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Elective caesarean section cost efficiency with time-driven activity-based costing

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ABSTRACT

Hospitals compete to increase the value of services, one of which is cost-efficiency. The complexity of the service process and many resources in health services make calculating costs difficult. Time-driven activity based costing (TDABC) can identify specific cost drivers so that it has the potential to help identify inefficient processes. This study analyzes the cost efficiency of caesarean section with the TDABC. This study uses a qualitative research design with a case study method at one of the hospitals in Bantul, Yogyakarta, Indonesia. Primary data was taken from direct observation and interviewing hospital staff. Secondary data were obtained from hospital annual report 2019, hospital financial reports 2019, and patient medical records. The cost of a caesarean section was calculated and analyzed using the seven-step TDABC model with one-year hospital 2019 data. The cost of an elective caesarean section with the TDABC method is IDR 4,576,182.72. Hospitals can reduce postoperative costs by 25% by reducing the use of medicine and antibiotics. Based on the research results, TDABC can properly analyze costs based on services and identify inefficient processes.

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1. INTRODUCTION

The globalization of cesarean section has been observed in the last few decades, characterized by a high increase in the number of operations internationally [1]. Various factors have contributed to the increase in caesarean sections. Social influences, including rapid modernization, the influence of information in the news and social media, the experience or fear of painful normal delivery, and may also play a role in the increasing number of cesarean sections [2]. This procedure is relatively safe compared to the past because of advances in surgical techniques, anesthesia, and antibiotic therapy [3]. As a result, these advances also require more resources requiring greater costs.

In addition, previous studies have identified a relationship between the increasing prevalence of cesarean section and private sector hospitals [4]. Recently, calls for hospitals to be more transparent in prices have increased [5]. The hospital's efforts to prepare for price transparency have focused on developing a method to calculate specific pricing of individual health care and insurance claims, communicating these prices to patients, and making arrangements for a share of patients' costs [6]. The prospect is that services' value (price and quality) will become the basis for competition between hospitals [7]. When hospitals receive fixed bundled payments for each diagnosis, they are held accountable for the entire cycle of care [8]. In Indonesia, fixed bundle payments for social health insurance are handled by Social Security Administrator/*Badan Penyelenggara Jaminan Sosial* (BPJS). Value-based health care (VBHC) has been suggested as a solution for

addressing the current health care difficulties [9]. The value defines the health outcomes achieved per unit of money spent across the care delivery value chain (CDVC) [10]. Successful implementation of VBHC requires an assessment of actual healthcare costs using methods that evaluate how each patient consumes resources in the healthcare system [11]. Hospitals' ability to compare health outcomes and costs is expected to improve through value-based competition [12]. Less attention has been dedicated to developing a cost calculation method [13]. Unfortunately, Developing process-oriented cost-accounting systems in health care, such as activity-based costing (ABC), has proven difficult because significant resource investments are required, resulting in partial or incomplete implications [14]. In addition, because of the system's complexity, only a few hospitals can apply it [15].

The time-driven activity based costing (TDABC) method is more straightforward and requires fewer resources to implement than the ABC method. TDABC can be well integrated with available data from hospital management information systems. TDABC is better able to deal with the complexities of health care, estimate the cost of care delivery for specific conditions, and reduce costs to increase health care value. TDABC also enables the fast and low-cost method to implement [16]. Identification of specific cost drivers that have the potential to know inefficient processes is one of the essential components of TDABC. Based on this background, the purpose of this study is to analyze the cost efficiency of caesarean section operation with the TDABC method.

2. RESEARCH METHOD

2.1. Research design and objectives

This study used a qualitative research design with the case study method at Hospital X at Bantul, Yogyakarta. The research was conducted at Hospital X, a Referral Hospital in Bantul with a densely populated area. The cost of cesarean section surgery was calculated by the TDABC method using a seven-step model, which will be explained in detail [17]. This study aimed to perform the cost efficiency of caesarean section operation with the TDABC method.

2.2. Data collection

Primary data is data taken from direct observation and interviews with hospital staff. The researcher will observe ten patients with elective cesarean section directly; the activity time is determined using a stopwatch. We interviewed hospital staff, including obstetricians, paramedics, chief operating room supervision, and representatives from the board of directors. This primary data will be used to create a care delivery value chain and a map of the service process for the caesarean section and resource capacity for one year.

