RBFHSS
Revista Brasileira de Farmácia Hospitalar e Serviços de Saúde

Original Paper

Open Access

Impact of the implementation of the daily rotating inventory on the accuracy of the medicines stock in a medium-sized public hospital

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Submitted: 25-03-2023 Resubmitted: 21-06-2023 Accepted: 05-07-2023

Peer review: blind reviewer and Jane Carvalho

Abstract

Objective: To evaluate the impact of implementing a daily rotating inventory on the accuracy of medicines stocks in a medium-sized public hospital. **Methodology:** This is a cross-sectional exploratory descriptive study that evaluated the implementation of a rotating inventory from January to July 2022. 143 medicines were selected and subsequently inventoried once a month over seven months. These medicines were classified according to the ABC, XYZ curve and the degree of divergence in low, medium and high. Accuracy was calculated for each group, over the analyzed months, and the Relative Percentage Change (RPC) for comparison between the initial and final period. **Result:** There was a 64% increase in the accuracy of medicines inventory, with a difference being observed between the ABC and XYZ groups. Regarding the ABC curve, group A had an increase of 170%, group B 358% and group C 23% in the same period. Regarding criticality, group Z had the highest accuracy, followed by groups Y and X. Medicines classified as having a high rate of divergence had a reduction of 80% and the low rate of 25% after implementation of the inventory. **Conclusion:** The implementation of the rotating inventory increased the accuracy of the medicines stock over the evaluated months. This tool can be a strategy used to improve medicine inventory management.

Key words: logistics; drug storage; pharmacy service, hospital; pharmaceutical services.

Impacto da implantação do inventário rotativo diário na acurácia do estoque de medicamentos em um hospital público de médio porte

Resumo

Objetivo: Avaliar o impacto da implantação do inventário rotativo diário na acurácia do estoque de medicamentos em um hospital público de médio porte. **Metodologia:** Trata-se de um estudo descritivo exploratório transversal que avaliou a implantação de um inventário rotativo de janeiro a julho de 2022. Foram selecionados 143 medicamentos que posteriormente foram inventariados, uma vez por mês, ao longo de sete meses. Esses medicamentos foram classificados segundo a curva ABC, XYZ e o grau de divergência em: baixo, médio e alto. Foi calculada a acurácia para cada grupo, ao longo dos meses analisados, e o Percentual de Mudança Relativa (PMR) para comparação entre o período inicial e final. **Resultado:** Houve um aumento de 64% na acurácia do estoque de medicamentos, sendo observada diferença entre os grupos ABC e XYZ. Em relação a curva ABC, o grupo A teve um aumento de 170%, o B de 358% e o C de 23% no mesmo período. Em relação a criticidade, o grupo Z foi o que teve maior acurácia, seguido dos grupos Y e X. Os medicamentos classificados como de alta taxa de divergência tiveram redução de 80% e o de baixa 25% após implantação do inventário. **Conclusão:** A implantação do inventário rotativo aumentou a acurácia do estoque de medicamentos ao longo dos meses avaliados. Essa ferramenta pode ser uma estratégia utilizada na melhoria do gerenciamento de estoque de medicamentos.

Palavras - chave: logística; estoque de medicamentos; serviço de farmácia hospitalar; assistência farmacêutica.

Introduction

In a hospital unit, the pharmacy is responsible for all processes related to medicine, including storage. The stockroom is a place where the storage and logistic processes for medicines and supplies are carried out until a product needs to be dispensed for use[1]. Therefore, management of this stock should ensure efficient replenishment of medicines and materials in the health unit to ensure smooth operation of the service without shortages[2,3].

Having in-depth knowledge about the Hospital Pharmacy's medicines stock is an important task and can contribute to reducing unnecessary losses, to effective medicine location due to good stock organization, to compliance with the current legislation and specifications for some medicines groups and, finally, to cost reductions. According to the World Health Organization (WHO), medicines represent 20%-30% of the global expenses in health[4]. Therefore, effective stock management can help minimize these expenses and unnecessary losses. In addition, stockouts or unnecessary expenses caused by deficient stock management can exert an impact on the health care provided, contributing to a reduction in patient safety and in care quality[5].

