Jurnal Aisyah: Jurnal Ilmu Kesehatan

Volume 6, Issue 4, December 2021, p. 623–630
ISSN 2502-4825 (print), ISSN 2502-9495 (online)

Comparative Analysis of Consumption Methods and Minimum Maximum Stock Level (MMSL) in Improving the Efficiency and Effectiveness Inventory of Antibiotic Drugs at Aisyiyah Hospital Bojonegoro

Pramono Apriawan Wijayanto[1*)]; Ayun Sriatmi[2]; Sutopo Patria Jati[3]

Public Health, Faculty of Public Health, Universitas Diponegoro, Indonesia

ARTICLE INFO

Article history:

Received 11 June 2021
Accepted 21 October 2021
Published 10 December 2021

Keyword:

Inventory control
Drugs
MMSL
Stock out

A B S T R A C T

Antibiotic spending at the Aisyiyah Hospital Pharmacy Installation showed a value of IDR 6,045,618,320.00 in 2018 increased to IDR 5,043,476,179.00 in 2019, and there were still often vacancies and excess stock. This study aimed to compare the efficiency and effectiveness parameters of planning consumption methods with simulation results using Minimum-Maximum Stock Level (MMSL) method for antibiotic drug types. Study samples was 17 types of antibiotic drugs category A obtained from ABC analysis, the inclusion criteria of drugs with high cost, high volume, and clinically important drugs, and the exclusion criteria were drugs with unstable supply. The results showed that there were significant differences in inventory value, ITOR, death stock, and stock out when controlling drug supplies by applying MMSL method. The inventory value when applying MMSL method decreased to IDR 503,938.00 with a p value of 0.000 < 0.05, while the ITOR value increased to 32.40 with a p value = 0.030 < 0.05, the number of death stocks decreased to 97 items of antibiotics with a p value of 0.048 < 0.05, while the value of stock outs is empty or zero stock out with a value of p = 0.004 < 0.05. Aisyiyah Hospital, Bojonegoro, should carry out the process of antibiotic drugs planning by applying integrated Management Information System (MIS) so that the data on supplies use and stock is accurate.

Kata kunci:

Pengendalian persediaan
Obat
MMSL
Stock out

**) corresponding author*

Public Health, Faculty of Public Health, Universitas Diponegoro, Indonesia
Jl. Panglima Polim No. 57 Sumbang Village, District Bojonegoro, Regency Bojonegoro, Indonesia

Email: dr_pramono@ymail.com

DOI: 10.30604/jika.v6i4.812

A B S T R A K

Nilai belanja antibiotik di IFRS Aisyiyah Bojonegoro menunjukkan sebesar Rp. 6.045.618.320,00 (2018) meningkat menjadi sebesar Rp. 5.043.476.179,00 (2019), dan masih sering terjadi kekosongan stok dan stok yang berlebih. Penelitian ini bertujuan membandingkan parameter efisiensi dan efektivitas perencanaan metode konsumsi dengan hasil simulasi menggunakan metode *Minimum-Maximum Stock Level* (MMSL) untuk jenis obat antibiotika. Sampel penelitian adalah 17 jenis obat antibiotika kategori A hasil analisa ABC, dengan kriteria inklusi adalah obat *high cost, high volume, clinically important drug*, serta kriteria eksklusi adalah obat dengan pasokan yang tidak stabil. Hasil penelitian menunjukkan terdapat perbedaan yang signifikan pada nilai persediaan, ITOR, *death stock*, dan stock out saat pengendalian persediaan obat dengan menerapkan metode kosumsi dengan metode MMSL. Nilai persediaan saat menerapkan metode metode MMSL menurun sebesar Rp. 503.938,00 dengan nilai p = 0,000 < 0,05, nilai ITOR meningkat mencapai 32,40 dengan nilai p = 0,030 < 0,05, jumlah *death stock* mengalami penurunan menjadi 97 item antibiotik dengan nilai p = 0,048 < 0,05, serta nilai *stock out* adalah kosong atau nol *stock out* dengan nilai p = 0,004 < 0,05. Rumah Sakit Aisyiyah Bojonegoro perlu melaksanakan proses perencanaan antibiotik melalui Sistem Informasi Manajemen (SIM) yang terintegrasi agar data pemakaian dan stok persediaan akurat.

