Contents lists available at: https://e-journal.unair.ac.id
AJIM (Airlangga Journal of Innovation Management)
Journal homepage: https://e-journal.unair.ac.id/AJIM

Effectiveness of Supply Chain Management Using Kanban System in Hospital Pharmacy Logistics: A Case Study

Cinthya Ratna Yuniar[1*], Wida Riana[2], Ulfa Nur Maa'idah[3], Erna Agung Rakhmawati[4]

[1,3,4] AKAFARMA Sunan Giri Ponorogo, Indonesia
[2] RSU Muhammadiyah Ponorogo, Indonesia

ARTICLE INFO

Paper Type:
Research Paper

Keywords:
Kanban, Supply Chain Management, Logistic Pharmacy, Inventory Management, Hospital

Article History
Received: 26 June 2023
Revised: 2 December 2023
Accepted: 7 December 2023
Available online: 8 December 2023

ABSTRACT

The aims of this research are, first to determine the stock profile of medical consumables before and after the implementation of Kanban system, and second to analysis the effectiveness inventory management of Kanban application. The research method uses descriptive quantitative by comparing the pre-experimental and post-experimental averages. An experiment was conducted to apply the Kanban system to pharmaceutical logistics at a hospital in Ponorogo for two months. Analysis using the FSN method based on TOR, ROP method, Safety Stock method followed by the implementation of the Kanban system. The results obtained are the average pre-Kanban purchase is 6715.7 and post-Kanban is 2232.8. The average ending inventory before Kanban is 8638.6 and after Kanban is 1656.2. The results of the paired t test yield a significant value for purchases of 0.168, which means that there are significant differences in pre-Kanban and post-Kanban purchases. The percentage of effectiveness tested with an N Gain score of 49.362% for purchases and for final stock of 47.655% shows that it is still in the less effective category. The benefit of this research is that in theory it provides an overview of the method for testing the effectiveness of kanban implementation, in practice it provides an overview of Kanban implementation.

*Corresponding author: cinthya.akafarma@gmail.com
Cite this article as: Yuniar, CR., Riana, W., Maa'idah, U and Rakhmawati, E. (2023). Effectiveness of Supply Management Using Kanban System in Hospital Pharmacy Logistics: A Case Study. *Airlangga Journal of Innovation Management, 4(2), 125-135.* https://doi.org/10.20473/ajim.v4i2.47010

Introduction

Pharmaceutical services are a part of the main revenue center in the hospital. Nearly 90% of health services in hospitals use pharmaceutical supplies (medicines, chemicals, radiological materials, consumable medical devices, medical devices, and medical gases) (Yuniar & Hidayat, 2022). More than 50% of all hospital income comes from managing pharmaceutical supplies, so it need be applied effective management (Susi, 2006). Pharmaceutical services in hospitals must ensure the availability of safe, quality, useful and affordable pharmaceutical preparations, medical devices, and medical consumables. The role of management logistics wares very important in supporting health services through a strategic management process for the movement and storage of goods, spare parts and finished goods from suppliers, between company facilities and to customers (Bowersox, 2006).

Since the outbreak of the Covid 19 pandemic that has hit the world in the last 2 years, there have been many stock outs of medicines, medical equipment, and consumable medical materials. The use of drugs, medical devices and medical consumables is still erratic, causing difficulties in determining the supplies of drugs, medical devices and medical consumables requested. One of the most important pharmaceutical supplies needed to support the running of services in hospitals is consumable medical materials. The need for medical consumables is very high in hospitals, they are classified as fast-moving items. All medical procedures use consumables medical materials provided by Hospital Pharmaceutical Logistics (Lanza-León et al., 2021). Procurement of logistics obtained from the hospital capital budget. Purchasing too many will result in large inventory and storage costs. Meanwhile, if it is too little, the hospital's needs will not be fulfilled optimally (Yudianti et al., 2021).