Discrepancies between physical and virtual stocks are significant challenges in the management of medicines in hospital pharmacies. They can exert directly impacts on the pharmaceutical care cycle, as lack of accurate information makes it difficult to properly plan purchases based on the hospital's actual demand, as well as availability of medicines as a therapeutic tool in the health care process[6,7]. These discrepancies can be measured by inventory accuracy, quantifying the conformity percentage between physical and virtual stocks[8].

Daily rotating inventory is a tool described as beneficial in improving stock accuracy by reducing the discrepancy between physical and virtual stock[9–11]. Based on this, this research analyzed the impact of implementing daily rotating inventory on medicines stock accuracy in a medium-sized public hospital.

Methods

Study characteristics and implementation period

This is a descriptive, exploratory and cross-sectional study that evaluated the influence of implementing rotating inventory on medicines stock accuracy in the distribution unit of a Hospital Pharmacy service. The study period evaluated was from January – when the new routine was implemented – until July 2022. The study was conducted in a medium-sized state public hospital which offers secondary-level care (specialized in Cardiology and Neurology) located in the city of Rio de Janeiro. The institution uses an individualized distribution system every 12 hours, with the distribution unit separated from the stock unit.

ABC and XYZ curves

A descriptive frequency analysis was performed to classify medicines into three categories based on consumption and cost, using the ABC curve (also known as the Pareto principle)[3,12]: A- High cost, B- Medium cost, and C- Low cost. In addition to that, in order to assess criticality of the standardized medicines in the unit, the XYZ curve[13,14] was used, in which low criticality is represented by the letter "X" and medium and high criticality by the letters "Y" and "Z", respectively.

Daily rotating inventory and stock accuracy

All medicines available for use in the Pharmacy Service distribution unit from January to July 2022 were included in the study, namely: I) Medicines with zero items in physical and virtual stocks; II) Medicines subjected to special control according to Ordinance 344/1,998; and III) Antimicrobials.

In this type of inventory, the pharmacy distribution unit analyzed a total of 143 items per month, with eight items a day until completing the total, starting a new cycle each month. In other words, each item was inventoried once a month. The medicines under special control and antimicrobials have a different control and inventory dynamics, reason why they were excluded from the study. After counting each medicine, the items were compared to the virtual stock and, if there were discrepancies, these were recorded numerically as follows: A) A positive value when the physical stock is greater than the virtual stock; B) A negative value when the virtual stock is greater than the physical stock; and C) A value of zero, indicating that there are no discrepancies between the stocks.

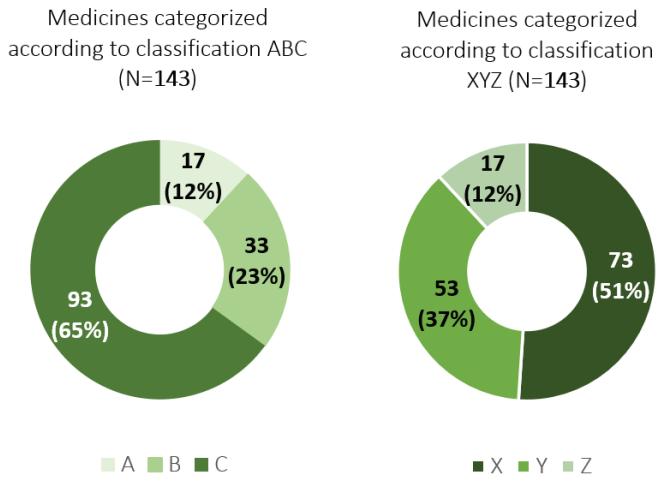
The medicine stock accuracy assessment was calculated as follows: number of medicines without discrepancies divided by the total number of medicines inventoried in the month, multiplied by 100. Considering that some medicines had a wide variation in terms of discrepancies, they were subclassified based on the discrepancy degree, as follows: I) Medicines without discrepancies - when there is no discrepancy; II) Medicines with low discrepancies - varying up to ten units up or down; III) Medicines with medium discrepancies - up to 50 units; and IV) High discrepancies - with variations of more than 100 units. Subsequently, the discrepancy rates were calculated for each group - low, medium and high - for each month during the seven months of analysis. These rates were calculated as follows: number of medicines with low discrepancies divided by the total number of medicines multiplied by 100. The same criteria were followed for the medium and high discrepancy groups.