INTRODUCTION

Minister of Health Regulation Number 72 of 2016 concerning Pharmaceutical Service Standards in Hospitals states that pharmacy installations as the only providers of pharmaceutical services in hospitals must ensure the availability of qualified, useful, and affordable pharmaceutical preparations, medical devices, and medical consumables by applying one door system management policy (Hospital Pharmacy Service Standar No. 58, 2014). The purpose of hospital pharmacy services related to drug procurement planning is to improve the quality and efficiency of services by considering the right patient, right dose, right method of use, right combination, right time, and right price (Kementerian Kesehatan Republik Indonesia, 2020).

The hospital must strive to ensure the availability of drugs in the long term, maintain the safety and effectiveness of the use of drugs for the smooth operation of the hospital pharmacy services. Therefore, the hospital requires a careful and responsible management that is recorded in the hospital's logistics management. Logistics management is an integrated system that coordinates the entire process in an organization or company in preparing and delivering products or services to consumers (Heizer & Render, 2014). Logistic management functions to plan, implement and control the efficiency and effectiveness of the flow of goods, storage of goods, services and information related with the point of origin to the point of consumption in order to meet the needs of the consumers (Seto et al., 2012).

Drug planning is an effort to determine the type, quantity, and quality of drugs according to needs. The success of planning the number of drug requirements can be achieved by involving a team and a combination of various methods (Quick, 1997). In drug management, the planning and procurement process greatly affects the availability of drugs and the hospital's economy. The guarantee of items and sufficient quantity of drugs is one of the most important aspects of a hospital to be able to provide the best service (Mahdiyani et al., 2018).

Data on the value of antibiotic spending at Aisyiyah Hospital Bojonegoro showed that the percentage of antibiotic spending from the total spending on pharmaceutical supplies was 28.25% (2018) and 20.08% (2019). The method that has been used in the management of drug supply at the Pharmacy Installation of Aisyiyah Bojonegoro Hospital is consumption method. This method applies the addition of 25% of the average use of antibiotics in the previous 1 month. However, this method is not sufficient to increase the efficiency of drug supply at the Pharmacy Installation of Aisyiyah Hospital, Bojonegoro, Indonesia. Problems that often occur in inventory planning are the excess drug inventory (stagnant or death stock) and the shortage of drug supply (stockout). Drugs are said to be stagnant if the remaining drugs at the end of the month are more than three times the average use per month (Mellen & Pudjirahardjo, 2013).

The consumption method is one of the standard methods used for planning the amount of drug needs. This method provides a good prediction of accuracy for planning drug needs, but only predicts how many drug needs will be planned without knowing when to re-order the drugs. During the COVID-19 pandemic, Aisyiyah Bojonegoro Hospital has attempted to achieve budget efficiency and reduce the value of antibiotic drugs supply without reducing the quality of its health services to the patients (Hartih Aeni et al., 2013).

For this reason, the Minimum Maximum Stock Level (MMSL) or minimum stock (Smin) and maximum stock (Smax) methods can be applied by the pharmacy installation to control the occurrence of drug stock out (Indarti et al., 2019). Minimum Maximum Stock Level (MMSL) is the simplest method of controlling drug inventory that can be applied in a hospital pharmacy installation (Health, 2012). To anticipate the tendency of hospitals to carry out excessive procurement patterns, while on the other hand it can also identify the minimum stock amount to avoid stock outs, the calculation of the maximum and minimum stock values using MMSL (Minimum-Maximum Stock Level) method needs to be applied by considering the safety stock so that the re-order point for each item of pharmaceutical supplies can be determined (Ma'wa et al., 2018).

The goal of efficient management of pharmaceutical supplies is to minimize the inventory value while considering the availability according to need. Efficiency indicators are the accuracy of planning of one type of drug within the planning of a number of items including the type of the drug itself in actual use; the drug adequacy, which is the number of months representing anticipated length of drug stock availability; and the death stock, the drug stock unused for three months or longer.