The first Kanban method introduced to the Japanese company, namely the Toyota Motor Company, in 1950 by Taiichi Ohno, so its application has been widely used in manufacturing industries such as automotive and warehousing. The Kanban method is still rarely applied as a whole in the procurement system for hospital pharmaceutical installations in Indonesia. This method is still a theoretical study in the pharmaceutical world. The application of Kanban is one method that can be used by hospital pharmacy logistics to overcome the problem of shortage and excess of goods. Kanban can be in the form of a card as a limit sign for reordering an item. the benefits of implementing Kanban are reducing inventory, reducing storage space requirements, avoiding stock outs (empty items), avoiding damaged/expired goods, reducing workload in logistics, reducing overall costs, improving quality (Mahardhika et al., 2013). In Ponorogo, there are no hospitals that implement the Kanban system. Most of them use manual stock recording system by writing the incoming and outgoing quantities, which are often not recorded due to the density of service activities. This condition happened because not many studies have presented the quality and benefits of using Kanban system as a supply chain management system.

Based on the background of phenomena, this case prompted the authors to conduct a more in-depth study of the effectiveness of the Kanban system in the stock of consumable medical materials in a hospital pharmaceutical logistics in Ponorogo. The authors want to know profile stock before and after implementation of Kanban system, is there a relationship between the application of Kanban system to the effectiveness of the stock. The scope of research is included in the field of Pharmaceutical Management regarding the application of the kanban method to the effectiveness of consumable medical stock supplies using the FSN Analysis method, the ROP method, the Safety Stock method followed by the application of the Kanban system for consumable medical materials.

The illustration of the results of this research is that there is a decrease in the average ending inventory or non-rotating goods which also has an impact on decreasing investment value and storage costs. This research is useful as a consideration in changing the system for providing consumables in hospitals which

is very risky if there are no vacancies and the risk if there is damage to consumables for patient safety in the hospital. The benefit of implementing Kanban is of course that user can divert capital from purchasing consumables to other needs that are no less important. Although the effectiveness of this research has not shown significant results because it was carried out in only two months, the results will be significant if the implementation is carried out for longer.

Literature Review

Inventory Management in Hospital

Drug planning is carried out to avoid gaps, conventional methods that are often used are the consumption method, epidemiology and combination of consumption methods and epidemiology method. The types of pharmaceutical supplies in Hospital are very diverse and not all of them have the same priority. In inventory management, Hospital pharmaceutical logistics are familiar with several terms including ABC (Always Better Control), VEN (Vital, Essential, Non-Essential), EOQ (Economic Order Quantity) and Minimum-Maximum stock (Nurwahyuni et al., 2017). FSN Analysis is a way of grouping inventory based on the speed of movement of goods. FSN Analysis takes into account the pattern of problems from the store. The three letters mean F (Fast) moves, S (Slow) moves, and N (Non-moving) (Brindha, 2014). Inventory control on item S and N can reduce funding and risk of damage. The way to see the movement of goods can be done based on the turnover ratio (TOR) of the inventory, which is to see the level of inventory turnover for one year (Hudori et al., 2019).

Kanban

Kanban is a Japanese word which means "visible sign" or card (Surendra et al, 1999). Kanban is defined as a Material Flow Control Mechanism (MFC) and controls the right amount and right time of production of the required product (Triana & Beatrix, 2019). It has been used around the world to mean card for using cards to arrange the delivery and or production of parts, goods, or raw materials (Graves et al, 1995). The Kanban system has many types, flexible to use in inventory management. Improving the process in a Kanban system is achieved by reducing total inventory to close to the safe limit of inventory in an order period (Siqueira et al., 2014). Since each Kanban represents a certain amount of stock, and the number of Kanban are strictly controlled and limited, this creates an upper limit on the inventory. The Kanban system is dealing real time with the real of what is happening (Apreutesei et al., n.d.).

A similar study was conducted by Arumsari, et al, (2015) about Proposed Design of Storage Allocation and Replenishment Process Using FSN Analysis Method and Kanban Card on Bin and Pigeonhole on XYZ Hospital Pharmacy Shelf. This study uses a combination of the FSN analysis method and Kanban cards and obtains results, namely reducing lost sales and increasing sales (Arumsari, 2015). Another study have been done by Papalexi et al (2016) about a case study of Kanban implementation within the pharmaceutical supply chain in International Journal of Logistics Research and Applications. This research shows that the application of the Kanban system improves service quality and provides input for changes in operational strategy (Papalexi et al., 2016).