Secondary data was obtained from annual report data and hospital financial reports for 2019, workload indicator staffing need (WISN) data in 2019, clinical pathway, and patient medical records. This data calculates the total cost of resources, including staff costs, facilities and infrastructure, medicine, food, consumables, laboratories, and indirect costs. The cost of facilities and infrastructure includes the cost of space, medical equipment, non-medical equipment, electricity, water, and cleaning.

Facilities and infrastructure costs are usually charged indirectly, but the TDABC method can be charged directly. The cost of medicine, food, and consumables can be charged directly to the Caesarean section surgery process. Meanwhile, indirect costs are indirect costs that cannot be charged to the care process. These costs include administrative and office operational costs. This data will be used as the basis for calculating the cost of caesarean section.

2.3. Data analysis

The data that has been collected will be analyzed in three stages: data reduction, data presentation, then establish conclusions and verification. The data that has been collected will be selected and summarized to be tailor-made for the purpose of this study. After that, the data will be analyzed based on the TDABC method, based on seven steps from Kaplan *et al.* [17] as: i) the medical condition studied was the process of elective caesarean section surgery from the patient coming to the hospital until the patient went home; ii) identification of care delivery value chain (CDVC) caesarean section; iii) making a process map of the caesarean section surgery; iv) determine the estimated time for each activity in the caesarean section surgery based on a process map; v) determine the estimated total cost of resources used in the care of patients with caesarean section surgery service; vi) determine the estimated practical capacity for each resource and then calculate the capacity cost rate (CCR) based on the total cost and practical capacity; vii) determining the total cost of caesarean section surgery services, this total cost is the sum of the costs of caesarean section service activities and indirect costs.

After determining the unit cost of the caesarean section surgery service with the TDABC method, the researcher will analyze the capacity utilization to determine the waste of capacity. In addition, researchers will compare these costs with the rates set by X Hospital and the caesarean section surgery rates determined by INA-CBGs for class III BPJS patient.

3. RESULTS AND DISCUSSION

3.1. Overview of subject characteristics and clinical conditions

Based on hospital annual report data, most of the users of maternity services are 19-35 years old with work as housewives, BPJS members, second pregnancy, and gestational age 37-41 weeks. The following Table 1 is an overview of demographic characteristics and clinical conditions. There is a very significant difference in rates between payments with government insurance in Indonesia (BPJS) and the rates charged by hospitals. The rate per patient with BPJS is IDR 4,975,200.00, and the average hospital rate per patient is IDR 7,579,322.73. There is a difference in costs equal to IDR 2,604,122.73, a difference of 34% in the rates charged to patients.

Table 1. Demographic characteristics and clinical condition of patients

Subject characteristics		Insurance		Total
		BPJS (Government) (144)	Out of pocket (22)	
Age group (year)	<19	3	0	3
	19-35	111	15	126
	>35	30	7	37
Occupacy	Housewife	50	8	58
	Private sector	53	10	63
	Labor	24	3	27
	Civil servant	12	1	13
	Other	5	0	5
Gestational age group (weeks)	≤36	1	0	1
	37-41	110	15	125
	≥42	33	7	40
Number of gestation (Gravida)	First pregnancy (G1)	49	10	59
	Second pregnancy (G2)	58	9	67
	Pregnancy more than 2	37	3	40
Rates	Total (IDR)	IDR 716,428,800.00	IDR 166,745,100.00	IDR 883,173,900.00
	Per patient (IDR)	IDR 4,975,200.00	IDR 7,579,322.73	

3.2. Calculation of the cost of caesarean section surgery with TDABC

After determining the medical condition of the elective caesarean section, the next step is to create a care delivery value chain (CDVC). This CDVC can be divided into three steps that are preoperative, intraoperative, and postoperative. Making a care delivery value chain based on clinical pathways and interviews with obstetric specialists were then confirmed by direct observation. The following is a CDVC Figure 1.