The efficiency of drug supply is also measured by ITOR (Inventory Turn Over Ratio), that is the turnover of the capital in one year. The drug ITOR value is the result of the calculation of the cost of goods sold divided by the average value of drug inventory. The higher the ITOR value, the more efficient the inventory management. The indicator of effectiveness is the emptiness of the stock, in which the final stock amount is 0 (zero) or stock out (Indarti et al., 2019). The management of Aisyiyah Hospital has a target to achieve this value of 0 in death stock and stock out for antibiotic drug control in 2021. For this reason, this study was conducted to determine the comparison of the application of consumption methods and MMSL related to the efficiency and effectiveness of inventory control at the Pharmacy Installation, Aisyiyah Hospital, Bojonegoro, Indonesia.

METHOD

This study was an analytic observational study to measure the increase in efficiency and effectiveness of drug supply management by observation in time sequences. The research data were retrospective, comprising logistic management data for antibiotics for one period. The secondary data were processed based on the results of observations and data analysis on the supply of category A antibiotics at the Pharmacy Installation of Aisyiyah Hospital, Bojonegoro, Indonesia. A qualitative approach was used as an analysis of the simulation of the implementation of consumption method and MMSL by comparing the value of inventory, ITOR, death stock, and stock out, as well as the aftermath of the impact.

Sample was determined by purposive sampling, involving 17 types of antibiotic drugs category A from the results of ABC analysis, with inclusion criteria being high cost, high volume, and clinically important antibiotic drugs

included within the Hospital Formulary in 2020, while the exclusion criteria were drugs with unstable supply (supply focus) as seen from the data on drug procurement at the Pharmacy Installation of Aisyiyah Bojonegoro Hospital in the period from January to December 2020.

Data processing technique to test the hypothesis that aimed to identify differences in the dependent variable that resulted from the independent variable was performed by Mann-Whitney test with a significance level of 0.05 (Sugiyono, 2017). The Mann-Whitney test was used to analyze differences in continuous-scale variables, such as inventory value, ITOR, death stock and stock out, which in this study were used as indicators for measuring the efficiency and effectiveness of antibiotic drug management.

RESULT AND DISCUSSION

Table 1
ABC Analysis Results in January – December 2020 Period for Determining Research Sampling

Categories	Antibiotics		Percentage of Total	Investment Value (IDR)	Investment Cumulative Percentage
	Types	Total usage			
A	Cefxon Inj 1gr	5,930	0.13%	1,643,426,475	19.68%
	Terfacef Inj 1g/ 28	3,391	0.20%	921,094,980	30.72%
	Cefila Cap 100mg/30	29,561	0.85%	758,669,309	39.80%
	Cefim Inj 1gr	2,753	0.91%	568,639,060	46.61%
	Fourcef Inj 1gr	1,051	0.93%	402,322,800	51.43%
	Broadced Inj 1gr	1,412	0.96%	363,448,800	55.79%
	Cefobactam Inj	1,256	0.99%	327,172,230	59.70%
	Cefspan Cap 100 Mg/30	9,181	1.19%	266,021,141	62.89%
	Baquinor Inf 100 Ml	694	1.20%	207,974,268	65.38%
	Cravox Inf 500mg	590	1.22%	203,132,754	67.81%
	Cravox Tab 500mg/10	48,555	2.27%	161,426,567	69.75%
	Starxon Inj 1gr	296,340	8.72%	144,317,580	71.48%
	Sporetik 100 Mg/30	25,450	9.28%	140,049,301	73.15%
	Simextam 1gr Inj	231,199	14.31%	138,560,400	74.81%
	Cefila Ds 30ml	109,560	16.70%	127,400,402	76.34%
	Pelastin Inj.	433,727	26.14%	127,053,432	77.86%
	Sporetik 200mg/10	36,861	26.94%	126,444,197	79.38%
B	Ceforim Inj	405,671	35.77%	125,736,996	80.88%
	Ce Fepime Inj 1gr	49,506	36.85%	121,039,955	82.33%
	Cinam Inj	183,876	40.85%	116,393,508	83.73%
	Meropenem Inj 1g	92,400	42.86%	106,136,960	85.00%
	Ceptik 100mg Cap/30	30,558	43.53%	104,803,886	86.25%
	Zidifec I Gr Inj.	337,404	50.87%	83,313,473	87.25%
	Baquinor F. Capl. /20	17,529	51.26%	79,372,733	88.20%
	Tricho Dazole Inf	114,972	53.76%	78,870,792	89.14%
	Taxegram Inj 1g/ 27	183,744	57.76%	78,826,176	90.09%
	Lefos 500mg Tab/10	388,996	66.23%	77,250,037	91.01%
	Levocin Inf	68,400	67.72%	71,966,268	91.88%
	Cipro Infus Iv	68,400	69.20%	69,539,820	92.71%
	Amikacin Inj 500mg	174,240	73.00%	67,430,880	93.52%
	Taxegram Inj 0.5g/ 27	93,645	75.04%	52,700,208	94.15%
	Cefat 500 Mg/100	13,081	75.32%	51,695,811	94.77%
	Ceftriaxone Inj 1g	10,310	75.55%	50,237,556	95.37%
C	Cefixime 100 Mg	5,930	75.61%	50,220,938	95.97%
	Bactesyn Inj.1.5gr	3,391	80.54%	44,144,100	96.50%
	Glybotic 500 Inj./4	29,561	85.32%	43,296,660	97.02%
	Amoxsan 500mg Kaps /100	2,753	85.41%	42,065,214	97.52%
	Levo Floxacin Inf 500mg	1,051	87.61%	41,959,512	98.02%
	Fosmidex Inj 2gr/10	1,412	92.64%	36,806,246	98.46%
	Claneksi Inj/6	1,256	95.26%	33,404,900	98.87%
	Viccilin-Sx Inj	9,181	97.62%	32,147,280	99.25%
	Claneksi F Syr	694	99.60%	31,934,341	99.63%
	Metro Inf 500mg	590	100.00%	30,680,253	100.00%
	Total	**4,593,597**		**8,349,128,199**	

