Management model based on prescription audit, ABC classification method and Kaizen to improve pharmaceutical service level

César Chunga, B. Sc.[1], Mayerly Mamani, B. Sc.[2], Karol Moore, MSc.[3] and Carlos Torres-Sifuentes, MSc.[4]

[1,4]Universidad Peruana de Ciencias Aplicadas, Peru, u201913803@upc.edu.pe, u201916176@upc.edu.pe, pcgekmoo@upc.edu.pe, carlos.torres@upc.pe

Abstract– In a public hospital in Peru, users must go to the hospital pharmacy service to obtain prescribed medications, but it has been identified that only 47.9% of prescriptions are filled completely, which prevents the delivery of all the medications needed to comply with the treatment indicated by the treating physician. This reveals a low level of service in the hospital pharmacy, according to the evaluation carried out during the period from January to December 2022. The causes of the problem include the inappropriate prescription of medicines, in the sense that sometimes the treating physician prescribes medicines that are not included in the Drug Formulary approved by the Ministry of Health, which means that the patient sometimes has to purchase the medicines in private pharmacies.

In addition, another cause is the lack of training of warehouse personnel. In this sense, the patient care management model was developed, based on the integration of methodologies such as the audit of medical prescriptions to address the lack of availability, the implementation of the ABC method whose purpose was the better control of medicines with higher economic rotation and higher consumption; as well as the implementation of training sessions with Kaizen approach to improve the processes in the warehouse management during the period from January to March 2023. This integration resulted in a significant increase in the complete dispensing of prescriptions, from 36% to 55%. In addition, there was an improvement in staff competencies in warehouse management, with the number of trained personnel increasing from 40% to 80%. These results highlight the positive impact of the improvements implemented in the processes of planning, storage and dispensing of medicines in the hospital pharmacy.

Keywords– Medication management, prescription audit, ABC method and Kaizen method.

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I. INTRODUCTION

In the health sector, one of the important activities is the dispensing of drugs to make the patient's treatment effective. [1] In Peru, the cost of drugs for a patient is a significant factor in total health care spending. According to experts, this cost represents about 45% of the total health care expenditure that a patient receives in a health facility, whether public or private. This problem becomes even more critical when the patient goes to a public health facility that lacks medicines in its pharmacy service.

[2] The demand for health care provided by each subsector of the National Health System. Thus, the Ministry of Health was responsible for 78.9% of all health care at the national level, followed by Essalud, which attended 13.7%. Between the two subsectors, MINSA and Essalud accounted for approximately 92% of health care at the national level. [3] In a public health facility, monthly outpatient medical care ranges from 7,098 to 15,818 visits.

In order to complete their medical care, users go to the hospital pharmacy service to access medicines according to the medical prescription by delivering their prescription to the dispensing area of the pharmacy. According to the evaluation of the care provided and prescriptions filled in a period from January to December 2022, it was evident that there is a low level of service in the hospital pharmacy, since 47.9% of the prescriptions were filled, which does not allow a total delivery of medicines to users according to the needs to comply with the indicated treatment. To measure the service level problem in the pharmacy, we used the indicator of the total number of prescriptions correctly dispensed, i.e. that they are delivered in full with respect to the total number of patients. In other words, in a perfect scenario, each user who enters the clinic leaves with a prescription for medication, which should be delivered completely to the pharmacy. [4] During the period from January to December 2022, the average efficiency in the percentage of prescriptions prescribed was 46%. This value means that the physician does not record the information of all the fields contained in the medical prescription, which is regulated by the current standards set forth by the Directorate of Medicines, Supplies and Drugs of the Ministry of Health. [5] The low percentage of prescription efficiency has several causes, the most relevant of which is the wrong choice of drug or drugs for the patient's diagnosed problem. For the purposes of this indicator, an ill-advised prescription drug would be a drug that is not available in stock and a drug that is not included in the National Pharmacological Formulary. It may seem unlikely that a physician would prescribe a drug that is not in stock, but it is not, because the physician in the hospital under study does not have the mechanisms for online information on drugs that are out of stock. [6] The root cause is the deficient number of warehouse management trainings for warehouse personnel. It is recognized that the improvement of personnel competencies is fundamental for the improvement of the processes of any company. Competence is understood as that in which personnel acquire knowledge, skills and attitudes aimed at improvement. [7] It is evident that there is a deficient number of training courses in warehouse management for the benefit of warehouse personnel. This value is 33%, which is a poor percentage because the correct storage, custody and rotation of medicines will allow cost savings, better availability and better control of medicine batches. The standard is 100%, i.e., all warehouse

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personnel should be trained, which reflects a programmed hard work ahead, it is understood in terms of training sessions.

