER) [online], 2016) (16).

CDU diagnostics can be a cost-effective tool for identifying patients with asymptomatic carotid artery stenosis for whom preventive carotid TEA is the most suitable treatment (6). The study determined the ICER/QALY ratio of \$110,000, in patients who were screened and underwent preventive TEA as a measure of revascularization. This was done with a reduction in ICV frequency

to 12.0%, compared to 17.6% in unscreened patients.

Högberg et al obtained similar results. (2018) (5) in a study that determined the number of patients who should be screened with CDU findings, in the prevention of ICV in asymptomatic carotid artery stenoses. This was achieved an absolute reduction of ICV of 22% and an economic profit of \$50,000/QUALY, based on optimal treatment for complications.

Modern research confirms the high benefit of carotid artery screening, including the prevention of complications and significant economic advantages. By analyzing the results, we determined the agreement of our research assumptions with previous studies. This was in terms of economic benefit in the prevention of complications during cardiac surgery in our clinic. Based on this, we performed an analysis of the financial justification of the purchase of a new Color Doppler ultrasound device, as well as assumed an economic benefit from the prevention of complications, which will make the investment justified, both for the clinic and for society as a whole, by reducing permanent disability and additional treatment after discharge from our clinic.

By looking at the operating volume in our clinic, for 5 years, we calculated that on an annual level (i.e., five-year average) the number of surgeries of this type is 337 surgeries. Based on the previously presented statistical indicators, which were confirmed in the practice of KCUS, 3% in the average population (that is, 10 patients per year) may receive ICV, and 10% of patients (34 patients per year) are likely to receive ICV as a perioperative complication in the population of cardiac surgery patients. (Table 1).

Additional costs charged by CCUS, which are not covered by the Institute, i.e. represent a direct cost for the clinic, are summarized in Table 2. We see that the price of a patient's stay in the intensive care unit (JIT) for 24 hours is 244 KM, and if we add to that the consultation by the Radiology Clinic, CDU 60 KM, and CTA 350 KM, the price of the stay increases by an additional 410 KM. If I have an extended stay of a patient in the ICU for one week, the loss of the shelled amount paid by FF ZO amounts to 1708 KM, to a maximum of 5124 KM if the stay is extended to three weeks, which is usually the maximum stay of such patients in the JIT. If we add 410 KM in just one act, the amount of consultation, we get a maximum loss of 5534 KM. If we multiply that loss by the probable annual incidence of ICV in cardiovascular patients, over the course of a year the total loss amounts to 238,280 KM, on an annual basis, only in the name of complications (Table 3).

In Table 4, which provides a summary overview of investment costs for the purchase of the latest Color Doppler ultrasound device. This in the five-year period amounts to 113,857.64 KM.

With the assumption that the discount factor of 4% is an adequate choice, as a technique for evaluating the profitability of the considered investment, we chose the method of calculating the Net Present Value of the investment (NPV). With the given and calculated parameters, the Net present value in Table 5 is 948,850 KM based on

the cash flows of the considered investment. The project acceptance criterion is that if the NPV is equal to or greater than zero, the project is acceptable. In general, a higher NPV indicates the investment is more desirable. We can see that our planned investment, according to the NPV parameter, is quite profitable and justified.

A complementary indicator that should make it easier to make an investment decision is the Internal Rate of Return (IRR). The usual acceptance criteria for IRR is to compare the IRR with the required rate of return, where the IRR must be higher than the required rate of return. Due to the specificity of the project itself, which does not have an imperative of profitability, it can be concluded from Tables 4 and 5 that it is a project with a high rate of profitability, which every subsequent calculation can confirm in exact terms. In the case studied, the IRR is an impressive 273%. This indicates that the project is absolutely acceptable according to these criteria.

Finally, as the last technique when making an investment decision, we calculate the value of the profitability index (PI), or the ratio of benefits and costs of the project. As for the acceptance criteria, it is accepted that the PI must be at least equal to 1. The higher its value is, the more profitable the project. In our case, the PI is 12.6, which is of course a very high value and in accordance with the previously calculated NPV and IRR values.

As each of the calculated indicators is taken into account individually, it is clear that the investment qualifies for acceptance based on each parameter. It is an extremely profitable investment, as the extremely high IRR and PI values suggest (17-27).

6. CONCLUSION

From the aspect of financial techniques for evaluating investment projects, the considered purchase of an ultrasound machine is an acceptable and extremely profitable project, which is fully in accordance with the studies available to us, and assumptions, or we can say that we defended the research hypothesis and confirmed that the purchase of the new vascular CDU device Affinity 30 is economically profitable and contributes to the reduction of treatment costs for cardiac surgery patients.

- **Author's contribution:** All authors were involved in all steps of preparation this article. Final proofreading was made by the first author.
- **Conflict of interest:** None declared.
- **Financial support and sponsorship:** Nil.

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