Results of Analysis with ABC Method (Always, Better, Control)

Prior to the application of the Minimum-Maximum Stock Level (MMSL) method, an ABC analysis or Pareto analysis was carried out on data on the use of antibiotic drugs during January – December 2020 to obtain drugs in category A according to the inclusion criteria and the stability of drug supply during 2020 that met the exclusion criteria. Data on drugs grouping at Aisyiyah Hospital Bojonegoro with ABC analysis showed that of 1442 items of drugs and medical devices managed by the Pharmacy Installation of Aisyiyah Hospital, 43 types of antibiotic drugs were included in groups A, B, and C. The results of the ABC analysis were based on usage values and the investment value is shown in Table 1. The research sample consisted of 17 types of antibiotic drugs category A (high cost, high volume) with a cumulative value of usage between 0 – 80% and included in the national formulary in 2020 (clinically important drugs), and the supply was stable in the period of January – December 2020. Stable supply means that there is a similarity between the number of orders and the number of receipts or deliveries from suppliers or distributors (Indarti et al., 2019).

Based on ABC analysis in 2020, category A antibiotics were 17 items from the total antibiotic items in the Pharmacy Installation with a usage value of 1,237,511 (26.94%) of the total use of antibiotics during the year 2020. Category B antibiotics amounted to 16 items from the total items with a usage value of 2,232,732 (48.61%) of the total use of antibiotics in 2020, while category C antibiotics were 10 items of the total antibiotic items with a usage value of 1,123,354 (24.45%) of the total usage antibiotics by the whole year 2020 (Table 2).

Table 2
Results of Classification of Antibiotics with ABC Analysis based on Usage Value

Categories	Items	% Items	Usage Value	% Usage
A	17	39.53%	1,237,511	26.94%
B	16	37.21%	2,232,732	48.61%
C	10	23.26%	1,123,354	24.45%
Total	**43**	**100.00%**	4,593,597	**100%**

Source: Aisyiyah Hospital Pharmacy Installation Logistics Data, 2020

ABC analysis in 2020 also showed that category A antibiotics are 17 items (39.53%) of the total antibiotic items in the Pharmacy Installation with a usage value of IDR 6,627.153,696.00 (79.38%) of the total use value of antibiotics. Category B antibiotics amounted to 16 items (37.21%) of the total antibiotic items with a usage value of IDR 1.335.315.059.00 (15.99%) of the total antibiotic use value, while category C antibiotics amounted to 10 items (23,26%) of the total antibiotic items with a usage value of IDR 386,659,444.00 (5,20%) of the total antibiotic usage value (Table 2). The results of the ABC analysis based on the investment value of antibiotics are presented in Table 3.