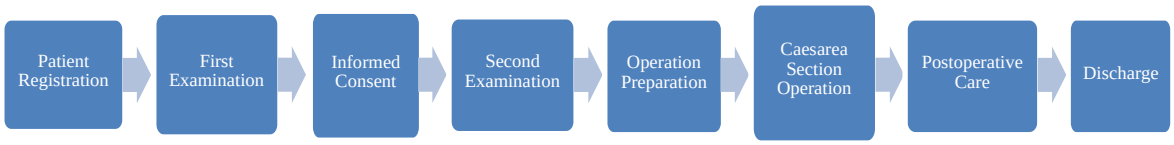

Figure 1. CDVC caesarean section

After making a CDVC, the third step is to create a process map. Hence, Figure 2 shows the caesarean section operation map process, divided into three processes: the preoperative process, the intraoperative process, and the postoperative process. The fourth step of TDABC is determining the time estimation for each activity. The most time spent for personnel is paramedic, for about 740 minutes. Table 2 estimates each activity's time based on the room and personnel used in the caesarean section process. The patient spent most of the time in the ward after undergoing a cesarean section, which was 4,320 minutes.

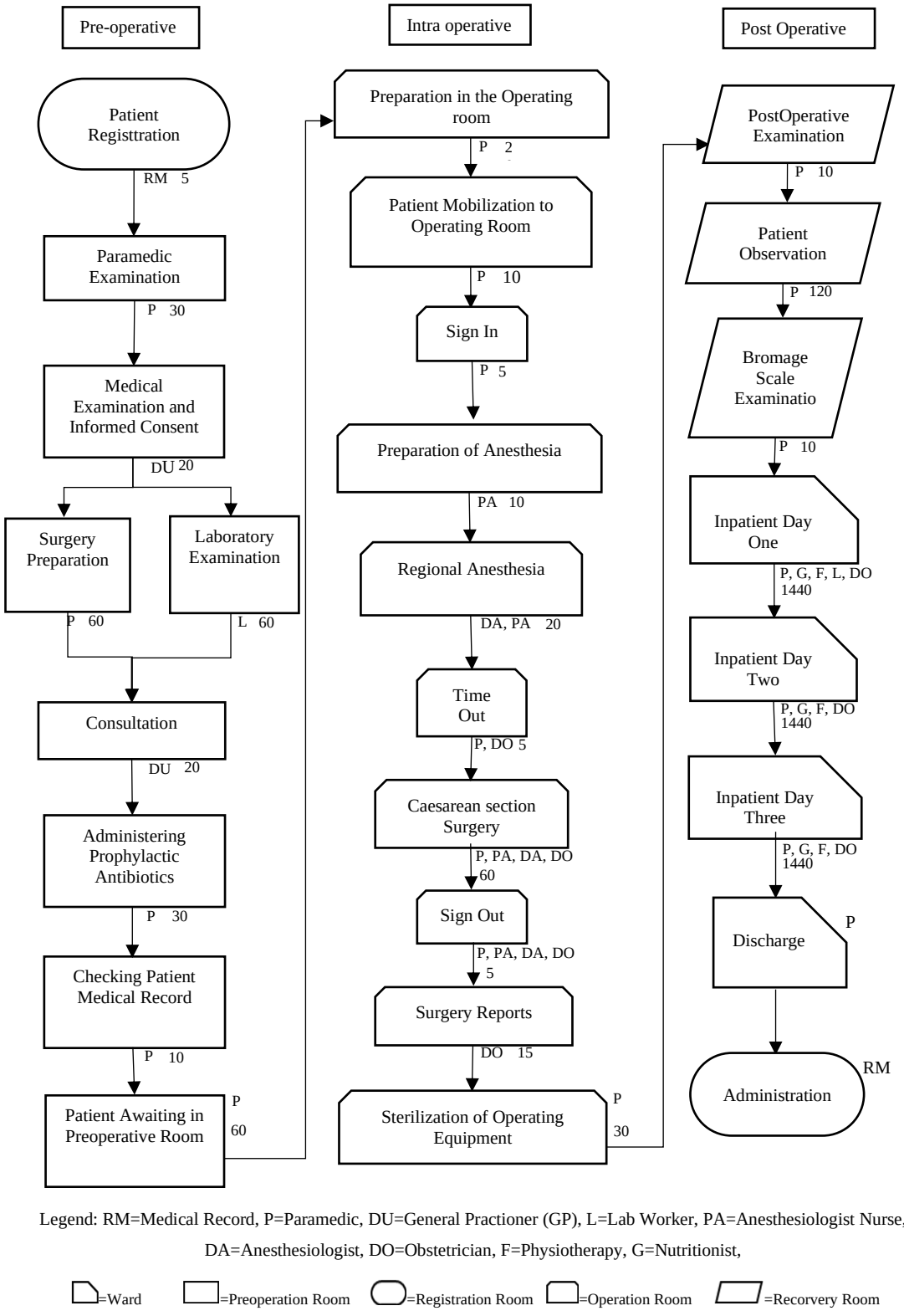

Figure 2. Caesarean section surgery process map

Table 2 estimates each activity's time based on the room and personnel used in the caesarean section process. The patient spent most of the time in the ward after undergoing a cesarean section, which was 4,320 minutes. After processing the data from the hospital's annual and financial reports, the capacity cost rate (CCR)