To assess the impact of implementing the daily rotating inventory, accuracy was measured, as well as the discrepancy degree between the stocks. Both accuracy and the discrepancy degree were measured month by month until completing the seven-month period after implementing the inventory. To compare the initial periods after implementation and the subsequent periods, the Relative Change Percentage (RCP) from January to June or July 2022 was calculated. The RCP was calculated as follows: RCP = (Final Value - Initial Value) / Initial Value x 100. The analyses were stratified for the ABC curve groups, XYZ classification and divergence degrees.

Results

The 143 medicines inventoried each month from January to July 2022 totaled 1,001 items over the seven months of evaluation. In relation to the ABC classification, 17 (12%) of the medicines belonged to Group A, 33 (23%) to Group B, and 93 (65%) to Group C (Figure 1A). In turn, regarding criticality (XYZ classification), it was observed that the high-criticality Group Z had 17 (12%) medicines, the medium-criticality Group Y had 53 (37%), and the low-criticality Group X had 73 (51%) medicines (Figure 1B).

Figure 1. Medicines inventoried from January to July 2022, grouped according to the ABC curve (A) and XYZ criticality classification (B) (N=143).



The total accuracy of medicines in January 2022 was 34%, increasing to 48% in February and 56% in June (Figure 2). The Relative Change Percentage (RCP) from January to June showed a 64% increase in accuracy of the medicines stock. When evaluated accuracy by ABC groups of medicines, there was a difference between the groups. In Group A, accuracy was 24% in January and increased to 65% in June, resulting in RCP = 170% increase in stock accuracy. Similarly, Group B medicines also saw an increase in stock accuracy, rising from 12% in January to 55% in June, resulting in RCP = 358% increase. On the other hand, the medicines from Group C did not show a significant variation in accuracy when compared to groups A and B. In January, accuracy in Group C was 43%, and rose to 53% in July, with an RCP = 23% increase (Figure 3).

Figure 2. Total accuracy of the medicines assessed between January and July 2022.

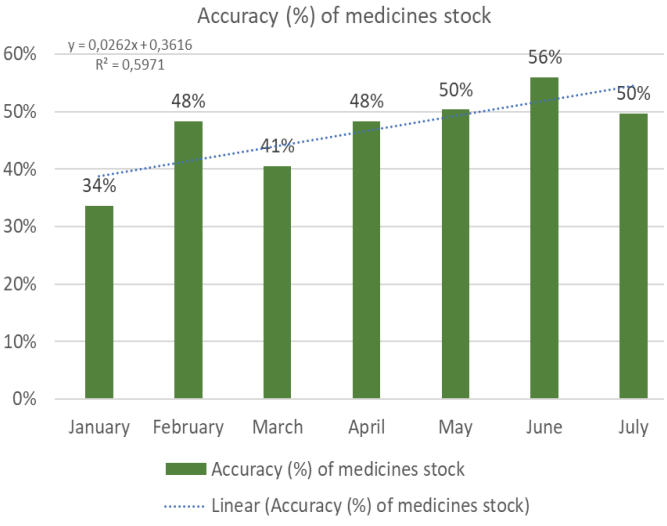
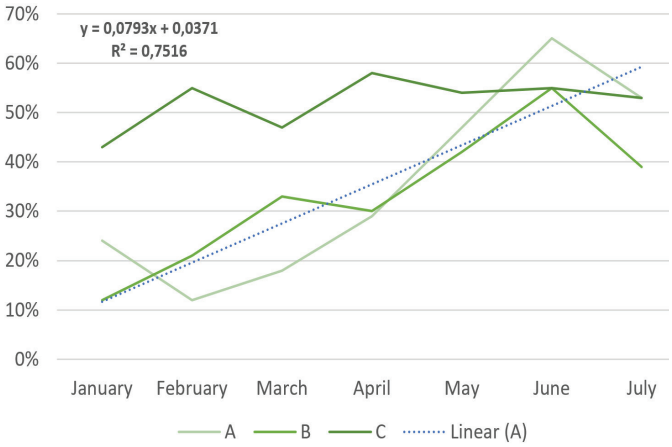


Figure 3. Medicines stock accuracy (%) for groups A, B and C (N=143).