Table 3. Results of Classification of Antibiotics with ABC Analysis based on Investment Value

Categories	Items	% Items	Investment Value (Rp)	% Investment
A	17	39.53%	6,627,153,696	79.38%
B	16	37.21%	1,335,315,059	15.99%
C	10	23.26%	386,659,444	4.63%
Total	**43**	**100.00%**	8,349,128,199	**100.00%**

Source: Aisyiyah Hospital Pharmacy Installation Logistics Data, 2020

Results of Analysis of Consumption Method and MMSL Method on Inventory Value, Inventory Turn Over Ratio, Death Stock, and Stock Out

The indicators used in this study were inventory value, ITOR, death stock, and stock out to measure the efficiency and effectiveness comparison between the application of consumption method and MMSL (Minimum-Maximum Stock Level) method. This study focused on group A antibiotics in the application of these two inventory control methods.

Inventory Value

The inventory value was obtained from the calculation of the final stock of drugs multiplied by the price of each drug item. The comparison of the inventory value of each method was based on the calculation of the average inventory value.

Table 4. Results of Comparative Analysis of Inventory Value

Inventory Value	N	Averge Inventory Value (IDR)	Mean Rank	Asymp. Sig (P)
Consumption Method	17	13,460,159	24.91	0.000
MMSL Method	17	503,938	10.09	

Source: Analysis by Mann Whitney Test, 2021

The average inventory value when applying consumption method was IDR 13,460,159.00, while MMSL method was IDR 503.938.00 (Table 4). Inventory value also decreased with the difference in inventory value between consumption

method and MMSL method amounting to IDR 220,255,758.00. Empirically this figure showed that consumption method and MMSL had significant difference in their application. Statistical test using Mann Whitney Test with Asymp value. Sig (P) = 0.000, p <0.05, indicating a significant difference between consumption method and MMSL method in the inventory value at the Pharmacy Installation of Aisyiyah Hospital, Bojonegoro.

Inventory Turn Over Ratio (ITOR)

ITOR is one of the important parameters in measuring the efficiency of antibiotic inventory control. ITOR shows the inventory turnover ratio between sale and procurement of a particular antibiotic inventory.

Table 5. Results of ITOR Comparative Analysis

Comparative Analysis	N	Average ITOR Values	Mean Rank	Asymp. Sig (P)
Consumption Method	17	15,02	13.79	0.030
MMSL Method	17	32,40	21.21	

Source: Analysis by Mann Whitney Test, 2021

The average ITOR in the application of consumption method was 15.02, while in the application of MMSL method the average ITOR increased to 32.40 (Table 5). The ITOR value when using MMSL method in general had increased compared to the application of consumption method. Whereas, the statistical Mann Whitney Test with the Asymp value. Sig (P) = 0.030, p <0.05 indicated a significant difference between the application of consumption method and MMSL method in ITOR value at the Pharmacy Installation of Aisyiyah Hospital, Bojonegoro.

Death Stock

Death stock indicates the stock of antibiotic drugs at the Pharmacy Installation that has not been used for three months or more, resulting in drugs stockpiling and even expiry.

Table 6. Result of Death Stock Comparative Analysis

Inventory Value	Items	Value (Rp)	Ratio	Mean Rank	Asymp. Sig (P)
Consumption Method	430	115.321.292	5.73	19.88	0.048
MMSL Method	97	42.071.519	1.66	15.12	

Source: Analysis by Mann Whitney Test, 2021

Table 6 shows that the death stock ratio of consumption method is higher than MMSL method. The total value of death stock when applying consumption method was IDR 115,321,292.00 with a total death stock of 430 items of antibiotics. The total value of death stock when applying MMSL method decreased by IDR 42,071,519.00 with a total death stock of 97 items of antibiotics. Statistical Mann Whitney Test with Asymp value. Sig (P) = 0.048, p <0.05 indicated a significant difference between the application of consumption method and MMSL method on the death stock value at the Pharmacy Installation of Aisyiyah Hospital, Bojonegoro.