for staff was determined, as shown in Table 3. The total cost of staff for elective caesarean section services is IDR 2,478,132.96. The obstetrician is the highest cost source, amounting to IDR 1,331,220.88 or 54% of the total staff costs. At the same time, the intraoperative process is the largest source of costs, for IDR 1,812,119.37 or 73%, because the intraoperative process is the core process, and operating procedures require a lot of expertise and more staff is involved.

Table 2. Time estimation for each activity

Key (Room)	Activity time (Minute)				Personel	Activity time (Minute)			
	Preoperation	Intraoperative	Postoperation	Total (Minute)		Preoperation	Intraoperative	Postoperation	Total (Minute)
Registration	15			15	Medical record	15		15	30
Preoperation	290			290	Paramedic	220	210	310	740
Operation		165		165	General practioner	40			40
Recorvery			140	140	Lab worker	60		60	120
Ward			4,320	4,320	Anesthesiologist asistant		20		20
					Anesthesiologist		20		20
					Obstetrician		85	30	115
					Nutritionist			60	60
					Physiotherapy			60	60

The capacity cost rate (CCR) for infrastructure is the cost of space and equipment used in elective caesarean section surgery services in IDR per minute. Room costs include space depreciation, electricity, water, and cleaning costs. The total cost of infrastructure and equipment is IDR 604,232.61. The operating room has the highest CCR, IDR 1,075.07 per minute because the operating room is a technology-intensive room with expensive equipment.

However, the highest cost source is in the third-class wardroom, IDR 315,932.22 or 52% of the total cost of facilities and infrastructure because it has the longest time allocation of 4,320 minutes. The operating room is the second cost source, amounting to IDR 177,386.17 or 30%, with an allocated time of 165 minutes. Table 4 reveals the result of the CCR calculation for facilities and infrastructure.

Table 3. Cost and CCR personel

Personel	CCR (IDR/Min)	Preoperation		Intraoperative		Postoperation		Total cost
		Minute	Cost allocation	Minute	Cost allocation	Minute	Cost allocation	
Medical record	IDR 273.23	15	IDR 4,098.43	0	-	15	IDR 4,098.43	IDR 8,196.87
Paramedic	IDR 372.25	220	IDR 81,896.05	210	IDR 78,173.50	310	IDR 115,398.98	IDR 275,468.53
Lab worker	IDR 360.46	60	IDR 21,627.44	0	-	60	IDR 21,627.44	IDR 43,254.88
GP	IDR 744.39	40	IDR 29,775.71	0	-	0	-	IDR 29,775.71
Obstetricien	IDR 11.575.83	0	-	85	IDR 983,945.87	30	IDR 347,275.01	IDR 1,331,220.88
Physiotherapy	IDR 330.53	0	-	0	-	60	IDR 19,831.85	IDR 19,831.85
Nutrisionist	IDR 339.74	0	-	0	-	60	IDR 20,384.24	IDR 20,384.24
Anesthesiologist					IDR 500,000.00			IDR 500,000.00
Surgery nurse					IDR 125,000.00			IDR 125,000.00
Anesthesiologist nurse					IDR 125,000.00			IDR 125,000.00
Total cost			IDR 137,397.63		IDR 1,812,119.37		IDR 528,615.96	IDR 2,478,132.96

There are indirect costs that cannot be integrated with the caesarean section surgery process map, so in this study, the indirect costs were charged based on the number of hospital patients in 2019. The total indirect costs in 2019 were IDR 725,200,273.40, with 7554 patients. Indirect per patient amounting to IDR 96,002.15, which will be charged directly at the end of the calculation. The following is a detailed calculation of indirect costs that cannot be charged to the process map. Indirect cost allocation as shown in Table 5.