Variations in medication stock accuracy were observed when subdivided according to XYZ criticality. The group of high-criticality medications ("Z") maintained the highest accuracy over the seven months. The group of lower criticality ("X") was the one with the lowest accuracy during the same period (Figure 4). The highest variation in accuracy was found in Group "Z" between January (47%) and June (76%) with RCP = 61% increase.

Regarding the classification of the medicines according to the divergence degree – low, medium and high – a difference in the divergence rate between the groups was observed. In January, the medicines from the high-divergence group, meaning those with a difference of more than 100 items between physical and virtual stocks, had a 20% divergence rate. After six months of having implemented the rotating inventory, the rate for this group dropped to 4%, representing an 80% reduction between January and July (RCP =-80%). On the other hand, the group of medicines classified as with low divergence had a smaller variation between January and July (31% and 39%, respectively), with RCP = 25% (Figure 5).

Figure 4. Medicines stock accuracy (%) for groups X, Y and Z (N=143)

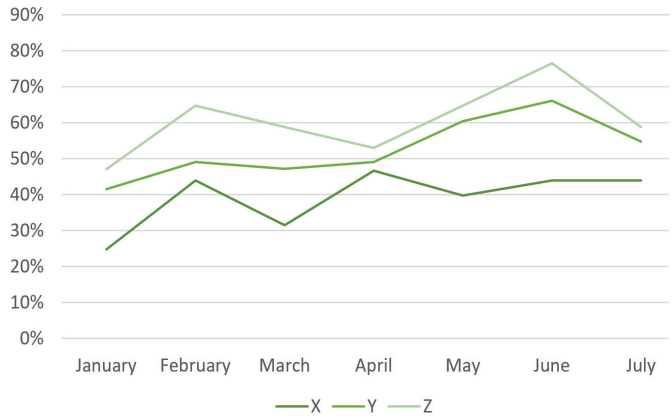
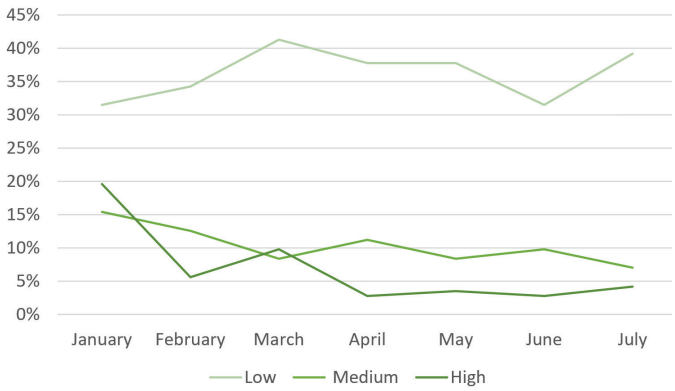


Figure 5. Divergence rate (%) between physical and virtual medicines stocks categorized by groups of low, medium and high discrepancies between January and July 2022.



Discussion

The distribution frequency among the ABC classifications in the study presented high similarity with some data from the literature, with Group A varying from 9% to 19%, Group B from 21% to 25%, and Group C from 55% to 68%[15,16]. These variations can be attributed to the individual characteristics of each hospital. Although the classification model has a standard format, the consumption and value corresponding to each item exert different impacts on the final cost, and this can alter the distribution among the three groups.

Regarding the XYZ medicines, the variations are associated with the criticality criteria, which are specific to each health unit and depend on the assistance context in which they operate. In this study, a difference in accuracy was observed, sustained over the months, being higher in Group Z, followed by Group Y group and then Group X. This difference can be associated with the criticality of each medicines group. Higher criticality items require more detailed logistics for their reception, storage, dispensing and return. This would justify the group with the highest criticality consistently maintaining higher accuracy and the group with the lowest criticality having lower accuracy throughout the evaluated months.

The results of this study showed an improvement in medicines stock accuracy after implementing daily rotating inventory, mainly in medicines from groups A and B. This difference between the ABC groups can be attributed to the higher turnover of medicines in groups A and B, as some of the medicines from Group A were classified in this category due to their high consumption, which significantly impacted the final budget. The high consumption of these medicines can exert an impact on the reception and dispensing logistics, thereby increasing the potential for errors and consequent discrepancies between stocks. A study that assessed medicines stock accuracy in a pharmaceutical company from Mato Grosso showed that the medicines from groups A and B have higher inventory turnovers. Therefore, these medicines had lower inventory accuracy when compared to Group C, which has low turnover[17].