Stock Out

Stock out is a condition where the amount of stock of antibiotic drugs at the Pharmacy Installation is empty or the stock is 0 (zero).

Table 7. Results of Stock Out Comparative Analysis

Inventory Value	Items	Value (IDR)	Occurrence	Mean Rank	*Asymp. Sig* (P)
Consumption Method	1,274	242,894,573	7 tmes	21	0.004
MMSL Method	-	-	-	14	

Source: Analysis by Mann Whitney Test, 2021

Table 7 shows that the occurrence of stock outs using consumption method for one year occurred 7 times, much higher than MMSL method which did not experience any stock out events. The total value of stock out when applying consumption method was IDR 242,894,573.00 with a total stock out of 1,274 items of antibiotics, while the value of stock out when applying MMSL method was empty or zero stock out. Empirically this finding was adequate to describe that there was a difference in the value of stock out between the application of consumption method and MMSL method. Similarly, the Mann Whitney Test statistical test with Asymp value. Sig (P) = 0.004, p < 0.05, indicated a significant difference between the application of consumption method and MMSL method on the stock out value at the Pharmacy Installation of Aisyiyah Hospital, Bojonegoro.

DISCUSSION

The application of ABC analysis presented in Table 1 in drug management aimed to identify antibiotics according to usage value and investment value, so that hospital management can concentrate on antibiotics which are few in number but have great investment opportunities. Without ABC analysis, antibiotic management may be ineffective because the hospital management may administer all

antibiotics with the same priority. Classifying antibiotics categorically into A, B, and C shows that the pharmaceutical installation has been able to control group A antibiotics, meaning that the hospital management is able to control about 80% to 95% of the usage value and investment value of antibiotics in the hospital as a whole (Doso et al., 2020). With this classification, the management method of each type of antibiotic will facilitate the preparation of forecasting and stock control, and the reliability of suppliers will also be better (Ma'wa et al., 2018). If the pharmacy installation is able to control the supply of antibiotics effectively and efficiently, it also means that the management of Aisyiyah Hospital is able to control the usage value of 26.94% (Table 2) and the investment value of 79.38% (Table 3) of the total the total supply of antibiotics.

Table 4 shows that the average inventory value using MMSL method is less than that using consumption method. Thus, it appears that the calculation of antibiotic drug control using MMSL method was lower or more economical. This was in accordance with research conducted by Indarti, et al (2019) which showed that MMSL method at Dr. Sardjito Yogyakarta had an impact in the form of a decrease in the stock value at the end of the year. The stock became smaller than using consumption method. (Indarti et al., 2019) Adjusting the number of purchases of antibiotics in accordance with the maximum stock becomes an important factor in the results of the inventory value at the end of the year. The difference in inventory value between consumption method and MMSL method showed the efficiency of budget costs in ordering category A antibiotics at the Pharmacy Installation of Aisyiyah Hospital, Bojonegoro.

Table 5 reveals that the comparison of ITOR with consumption method and ITOR with MMSL method shows an increase. The inventory turnover ratio at the Aisyiyah Hospital Pharmacy Installation with consumption method was 15.02 and MMSL method was 32.40. The inventory turnover rate at Aisyiyah Hospital was quite high because this hospital carried out weekly orders, not monthly like government hospitals in general which tend to have scheduled orders. The higher ITOR level with MMSL method shows that the available supply of antibiotic drugs was more accurate, both in quantity and in items (Hartih Aeni et al., 2013). On the other hand, a lower ITOR value means that there are unsold stock which results in impeding cash flow so that it affects the calculation of profits. (Indarti et al., 2019)

The comparative test of ITOR value with Mann Whitney between consumption method and MMSL method showed significant results, so that inventory control using MMSL method proved efficient in increasing the ITOR value (Table 5). This was in accordance with Pudjaningsih's (2006) statement that ITOR was the main indicator to measure the efficiency of inventory control that had been carried out (Hartih Aeni et al., 2013). The procurement period determined by the Head of the Pharmacy Installation of Aisyiyah Hospital is a scheduled purchase with an time allocation of every week or for 7 days. This scheduled order prevents overbooking, the funds provided are also not too large, and the estimated drug use plan also becomes more precise (Indarti et al., 2019). The application of the MMSL method showed that the average value of the need for antibiotics had decreased compared to the consumption method. If the value of antibiotic needs decreases while the turnover of the antibiotics increases, automatically the amount of funds that will be spent by the hospital management becomes more economical and efficient.