The total cost of consumables, drugs, and food is IDR 1,137,815.00, with details of the costs used in each process can be seen in Table 6. Only in the preoperative and postoperative process were laboratory tests

carried out. Preoperative laboratory examination is needed before surgery. While laboratory tests after surgery are needed to evaluate bleeding that occurs during surgery. The total cost of the laboratory is IDR 260,000.00.

Table 4. Cost and CCR infrastructure

Room	CCR	Preoperation		Intraoperative		Postoperation		Total cost
		Minute	Cost allocation	Minute	Cost allocation	Minute	Cost allocation	
Registration room	IDR 59,44	15	IDR 891,61	0	-	0	-	IDR 891.61
Preoperation room	IDR 219,99	290	IDR 63,795.76	0	-	0	-	IDR 63,795.76
Operation room	IDR 1,075.07	0	-	165	IDR 177,386.17	0	-	IDR 177,386.17
Recorvery room	IDR 330,19	0	-	0	-	140	IDR 46,226.84	IDR 46,226.84
Ward	IDR 73,13	0	-	0	-	4,320	IDR 315,932.23	IDR 315,932.23
Total			IDR 64,687.37		IDR 177,386.17		IDR 362,159.07	IDR 60,232.61

Table 5. Indirect cost allocation

Source of cost	Annual indirect cost per-category
Service operational cost	IDR 2,252,500.00
Office administration cost	IDR 90,685,099.00
Service administration cost	IDR 10,078,000.00
Office operational cost	IDR 28,236,732.00
Service support salary cost	IDR 593,947,942.40
Total indirect costs for 2019	IDR 725,200,273.40
Total number of patients in 2019	7,554 Patient
Indirect cost per patient	IDR 96,002.15

Table 6 describes the total cost is the sum of the total activity costs calculated based on the process map with the TDABC method and added to the indirect costs charged to all hospital patients in 2019. Based on the calculation, the total cost of elective caesarean section services is IDR 4,576,182.72.

Table 6. Total cost of caesarean section

Source	Preoperation	Intraoperastion	Postoperation	Total	Percentage
Personel	IDR 137,397.63	IDR 1,812,119.37	IDR 528,615.96	IDR 2,478,132.96	54%
Room	IDR 64,687.37	IDR 177,386.17	IDR 362,159.07	IDR 604,232.61	13%
Laboratory	IDR 238,000.00		IDR 22,000.00	IDR 260,000.00	6%
Medicine, Food, Consumable	IDR 108,091.00	IDR 546,037.00	IDR 483,687.00	IDR 1,137,815.00	25%
Indirect cost	IDR 96,002.15				2%
Unit cost elective caesarean section	IDR 644,178.16	IDR 2,535,542.54	IDR 1,396,462.02	IDR 4,576,182.72	100%
Percentage	14%	55%	31%	100%	

Based on the Hospital's Case Manager, the claim rate provided by BPJS National Health Insurance for elective caesarean section surgery patients is IDR 4,975,200.00. Meanwhile, based on administrative data at the hospital, the caesarean section operating rate is IDR 7,300,000.00.

3.3. Discussion

Based on the TDABC calculation, elective caesarean section cost is IDR 4,576,182.72. Personel is the largest cost burden of 54% of the total cost, IDR 2,478,132.96, followed by the cost of medicine, food, and consumables, which is IDR 1,137,815.00. Personnel costs contributed the most to the cost of surgical care [18]. This is different from the research conducted by Odhiambo *et al*. where the cost of drugs and medical consumables is the largest source of costs in the caesarean section [19]. This cost variability may be due to country differences [20].

Based on the average tariff per patient in the hospital, the caesarean section surgery with a class III rate is IDR 7,579,322.73. With a margin of 40% from the costs calculated using the TDABC method. Meanwhile, the BPJS claim rate obtained by the hospital is IDR. 4,975,200.00, with an 8% difference.

The intraoperative process is the process with the highest cost, which is IDR 2,535,542.54. According to Haqim *et al*. [21], the unit cost of an uncomplicated caesarean section operation procedure utilizing the Activity Based Costing method is IDR 2,703,919. The intraoperative process is the source of the highest cost because it involves many health workers, especially doctors, the high cost of infrastructure and equipment, and

the consumables cost are more expensive. TDABC may provide a more accurate cost estimate of the resources required to treat a patient [22]. This calculation method actively involves doctors, paramedics, administrative staff, and financial staff making process maps and estimating the cost of resources involved in taking care of the patient throughout the treatment cycle. This method connects the management and health personnel in a cost-cutting measure. TDABC may increase transparency and facilitate decision-making, leading to a better work organization and allocation of resources [23].