Methodology

Pre-Kanban data collection uses inventory and usage document for the past. Preparation for the research on the application of the Kanban system was carried out by grouping fast moving, slow moving, death moving items using the FSN method based on TOR. The samples taken are fast moving consumable

medical materials and is calculated for safety stock and Reorder Point. For each sample item, a Kanban card is made which contains information on the identity of the goods, the amount of safety stock, minimum stock and maximum stock obtained from data for a period of one month prior to implementing Kanban. Observations were carried out for two months (Yusoff et al., 2013). Observation results were analyzed using the normality test, paired T test and N-Gain score test. The results are compared within pre-Kanban and Post-Kanban.

Inventory Control Using FSN Analysis Method Based on TOR

The movement of goods can be seen from the value of the inventory turnover ratio (TOR), which is to see the level of inventory turnover for one year (Yanuar, 2020). FSN method analysis steps with TOR are (1) Determination of initial inventory, namely raw material inventory at the beginning of each observation period. (2) Determination of ending inventory, namely the final inventory remaining at the end of each observation period. The inventory at the end of the observed period is the initial inventory for the next period. Ending inventory calculation

$$Pak = Paw + Pms - Ppk$$

(3) Calculation of the average value of inventory, namely the average value of raw material inventory in each observation period. The average value of inventory calculation.

$$Prt = (Paw + Pak)/2$$

(4) Partial calculation of the turnover ratio (TOR), namely the ratio of inventory turnover in each current period. Partial TOR value calculation.

$$TORp = Pmk / Prt$$

(5) Calculation of storage time, namely the average time experienced by each raw material to experience storage in the warehouse. Length of time storage of goods calculation.

$$Wsp = Jhp / TORp$$

(6) Calculation of Turn Over Ratio (TOR), namely the ratio of inventory turnover for one year. TOR value calculation

$$TOR = Jht / Wsp$$

(7) Grouping of goods with FSN Analysis (Fast, Slow and Non-moving) based on TOR, with the following criteria : Order based on TOR value from highest to lowest and the determination of classification F (TOR > 3), S (3 ≤ TOR ≤ 1), N (TOR < 1).

Information:

P*ak*	=	Ending inventor	P*mk*	=	use of goods during observation
P*aw*	=	Beginning inventor	W*sp*	=	length of storage time
P*ms*	=	Incoming goods	J*hp*	=	number of days during the observation period
P*pk*	=	goods used	TOR	=	inventory turnover for one year
P*rt*	=	Average inventory	J*ht*	=	number of days during one year
TOR*p*	=	partial inventory turnover during the observation period			

Inventory Control Using Safety Stock

Safety stock is intended to avoid vacancies during reordering and determine the amount of safe stock needed during the grace period to fulfill demand request (Rangkuti, 1997:92). Calculation safety stock using the formula :

$$\text{Safety Stock} = Z \times \text{Standart deviation of lead time} = Z \times \sigma \times \sqrt{LT}$$

Z = Servise Level; σ = Standart deviation; LT = *Lead Time*

Source : Walter, 2003

Inventory Control Using ROP (ReOrder Point) Method

Safety stock method was chosen because it can determine the safe stock that must be available, while the ROP method was chosen because it can find out quantity an item must be re-ordered. ROP can be used as a reference for the minimum stock that must be provided including the amount of safety stock.
Calculation ROP using the formula :

$$\text{Reorder Level} = \text{Lead time demand} + \text{safety stock} = LT \times D + Z \times \sigma \times \sqrt{LT}$$

Source : Walters, 2003.

Application of The Kanban System

The steps for using a kanban in the form of a card are:

1. Kanban cards can consist of several colors to mark fast-moving, slow-moving and death-moving goods in this case the author used a color to sample fast-moving items
2. Information written in the Kanban can contain the identity of the goods, information on the minimum stock quantity, the maximum stock quantity, and the number of orders. Card have been counted and placed on the limit of the number of safe stocks of goods in the warehouse.
3. The collection of goods has reached the limit safe stocks. The officer can release or revoke the production/re-order Kanban card from the physical unit to be placed at the Kanban receiving post (ordering/production unit).
4. Goods are ordered according to what is on the Kanban card, items that are still available can be issued first.
5. The goods have arrived and their condition is checked, the Kanban card can be placed back in a number of new safe stocks of goods.
6. There is a discrepancy, it can be immediately identified.
7. Recording the number of purchases and final stock in observation period

Effectiveness Test Using N-Gain Method

The normalized gain or N-gain score intends to identify the effectiveness of using a particular method or treatment in one group pretest posttest design research (experimental design or pre-experimental design) as well as research using a control group (quasi experiment or true experiment). Interpretation category N-gain can show the effectiveness of the treatment.