Febriani's research (2016) shows that the value of death stock and stock out of antibiotic drugs need to be a concern, because drug procurement that occurs outside of the predetermined needs planning, since it does not have a definite minimum and maximum limit, may result in drugs death stock and stock out (Febreani & Chalidyanto, 2016). The results of the death stock study in Table 6 show a significant difference between consumption method and MMSL method. The types of category A antibiotics that experienced death stock using the consumption method included Broadced, Cefspan, Simextam, Cravox Inf, Cefobactam, and Baquinor Inf with a total death stock of 430 items. After applying MMSL method, the type of antibiotics category A whose death stock decreased was only one type, the Cefila Ds, as many as 97 items. The lower death stock by the application of MMSL method indicated that the logistics management system had been implemented properly so as to minimize losses due to the accumulation of antibiotic drugs in the Pharmacy Installation. (Ma'wa et al., 2018)

Safety stock is highly necessary because it is an additional inventory held to protect from or to anticipate the possibility of stock out (Mendrofa & Suryawati, 2016). In the management of antibiotic supplies, out-of-stock conditions must be avoided because they can result in high costs, both external costs and internal costs. External costs include dissatisfied customers, which can result in decreased sales. Internal costs, for example, workers who are less employed, while their salaries must still be paid. Out of stock may occur due to the increase in the use of supplies or delays in the arrival of supplies or both at once. With safety stock, it is hoped that there will be no stock outs.

Types of category A antibiotics that experienced stock out with the application of consumption method included Cefxon, Cefila Caps, Fourcef, Broadced, Cefspan, Cravox Inf, and Pelastin Inf. Whereas, the MMSL inventory control method was able to create stock out events to be empty (zero). This was in accordance with the management target of Aisyiyah Hospital in terms of controlling its pharmaceutical inventory. In controlling the supply of antibiotics, stock outs can have an impact on service disruptions, while over stocks can cause inventory costs to increase. The comparative analysis of the stock out value in Table 7 shows the difference in stock out value between consumption method and MMSL method, which shows the effectiveness of controlling the inventory of category A antibiotics at the Pharmacy Installation of Aisyiyah Hospital, Bojonegoro.

LIMITATION OF THE STUDY

The limitation of this research is that there are several other factors such as nurses' external stressors which were not examined in this study.

CONCLUSION AND SUGGESTION

The application of the Minimum-Maximum Stock Level (MMSL) method has a positive impact on the efficiency of the supply of category A antibiotics. There is a decrease in inventory value, an increase in the value of Inventory Turn Over Ratio (ITOR), and a decrease in the value of death stock. In addition, the application of MMSL method also has a positive impact on the effectiveness of category A antibiotic drug supplies by reducing the occurrence of stock outs. Thus,

the application of the MMSL method is more effective and efficient in controlling drug inventory at IFRS Aisyiyah Bojonegoro compared to the consumption method.

Aisyiyah Bojonegoro Hospital needs to carry out the process of planning and procuring antibiotic drugs with an integrated Management Information System (SIM) so that the usage data and inventory stock data is accurate by considering the minimum and maximum stock quantities, lead time, and safety stock. Management of drug procurement through SIM can also avoid stock outs of antibiotics so as to improve hospital services to their patients. The procurement process at the Aisyiyah Hospital Bojonegoro Pharmacy Installation can be carried out in stages according to the inventory level at the re-order point so that the inventory received does not accumulate and the optimal amount of inventory can be obtained.

Acknowledgment

The author expresses gratitude to Aisyiyah Hospital Bojonegoro which has given permission to the author in completing this paper as a prerequisite for graduation from the Master of Public Health study program, Faculty of Public Health, Diponegoro University, Semarang, Indonesia.

Funding Statement

The authors did not receive support from any organization for the submitted work and No funding was received to assist with the preparation of this manuscript.

Conflict of Interest statement

The author declares that there is no potential conflict of interest in relation to the authorship and publication of this article.