Cost analysis using time-driven activity based costing can show when and where health workers are not effective in providing services and show things that can be improved in health services [24]. A process in caesarean section operation at RS X can be eliminated, namely the administration of antibiotics and protein supplements after a cesarean section during postoperative care. Removing this process can reduce medical costs, consumables costs, and the times of paramedics providing care. According to research conducted by Purnamaningrum, 2014 at the Regional General Hospital Dr. Moewardi, The prophylactic antibiotic used in all patients was Ceftriaxone at a dose of 1 gram which was given once intravenously before surgery and proved to be effective [25]. In addition, according to research conducted by Marni, 2014 there was no difference in using ceftriaxone before surgery with ceftriaxone before and after caesarean section surgery [26].

Single-dose ceftriaxone is simpler, well-tolerated, cheaper, and safer (no overgrowth of pathogens). It is the antibiotic regimen of choice for prophylaxis at caesarean section compared to multiple doses of antibiotics [27]. Oral supplementation after surgery is not cost-effective. According to Smedley *et al.* supplementation after surgery has no impact on postoperative care, and supplementation should be carried out before surgery and is more cost-effective [28]. Based on this, antibiotics and supplementation can be stopped after surgery. This will reduce the time paramedics by 20 minutes, cost savings of IDR 122,647.64, or reduce postoperative costs by 25%. This analysis demonstrates how TDABC can be used to determine resources not needed and as a resource to discuss with clinicians for cost-saving. TDABC can help identify opportunities to reduce costs, increase clinical efficiency, and can help identify unused personnel capacity [29].

The TDABC method cannot take into account some indirect costs. The indirect costs are charged based on the number of patients in 2019. So, the cost of elective caesarean section services can be higher if there are fewer patients. TDABC determines the cost of space depreciation based on the square footage used in proportion to the cost of the building's square footage [30]. In this study, the operating room depreciation costs calculation is still based on the depreciation cost of the entire hospital building. Usually, the depreciation cost in the operating room is higher than the other room's depreciation costs. Research conducted by Koolmess *et al.* determined indirect costs based on a fixed ratio set by the Hospital [31]. In this study, the calculation for the cost of the anesthesiologist, operating room nurse, and anesthesiologist charges based on the cost of arrival every time there is an elective cesarean section because the staff has not become hospital jobholders and there are no working hours determined by the hospital.

Apart from these limitations, this study did not calculate the estimated resuscitation and newborn care cost. Meanwhile, BPJS does not cover the costs of newborns after elective caesarean section. However, there are costs for visiting pediatricians, resuscitation costs for newborn babies, costs of immunizing newborns, costs for newborn medicine, and costs for newborn care. Suppose the cost of the newborn is calculated and included in the cost of the surgery. In that case, the BPJS claim for elective caesarean section is not enough to cover the cost of elective caesarean section at the hospital.

4. CONCLUSION

The cost of elective caesarean section operation based on the Time-driven activity-based costing method was IDR 4,576,182.72, which has a positive margin for BPJS claims of 8% and hospital rates of 40%. In addition, hospitals can reduce postoperative costs by 25% by reducing the use of medicine and antibiotics. Based on the research results, TDABC can properly analyze costs based on process and identify inefficient processes. This research can support data for cost savings for medical personnel.

The results of this study also can be considered by the BPJS social health insurance to evaluate elective caesarean section claims given to hospitals. The cost of the elective caesarean section with the TDABC method can be lower because of the limitations of this study. The cost of the elective caesarean section can be higher if the hospital has fewer patients. This study calculates the operating room depreciation costs as the wardroom. Some staff cannot be calculated for their working hours because they do not have fixed working hours. This study only calculates the cost of the mother but does not calculate the cost of the newborn baby. Further research is needed to determine indirect costs that cannot be charged based on the service map process so that cost calculations can be more accurate.

REFERENCES

[1] T. Boerma *et al.*, "Global epidemiology of use of and disparities in caesarean sections," *The Lancet*, vol. 392, no. 10155, pp. 1341–1348, Oct. 2018, doi: 10.1016/S0140-6736(18)31928-7.