Table 3.1 Effectiveness Categories Using N-Gain Score Range

Percentage %	Effectiveness Interpretation
< 40	Inffective
40 – 55	Minimum Effective
56 – 75	Moderate Effective
> 76	Effective

Source : Nasir (2016)

Results and Discussion

FSN Analysis Based on TOR

The data analysis method used is FSN Analysis based on TOR which is calculated from data for March 2022. Group F (Fast-moving) includes 59 types of medical consumables. Inventory of these items should be managed properly so as not to cause stockout conditions. Lack of items in this category can disrupt services and even endanger patients if not handled immediately. Inventory control for these items can be done by implementing safety stock and reorder point (ROP). Meanwhile, for group S (slow-moving) there are not too many, around 12 types of medical consumables, and group N (non-moving) there are around 56 types of medical consumables. For research on the effectiveness of the kanban system, five samples will be taken from group F (Fast-moving) which will be used in the study. The selected samples are not included in the types of goods used during the Covid-19 pandemic because the systematics of their use are still uncertain. Inventory grouping data is obtained as shown in table 4.1.

Previous research by Arumsari (2015), related to the design of storing drugs in pigeonholes/bin shelves based on FSN categories to facilitate monitoring of the risk of drug empties and drug damage. In this research, the Kanban method was also used to optimize the re-procurement process. Other research by Kasna et al., (2020) regarding the implementation of a pharmacy information system using the time series and FSN methods, it is concluded that the FSN method can predict drug supplies well for several products, but in different product procurement patterns it has less effectiveness.

Table 4.1 Inventory Result Use FSN Analysis Method Based on TOR

Groups	**Low Value TOR**	**High Value TOR**	**Average Value TOR**	**Type of Goods (Quality)**
F *(fast moving)*	3.27	28.15	9.87	59
S *(slow moving)*	1.09	2.71	1.8	12
N *(non moving)*	-	0.91	0.12	56
SUM				127

Source : Author (2023)

Safety Stock And ROP

A higher Z (Service level) value provides a higher safety stock and a lower probability of shortage. In table Z, for level 0.95 it has a Z value of 1.64 (King, 2011). Calculation result of safety stock and ROP shown in table 4.2

Table 4.2 Calculation Result of Safety Stock and ROP

No	Code	Name	Z	D	Standart Deviation	Lead Time	SafetyStock (SS)
1	33SP09	Spuit 3cc BD reg	1.64	92	4,490,731	4	1473
2	33HA02	Handschoen Gammex PF7	1.64	24	567,646	4	186
3	30ST02	Stardine sol 1 ltr	1.64	0.6	0,5477	4	2
4	33PD01	PD Alkohol Swab	1.64	736	3,363,671	4	1103
5	33HA14	Hansaplast	1.64	180	1,824,437	4	598

Source : Author (2023)

Kanban System Effectiveness

The effectiveness of the Kanban system is shown through a comparison of the purchase of goods and remaining final stock pre-Kanban and post-Kanban system. In this study compared April 2019 and March 2022 as pre-Kanban and, April 2022 and May 2022 as post-Kanban. Purchase units in period are presented in table 4.3 and remaining final stock are presented in table 4.4

Table 4.3 Purchase Units in Period

No	Name	Pre Kanban (Units)				Post Kanban (Units)			
		Apr 2019	March 2022	Average	%	Apr 2022	Mei 2022	Avarage	%
1	Stardine sol 1liter	7	0	3.5	**20**	20	8	14	**80**
2	Spuit 3cc BD	3000	3900	3450	**75.83**	1200	1000	1100	**24.17**
3	Handschoen GammexPF7	0	750	375	**55.56**	450	150	300	**44.44**
4	PD Alkohol Swab	23600	20000	21800	**74.40**	15000	0	7500	**25.60**
5	Hansaplast	13000	2900	7950	**77.94**	3000	1500	2250	**22.06**

Source : Author (2023)