REFERENCES

Doso, T., Sunarni, T., & Herdwiani, W. (2020). Analisa Pengendalian Persediaan dengan Metode EOQ, JIT dan MMSL di Instalasi Farmasi Rumah Sakit XXX Kota Mojokerto. *Journal of Pharmasi Science and Practice*, *Vol. 7 No.*, 81–85.

Febreani, H., & Chalidyanto, D. (2016). Pengelolaan Sediaan Obat pada Logistik Farmasi Rumah Sakit Umum Tipe B di Jawa Timur. *Jurnal Administrasi Kesehatan Indonesia*, *4*(2), 136–145.

Hartih Aeni, N., Satibi, & Pamudji Widodo, G. (2013). Penerapam Metode Economic Order Quantity Dan Reorder Point Dalam Meningkatkan Efisiensi Persediaan Obat. *Jurnal Manajemen Dan Pelayanan Farmasi*.

Health, M. S. for. (2012). Revolving drug funds and user fees. *Managing Access to Medicines and Health Technologies*.

Heizer, J., & Render, B. (2014). Operations Management Sustainability and Supply Chain Management 11th edition. In *Pearson Education, Inc,*.

Indarti, T. R., Satibi, S., & Yuniarti, E. (2019). Pengendalian Persediaan Obat dengan Minimum-Maximum Stock Level di Instalasi Farmasi RSUP Dr. Sardjito Yogyakarta. *JURNAL MANAJEMEN DAN PELAYANAN FARMASI (Journal of Management and Pharmacy Practice)*. https://doi.org/10.22146/jmpf.45295

Kementerian Kesehatan Republik Indonesia. (2020). *DIREKTORAT JENDERAL KEFARMASIAN DAN ALAT KESEHATAN*. 2020 Direktorat Jenderal Kefarmasian Dan Alat Kesehatan - Kementerian Kesehatan Republik Indonesia.

Ma'wa, J., Rivai, F., & Masni. (2018). Sistem Pengendalian Persediaan Obat Menggunakan Kombinasi Metode Analisis ABC, Minimum Maximum Stock Level (MMSL) dan Reorder Point (ROP) di Rumah Sakit Universitas Hasanuddin. *Jurnal Manajemen Administrasi Rumah Sakit*, 29–37.

Mahdiyani, U., Wiedyaningsih, C., & Endarti, D. (2018). Evaluasi Pengelolaan Obat Tahap Perencanaan dan Pengadaan di RSUD Muntilan Kabupaten Magelang Tahun 2015 – 2016 Drug Management Evaluation Focusing oOn Procurement at Muntilan District Hospital. *Jurnal Manajemen Dan Palayanan Farmasi*.

Mellen, R. C., & Pudjirahardjo, W. J. (2013). FAKTOR PENYEBAB DAN KERUGIAN AKIBAT STOCKOUT DAN STAGNANT OBAT DI UNIT LOGISTIK RSU HAJI SURABAYA. *Jurnal Administrasi Kesehatan Indonesia Volume 1 Nomor 1 Januari – Maret 2013*.

Mendrofa, D. E., & Suryawati, C. (2016). Analisis Pengelolaan Obat Pasien BPJS Di Instalasi Farmasi Rumah Sakit Panti Wilasa Citarum Semarang. *Jurnal Manajemen Kesehatan Indonesia*. https://doi.org/10.14710/jmki.4.3.2016.214-221

No.58, P. (2014). STANDAR PELAYANAN KEFARMASIAN DI RUMAH SAKIT. *Permenkes No.58*.

Quick, J. T. S. (1997). *Distribution and Use of Pharmaceuticals in Managing Drug Supply* (Second Edi). Kumarin Press Book on International Development.

Seto, S., Nita, Y., & Triana, L. (2012). *Manajemen Farmasi: Lingkup Apotek, Farmasi Rumah Sakit, Pedagang Besar Farmasi, Industri Farmasi*. Surabaya: Airlangga University Press.

Sugiyono. (2017). MetodePenelitian Kuantitatif, Kualitatif dan R&D. Bandung: PT Alfabet. In *Sugiyono. (2017). MetodePenelitian Kuantitatif, Kualitatif dan R&D. Bandung: PT Alfabet.*

 ISSN 2502-4825 (print), ISSN 2502-9495 (online)