[2] I. Jayanti, "Evidence based in midwifery practice (in Indonesian: E*vidence Based Dalam Praktik Kebidanan*)," Yogyakarta, *Deepublish*. pp. 48–68, 2019.

[3] S. Dhakal-Rai, E. Van Teijlingen, P. R. Regmi, J. Wood, G. Dangal, and K. B. Dhakal, "A brief history and indications for cesarean section," *Journal of Patan Academy of Health Sciences*, vol. 8, no. 3, pp. 101–111, Dec. 2021, doi: 10.3126/jpahs.v8i3.27657.

[4] N. P. Shabila, "Rates and trends in cesarean sections between 2008 and 2012 in Iraq," *BMC Pregnancy and Childbirth*, vol. 17, no. 1, p. 22, Dec. 2017, doi: 10.1186/s12884-016-1211-6.

[5] A. B. Paul, R. Oklu, S. Saini, and A. M. Prabhakar, "How much is that head CT? Price transparency and variability in radiology," *Journal of the American College of Radiology*, vol. 12, no. 5, pp. 453–457, May 2015, doi: 10.1016/j.jacr.2014.12.016.

[6] N. Carroll and J. C. Lord, "The growing importance of cost accounting for hospitals," *Journal of Health Care Finance*, vol. 43, no. 2, pp. 171–185, 2016.

[7] R. E. Herzlinger, "Let's put consumers in charge of health care," in *Harvard Business Review*, 2002, vol. 80, no. 7, pp. 44–50.

[8] R. S. Kaplan and M. L. Witkowski, "Better accounting transforms health care delivery," *Accounting Horizons*, vol. 28, no. 2, pp. 365–383, Jun. 2014, doi: 10.2308/acch-50658.

[9] M. E. Porter and T. H. Lee, "The strategy that will fix health care," *Harvard Business Review*, vol. 91, no. 12, p. 24, 2013.

[10] R. J. V. Alves, A. P. B. da S. Etges, G. B. Neto, and C. A. Polanczyk, "Activity-based costing and time-driven activity-based costing for assessing the costs of cancer prevention, diagnosis, and treatment: A systematic review of the literature," *Value in Health Regional Issues*, vol. 17, pp. 142–147, Dec. 2018, doi: 10.1016/j.vhri.2018.06.001.

[11] S. W. Dutta *et al.*, "Time-driven activity-based cost comparison of prostate cancer brachytherapy and intensity-modulated radiation therapy," *Brachytherapy*, vol. 17, no. 3, pp. 556–563, May 2018, doi: 10.1016/j.brachy.2018.01.013.

[12] P. Nordin, A. A. Kork, and I. Koskela, "Value-based healthcare measurement as a context for organizational learning: Adding a strategic edge to assess health outcome?," *Leadership in Health Services*, vol. 30, no. 2, pp. 159–170, May 2017, doi: 10.1108/LHS-10-2016-0053.

[13] J. J. Fredriksson, D. Ebbevi, and C. Savage, "Pseudo-understanding: An analysis of the dilution of value in healthcare," *BMJ Quality and Safety*, vol. 24, no. 7, pp. 451–457, Jul. 2015, doi: 10.1136/bmjqs-2014-003803.

[14] G. Keel, C. Savage, M. Rafiq, and P. Mazzocato, "Time-driven activity-based costing in health care: A systematic review of the literature," *Health Policy*, vol. 121, no. 7, pp. 755–763, Jul. 2017, doi: 10.1016/j.healthpol.2017.04.013.

[15] L. Piersiala, "Cost accounting for management of health services in a Hospital," *Acta Universitatis Lodziensis. Folia Oeconomica*, vol. 3, no. 329, Sep. 2017, doi: 10.18778/0208-6018.329.14.

[16] R. S. Kaplan and S. R. Anderson, "Time-driven activity-based costing: a simpler and more powerful path to higher profits," in *Harvard Business School Press Books*, vol. 82, Harvard Business School Press, 2007, p. 266.

[17] R. E. Herzlinger, "How to solve the cost crisis in health care," *Harvard Business Review*, vol. 89, no. 11, pp. 46–52, 2011.

[18] N. S. Nagra *et al.*, "Time-driven activity-based costing in breast cancer care delivery," *Annals of Surgical Oncology*, vol. 29, no. 1, pp. 510–521, Jan. 2022, doi: 10.1245/s10434-021-10465-5.