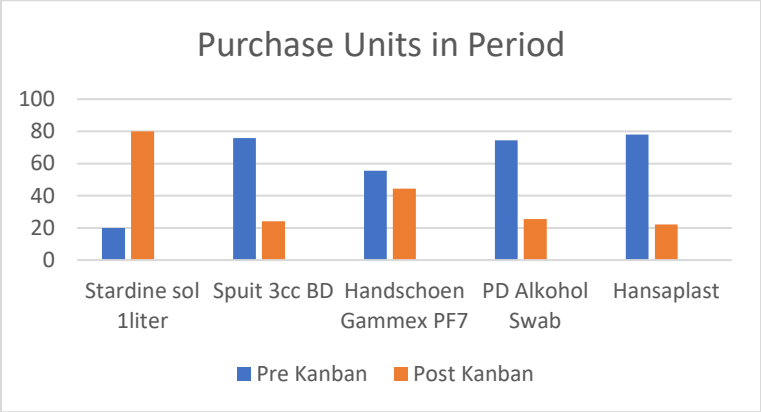

Figure 4.1 Graph of Purchasing Units in Period

Source : Author (2023)

Table 4.4 Remaining Final Stock

No	Name	Pre Kanba (Units)				Post Kanban (Units)			
		Apr 2019	Maret 2022	Average	%	Apr 2022	Mei 2022	Average	%
1	Stardine sol 1liter	23	3	13	**68.42**	8	4	6	**31.58**
2	Spuit 3cc BD	1500	1600	1550	**77.5**	900	0	450	**22.5**
3	Handschoen Gammex PF7	210	350	280	**50.45**	300	250	275	**49.55**
4	PD Alkohol Swab	50000	13200	31600	**83.60**	11200	1200	6200	**16.40**
5	Hansaplast	16700	2800	9750	**87.84**	2200	500	1350	**12.16**

Source : Author (2023)

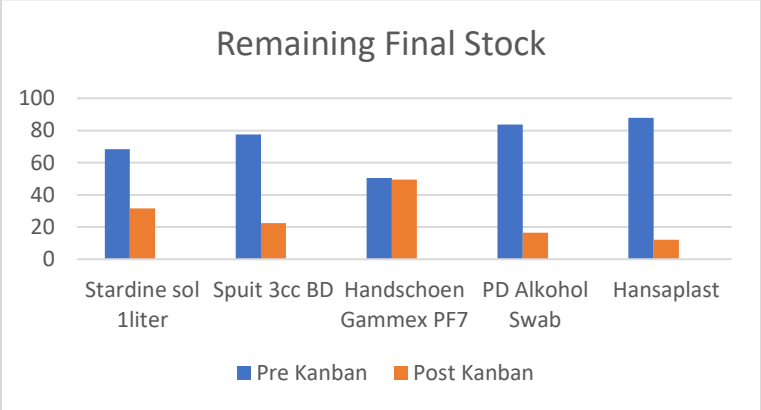

Figure 4.2 Graph of Remaining Final Stock

Source : Author (2023)

The normality test Shapiro-Wilk was carried out to find out whether the data was normally distributed or not for sample is less than one hundred (100), namely 5 samples. The results of the normality test of the purchase show that the data is normally distributed (significance) > 0.05 and the remining final stock unnormally distributed, this could be due to the number of samples being too small. The significance results for normality test of the purchase obtained for pre-Kanban were 0.115 and post-Kanban were 0.063 and normality test of the remaining final stock obtained for pre-Kanban were 0.030 and post-Kanban were 0.013.

Table 4.5 Test of Normality on Purchase

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
pre kanban	.246	5	.200*	.819	5	.115
pos kanban	.298	5	.169	.787	5	.063

Source : Primary data processed with SPSS 24, 2023

Table 4.6. Test of Normality on Remaining Final Stock

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
pre kanban	.301	5	.157	.750	5	.030
post kanban	.347	5	.049	.714	5	.013

Source : Primary data processed with SPSS 24, 2023

Analysis is followed by the Paired Sample T test. The purpose of this test is to paired samples meaning a sample with the same subject but experiencing different treatment (Purnomo, 2017). The paired Sample T Test result for purchase between pre-Kanban and post-Kanban system decreased from 6715.7 (mean pre-Kanban) to 2232.8 (mean post-Kanban). There is a significant correlation, the sig value (0.00) < 0.05. In the Paired Sample T Test shows that the sig count is greater than 0.05 (Sig. 0.168 > 0.05), show that the Kanban system has no significant effect on purchases. From these results, although there has not been a significant difference, it appears that there is an average difference between pre-Kanban and post-Kanban. Determine the effectiveness of the Kanban system, the N Gain Score test is carried out.