[8] The lack of adequate control of information on incoming and outgoing movements of medicines, especially those with the highest turnover, is the root cause of the deficiency in the overall control of medicines. This problem is reflected in a key indicator, the percentage of control of fast-moving drugs by unit consumption. [9] The goal is to achieve 100% control in this segment of drugs, since they represent a significant volume of turnover. Currently, the deficiency in the control of medicines with the highest turnover is 20%, which implies harmful consequences and a high cost in the warehouse. It is crucial to improve this control in order to guarantee the availability and proper dispensing of medicines to users.

The reason why the case study in a low level of service in a hospital pharmacy is the percentage of non-dispensed prescriptions with the identification of these cases will allow optimizing the delivery of medicines of the prescriptions prescribed, for this will be used as a tool the audit of the prescription and the percentage of staff with skills in handling warehouse management, with emphasis to staff for their level of understanding of warehouse management, this is key factor so that it can operate well the functions in the warehouse in the supplies of medicines. For this purpose, the Kaizen method will be used as a tool. The organization of this work will be divided into 5 parts which are state of the art, contribution, validation, discussion and conclusions. For the analysis and discussion of the results, a descriptive analysis and control tools were mainly used.

II. HELPFUL HINTS

The following typologies obtained after a preliminary exploration were considered for this study. The main concepts to be developed and their relationship are detailed below.

A. Kaizen Methodology

Kaizen methodology is a continuous improvement approach that focuses on implementing small incremental changes in an organization's processes with the objective of achieving significant improvements over the long term.[10] This methodology applied in the field of pharmacy technician training will provide satisfactory results because it allows identifying which topics require training and this is done in a progressive manner.[11] Project teams can generate process improvement routines in a higher education context through a research approach, which is used to track these over time. [12] Several continuous improvement programs are mentioned, such as Supply Chain Management (SCM), Six-Sigma, Total Quality Management (TQM), Kaizen, Just-in-Time (JIT) and Total Productive Maintenance (TPM). [13] Consequently, it is important to improve the training and education of drug managers to improve drug management in primary health care facilities.

B. Recipe Audit

The prescription audit refers to the process of systematically reviewing and evaluating the components and stages of a prescription prescription process. [14] Therefore, if the user's data is correctly filled in the prescription for the patient's treatment, an improvement in the quality of prescriptions can be seen. [15] If the results of the audit indicate that five parameters (generic drug name, dosage, total number of medications required, patient's address and readability of the prescription) are deficient in comparison with the basic WHO prescription factors. A monitoring tool may be implemented to see the improvement in drug prescribing factor. [16] In case of implementing audit on a frequent basis causes the identification of which drugs are being implemented to the treatment such as quantity, name and other characteristics. [17]. It is necessary to evaluate the use of unnecessary drugs and establish guidelines for the responsible use of antibiotics, which should be monitored and evaluated periodically by prescribers.

C. ABC Method

The ABC method is based on the Pareto principle, better known as the 20/80 principle, which essentially states that 20% of our efforts should account for 80% of the results. [18] The Essential Drugs List helps to ensure access to essential drugs for the population in primary care facilities. [19] ABC-VED analysis is a technique used in inventory management that classifies products into different categories according to their value and criticality. This helps to identify the most important products and make informed decisions about the amount of inventory to hold for each.[20] This is a valuable technique for pharmaceutical inventory management and can help healthcare facilities identify priority items that require tighter control and more efficient management. [21] The results of the study suggest that inventory management of vital and expensive products, such as antibiotics, antihypertensive pharmaceuticals, consumables, and bulk solutions, should be carefully monitored to avoid shortages of such products in healthcare facilities.

D. Drug Inventory Management

Drug inventory management refers to the practices and strategies used to efficiently and effectively manage drug inventory in a healthcare institution, such as a hospital, clinic, or pharmacy. [22] The identification of the optimal supply chain structure for drug distribution provides essential information on the drug supply chain. [23] Applications of techniques such as IPLS in healthcare facilities are processes that require analysis and response to challenges, after implementation the results are satisfactory and beneficial to the institutions. [24] Through the sampling technique and an analysis of the data collected in health facilities and with established criteria such as functional store, dispensary unit and essential medicines. [25] These results are important for improving the efficiency of inventory management and the utilization rate of inventory resources in industrial enterprises in the supply chain environment.

III. UNITS

A. Base Model

In a public hospital in Peru, patients must go to the hospital pharmacy to obtain their prescriptions. However, it has been observed that only 47.9% of prescriptions are filled, which prevents the complete provision of the necessary drugs to comply with the indicated treatment. This indicates that the

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level of service in the hospital pharmacy is deficient. In order to address the identified problem, models and methodologies previously analyzed in the scientific literature were considered, which aimed to improve the level of service in the pharmacy.