[19] J. Odhiambo *et al.*, "Health facility cost of cesarean delivery at a rural district Hospital in Rwanda using time-driven activity-based costing," *Maternal and Child Health Journal*, vol. 23, no. 5, pp. 613–622, May 2019, doi: 10.1007/s10995-018-2674-z.

[20] H. T. Debas, P. Donkor, A. Gawande, D. T. Jamison, M. E. Kruk, and C. N. Mock, Eds., *Disease control priorities, third edition (volume 1): Essential surgery*. The World Bank, 2015.

[21] R. Maulana Haqim and F. Pribadi, "Unit cost analysis of sectio caesarea with activity-based costing in Yogyakarta city Hospital," *Jurnal Medicoeticolegal dan Manajemen Rumah Sakit*, vol. 8, no. 1, 2019, doi: 10.18196/jmmr.8183.

[22] D. L. McCreary, M. White, S. Vang, B. Plowman, and B. P. Cunningham, "Time-driven activity-based costing in fracture care: Is this a more accurate way to prepare for alternative payment models?," *Journal of Orthopaedic Trauma*, vol. 32, no. 7, pp. 344–348, Jul. 2018, doi: 10.1097/BOT.0000000000001185.

[23] C. Campanale, L. Cinquini, and A. Tenucci, "Time-driven activity-based costing to improve transparency and decision making in healthcare A case study," *Qualitative Research in Accounting and Management*, vol. 11, no. 2, pp. 165–186, Jun. 2014, doi: 10.1108/QRAM-04-2014-0036.

[24] B. J. Yun *et al.*, "Time-driven activity-based costing in emergency medicine," *Annals of Emergency Medicine*, vol. 67, no. 6, pp. 765–772, Jun. 2016, doi: 10.1016/j.annemergmed.2015.08.004.

[25] F. Purnamaningrum, "Efektivitas penggunaan antibiotik profilaksis pada pasien bedah sesar (Sectio Caesarea) di Rumah Sakit 'X' Tahun 2013," *Naskah Publikasi*. p. 13, 2014, [Online]. Available: http://eprints.ums.ac.id/30099/10/NASKAH_PUBLIKASI.pdf.

[26] H. Marni, D. Djanas, and H. Bachtiar, "Pengaruh pemberian antibiotik profilaksis sefazolin, seftriakson dan antibiotik seftriakson sebelum dan sesudah operasi terhadap infeksi luka pasca operasi," *Journal Obgin Emas*, vol. 4, no. 1, pp. 77–86, Jan. 2020, doi: 10.25077/aoj.4.1.77-86.2020.

[27] U. Mandach, R. Huch, A. Huch, and R. Malinverni, "Ceftriaxone (single dose) versus cefoxitin (multiple doses): Success and failure ofantibiotic prophylaxis in 1052 cesarean sections," *Journal of Perinatal Medicine*, vol. 21, no. 5, pp. 385–397, Jan. 1993, doi: 10.1515/jpme.1993.21.5.385.

[28] F. Smedley *et al.*, "Randomized clinical trial of the effects of preoperative and postoperative oral nutritional supplements on clinical course and cost of care," *British Journal of Surgery*, vol. 91, no. 8, pp. 983–990, Jul. 2004, doi: 10.1002/bjs.4578.

[29] K. Balakrishnan, B. Goico, and E. M. Arjmand, "Applying cost accounting to operating room staffing in otolaryngology: Time-driven activity-based costing and outpatient adenotonsillectomy," *Otolaryngology - Head and Neck Surgery (United States)*, vol. 152, no. 4, pp. 684–690, Apr. 2015, doi: 10.1177/0194599814568273.

[30] A. A. Laviana *et al.*, "Utilizing time-driven activity-based costing to understand the short- and long-term costs of treating localized, low-risk prostate cancer," *Cancer*, vol. 122, no. 3, pp. 447–455, Feb. 2016, doi: 10.1002/cncr.29743.

[31] D. Koolmees, P. N. Ramkumar, L. Hessburg, E. Guo, D. N. Bernstein, and E. C. Makhni, "Time-driven activity-based costing for anterior cruciate ligament reconstruction: A comparison to traditional zccounting methods," *Arthroscopy, Sports Medicine, and Rehabilitation*, vol. 3, no. 1, pp. e39–e45, Feb. 2021, doi: 10.1016/j.asmr.2020.08.006.

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