Table 4.7. N Gain Score

No	Name	Purchase (%)	Final Stock (%)
1	Stardine sol 1liter	10.88	-8.05
2	Spuit 3cc BD	27.27	2.78
3	Handschoen Gammex PF7	65.9	75.86
4	PD Alkohol Swab	70.15	80.63
5	Hansaplast	72.61	87.05
	Total (%)	**49.362**	**47.655**

Source : Author (2023)

The authors want to test how big the percentage of the effectiveness of the Kanban system on purchases and final stock, N Gain Score test is used by SPSS. The result of the effectiveness of the Kanban system on purchases was 49,362% and on stock was 47,655%. In accordance with the N-gain interpretation category table, the results obtained show that between Purchases and final stock are in the less effective category, because they fall within the 40-55% effectiveness interpretation range, shows that the Kanban system has not been able to run effectively in a short time.

However, if we look at the percentage of each treatment in the field, the Kanban method is considered to show efficiency in inventory management. This is supported by comparative data before kanban was implemented and after kanban was implemented, there was a decrease in the percentage of purchases for 4 sample items, namely 3cc BD syringes from 75.83% to 24.17%, Handschoen Gammex PF7 from 55.56% to 44.44%, PD Alcohol Swabs from 74.83% to 25.60 % and Hansaplast 77.94% to 22.06%, which means that the purchase investment value decreases without causing stock vacancies. The ending stock results show efficiency in goods turnover, supported by data on the reduction in the percentage of ending stock for 5 sample items, namely Stardine sol 1 liter 68.42% to 31.58%, Spuit 3cc BD 77.5% to 22.5%, Handschoen Gammex PF7 50.45% to 49.55%, PD Alcohol Swab from 83.60% to 16.40% and Hansaplast 87.84% to 12.16% which means that storage costs, risk of damage and death stock decrease.

Conclusion

Kanban is an investment management method that can be applied to the logistics of pharmaceutical supplies in hospitals. It is hoped that the implementation of the Kanban system in hospitals can reduce storage costs and reduce damage to pharmaceutical supplies which can have fatal effects on health. Based on several studies, this method can reduce the risk of stock shortages, so that it is expected to improve health services in hospitals and minimize the risk of delays in handling medical emergency conditions. Determining the time and amount of reordering an item is the focal point of the Kanban system. In this study it was applied to a hospital in Ponorogo. Samples are in the form of consumable medical materials which are the main support for services and fast-moving items. The results obtained by the average purchase before Kanban is 6715.7 and after Kanban is 2232.8 there has been a decrease in purchases. The average ending inventory before Kanban was 8638.6 and after Kanban was 1656.2 which had an impact on reducing investment value and storage costs, reducing goods not rotating in logistics. The results of the paired t test yield a significant value for purchases of 0.168, which means that there are significant differences in pre-Kanban and post-Kanban purchases. The percentage of effectiveness tested with an N Gain score of 49.362% for purchases and for final stock of 47.655% shows that it is still in the less effective category. Suggestions for further research are to increase the number of samples and extend the observation time, so that investment management optimization progress can be seen. Suggestions for hospitals that will implement the Kanban method, to carry out monitoring of the effectiveness of the method for a period of 1 year along with financial reports, to separate shelves for materials into Fast-Moving, Slow-Moving and Non-Moving categories to make monitoring easier.

Author's Contribution

All authors have contributed to the final manuscript. The contributions of each author are as follows, Cinthya Ratna Yuniar; collecting data, drafting manuscripts and drafting drawings, drafting key conceptual ideas; Riana Wida: collecting data and Ulfa Nur Maa'idah and Erna Agung Rakhmawati provided excellent guidance and provided critical revisions of articles. All authors discussed the results and contributed to the final manuscript.

Acknowledgements

Finally, the authors would like to thank our beloved family, The Health Campus AKAFARMA Sunan Giri Ponorogo and Muhammadiyah Hospital Ponorogo, who are willing to facilitate the authors in applying the method in research and providing data that supports the achievement of this research.

Declaration of Competing Interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Reference

Apreutesei, M., et al. 2010. *Application of kanban system for managing inventory*. *Bulletin of the Transilvania University of Brasov. Engineering Sciences.* Series I 3: 161.