Two Brazilian studies[18,19] and two international ones[20,21] assessed medicines stock accuracy with variations from 44% to 100% accuracy across the studies. This high variation can be influenced by several factors such as having a qualified technical team, an adequate number of employees, classification criteria, the type of medicines dispensation system, and management tools that assist in controlling stocks. Studies have reported an improvement in stock accuracy after implementing a system that uses barcodes[22], as well as improvements in inventory management and dispensing with the use of robotic systems for medicines dispensing[5,23–25].

The Brazilian reality imposes limitations in terms of resources within the public health system. A group of researchers evaluated pharmaceutical assistance management in some municipalities from the state of Paraíba and, in 52% of the locations, there was either no stock control or it was deficient[26]. In a work developed by another research group, pharmaceutical stock control systems were evaluated in various regions of the country in primary health care settings. They found that 58% of the stock control was done manually, 36% was computerized, and 5% had no inventory control in place[27].

Another aspect observed from the results were the differences among groups classified as with low, medium and high medicines stock discrepancy. There was an increase in the stock discrepancy rate, especially in the high discrepancy group, after implementing the rotating inventory. On the other hand, the low discrepancy group had little influence from the inventory. The stratification of discrepancies into the three major groups showed that the rotating inventory appears to be beneficial when there are large and/or medium discrepancies in the stocks until reaching a plateau. However, it does not seem to be as effective when dealing with small stock discrepancies. The medicines movement chain between units directly impacts the final stock. Therefore, a larger error during this movement chain can be better noticed and corrected when compared to smaller ones.

Although the total medicines stock accuracy did not reach values above 56% over the months evaluated, it is believed that there has been an improvement in reducing stock discrepancies after implementing the rotating inventory system. The accuracy calculation only considers medications without discrepancies. However, from this study, it was observed that the medicines with low discrepancies – up to ten items – are the most frequent. Therefore, if considered together, medicines without discrepancies and with low discrepancies represent between 65% and 89% from January to July 2022.

Among future perspectives, it is necessary to conduct studies to better understand the improvement in small discrepancies because they are more representative and influence stock accuracy. In addition to that, it is necessary to understand the operational factors at work that are linked to errors and how certain groups of medicines are more susceptible to them.

This study presents limitations such as the short analysis period and data collection from a single center. One of the strengths of this study is the scarcity of research with this approach in the field of medicines management. National studies are important because the realities of Brazilian public and private hospitals, as well as those in other countries, can be significantly different. Proper stock management contributes to optimizing financial resources and access to medicines in health institutions.

Conclusion

The implementation of daily rotating inventory contributed to increasing medicines stock accuracy and can be used as a tool to improve inventory management. In the context of hospital units with limited technological resources for medicines reception, dispensing and return control, this tool can contribute to maintaining highly accurate stocks. Especially, the ABC and XYZ groups and the discrepancy degrees should be individually assessed, considering the individual impact each group may exert on medicines stock accuracy.

Funding sources

The authors declare that the research did not receive funding for its conduction.

Collaborators

LCCJ: Project development and management, data collection and analysis, writing, formatting and review of the manuscript; GGC: Project development, data collection, writing and review of the manuscript; BST: Data collection, translation, writing, formatting and review of the manuscript; SGA: Data collection, formatting and review of the manuscript; JTS: Data collection, formatting, writing and review of the manuscript; PR: Data collection and review of the manuscript; GCA: Data collection, writing and review of the manuscript; LCS: Data collection and review of the manuscript; MMG: Data collection and review of the manuscript; MDS: Data collection and review of the manuscript; FJGB: Data collection, writing and review of the manuscript; LSS: Data collection and review of the manuscript; ZAS: Data collection and review of the manuscript; CTC: Project development and management and review of the manuscript; CZS: Project development and management, data collection, writing and review of the manuscript.

Acknowledgments

We would like to thank the entire team of professionals at the Pharmacy Department of the Anchieta State Hospital (*Hospital Estadual Anchieta*, HEAN) from Rio de Janeiro-RJ, as well as the managers and other professionals at the unit who directly or indirectly contributed to conducting this research.

Declaration of conflict of interests

The authors declare that there are no conflicts of interests in relation to this article.

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