Arumsari, Maya Putri; Damayanti, Dida Diah; Santosa, Budi. 2015 *Rancangan Usulan Alokasi Penyimpanan Dan Proses Replenishment Menggunakan Metode Fsn Analysis Dan Kanban Card Pada Bin Dan Pigeonhole Di RakApotek Rumah Sakit Xyz. eProceedings of Engineering*, 2.1.

Brindha DG. 2014. Inventory Management. International *Journal of Innovative Research in Science, Engineering and Technology*. 3(1): 8163- 8176.

Bowersox, Donald J., 2006, *Manajemen Logistik Integrasi Sistem-Sistem Manajemen Distribusi Fisik dan Manajemen Material*, Jakarta: Penerbit PT. Bumi Aksara.

Graves, Robert J., John M. Konopka, and R. John Milne. 1995 *Literature reviewof material flow control mechanisms. Production Planning & Control* 6.5 :395-403.

Hudori, M., and Niro Tami B. Tarigan. 2019. "Pengelompokan Persediaan Barangdengan Metode FSN Analysis (Fast, Slow and Non-moving) Berdasarkan Turn Over Ratio (TOR)." *Jurnal Citra Widya Edukasi* 11.2 : 205-215.

King, L. 2011: Crack the code: Understanding safety stock and mastering its equations, APICS Magazine, July/August 2011, p.33-36. Retrieved from https://web.mit.edu/2.810/www/files/readings/King_SafetyStock.pdf

Lanza-Leon, Paloma; Sanchez-Ruiz, Lidia; Cantarero-Prieto, David. 2021.*Kanban system applications in healthcare services: A literature review. The International journal of health planning and management*,36.6: 2062-2078.

Mahardhika, A., Rahman, A., & Efranto, R. Y. (n.d.). *Comparison Of The Economic Order Quantity Method And The Kanban Method On Raw Materials Inventory Control*.

Nasir, A. Muhajir. 2016. *Statistik Pendidikan*. Yogyakarta: Media Akademi

Papalexi, Marina; Bamford, David; Dehe, Benjamin. 2016. *A case study of kanban implementation within the pharmaceutical supply chain. International Journal of Logistics Research and Applications*, 19.4: 239-255.

Purnomo, H., Syamsul, E.S, 2017, *Statistika Farmasi (Aplikasi Praktis Dengan SPSS)*, Yogyakarta

Rangkuti, F., 1997, *Manajemen Persediaan*. Jakarta: PT Raja Grafindo.

Siqueira B, Domingos M, Sabbadini F, 2014, Process Improvement and Reorganization of Kanban Inventory in an Industry of Machinery and Equipment: A Case Study. *Journal of Mechanical Engineering and Automation (2014) 4(2) 49-54*

Surendra, M. Gupta, A. Y. Yousef, and F. Perry Ronald.1999. "Flexible kanban system." *International Journal of Operations & ProductionManagement* 19.10 : 1065-1093

Triana, N. E., & Beatrix, M. E. (2019). *Production System Improvement Through Kanban Application In Labor Intensive Company*. *SINERGI*, *23*(1), 33. https://doi.org/10.22441/sinergi.2019.1.005

Waters, D., 2003. *Inventory Control and Management*. 2nd ed. England: John Wiley & Sons.

Yanuar, A. 2020. *Analisis Pengendalian Persediaan Menggunakan FSN, Analysis Pada Warehouse UKM Online.* Jurnal Logistik Bisnis, 10.

Yudianti, N. W. Y., Lestari, P. N. E., Darma, G. S., & Suardana, I. R. 2021. *Inventory Control Of Disposable Medical Materials At The Bali Mandara Eye Hospital*. *Jurnal Administrasi Kesehatan Indonesia*, *9*(2), 180. https://doi.org/10.20473/jaki.v9i2.2021.180-190

Yuniar, CR and Hidayat, W. 2022. *Competitive Strategy Through Supply Chain Management On Pharmacy Installation: Comparison Study In Two Hospital*. Airlangga Journal of Innovation Management. 3(1), 18-32.

Yusoff, N., Jaffar, A., Hayati Abdul Halim, N., Naufal Bin Adnan, A., bin Jaffar, A., Binti Yusoff, N., & Hayati Binti Abdul Halim, N. (2013). *Implementation of Just in Time Production through Kanban System Manufacturing Process Improvement View project Green Manufacturing View project Implementation of Just in Time Production through Kanban System*. *3*(6). www.iiste.org