First, the ABC method is used to classify drugs into A, B and C categories, which allows prioritizing the drugs of greater importance and flow for better inventory and storage management. Secondly, the prescription audit is implemented as a tool to identify weaknesses and opportunities for improvement in prescriptions. This audit is performed through periodic inspections. Finally, the Kaizen method is used to train warehouse personnel. They are taught proper warehouse management practices and their correct application is verified using a checklist. In summary, different methodologies are applied in the public hospital to address the problems in the pharmacy. These include the ABC method for inventory management, prescription auditing to improve prescriptions, and the Kaizen method for training warehouse personnel. These measures aim to improve efficiency and quality of service in the hospital pharmacy.

Therefore, the following table presents the methodologies that will be used in the current research.

TABLE 1
GENERATION OF SUPPORTING INFORMATION ACCORDING TO THE ROOT CAUSE IDENTIFIED

	Description	Indicator	Target	Tool
Causes	Poor choice of drug(s) for the patient's diagnosed problem. the patient's diagnosed problem	% of wrong drug choices	Provide information to physicians on medications available in pharmacies.	Recipe audit
	Deficiency in the control of the most of the drugs with the highest rotation	% Control of medicines with the highest rotation by unit consumption	Stock control in the warehouse	ABC Method
	Deficient number of training courses on warehouse management for warehouse personnel	% Training in warehouse management	Improving warehouse management competencies	Kaizen Method
Consequences	6,626 prescriptions per month were not filled	% Prescriptions not dispensed not dispensed	Optimize the availability information of existing drugs in the pharmacy	Recipe audit
	Inadequate information on the actual actual drug supply situation of medicines	% Medicines with substock	Control inventory management	ABC Method
	Inadequate staff competence in the management of warehouse management	% of personnel with skills in warehouse management	Strengthen the competencies of pharmacy personnel in warehouse management	Kaizen Method

From the above table we conclude that the proposed model involves 3 methods:

B. Proposed Model

The ABC method will be used to manage inventory, prioritizing the drugs with the highest turnover and economic value. The Kaizen method will be applied in the training of warehouse personnel, ensuring compliance with good practices. Prescription auditing will be used to identify improvements in medical prescriptions.

The proposed model has as its fundamental input the low level of service of the pharmacy and the output is expected to significantly increase this indicator. So the model is based on 3 phases: Implementation of the ABC method, Audit of the prescription and Kaizen method.
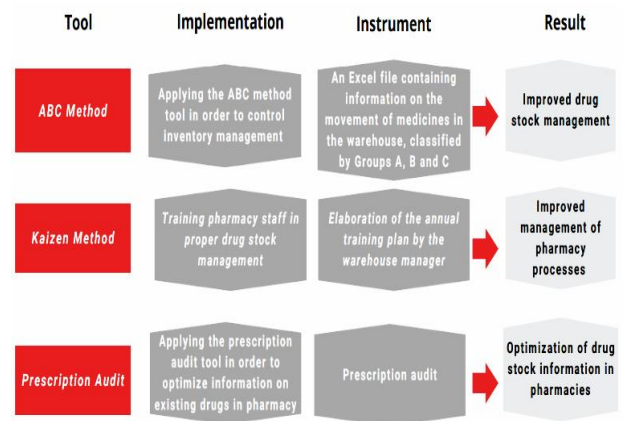

Fig. 1 The model design for the research

C. Structure of the proposed model

1) Phase 1: Application of the ABC Method

The optimal application of the ABC method implied focusing on three fundamental aspects. The first aspect is the technical qualification of the Warehouse Manager regarding the knowledge and application of the conceptual bases of the ABC method, as mentioned above, based on the Pareto principle.

The second aspect refers to the hardware and software equipment of the warehouse; although it may not seem a very relevant aspect, however, we are dealing with a public entity with the already known budget limitations. And the third aspect corresponds to the management and decision making on the information reports generated.

The ABC method will be applied to analyze the rotation behavior of medicines in the warehouse, dividing them into groups A, B and C according to the Pareto principle. An Excel table will be used to record the movement of drugs. The ABC method will offer comparative advantages and will be approached from two perspectives: economic and physical unit consumption. Medicines will be classified according to their economic value and consumption, prioritizing those of greatest importance in each category. However, due to research restrictions in a public entity, the implementation of the ABC method will initially focus on the documentary organization of inventory management in the three aforementioned groups.

A checklist was also incorporated to ensure the correct execution of the process.

The Table II shows the cheklist that was used to monitor the use of the ABC method.

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TABLE II

ABC METHOD CHECKLIST

Check the box if the article is complete	Checklist for the ABC method process
☐	The warehouse manager has an intermediate level of knowledge of the Excel tool
☐	The warehouse manager has a high level of knowledge of the ABC method as a management tool
☐	The Excel file with the relation and rotation of medicines, under the ABC approach, is incorporated in the hardware of the medicine warehouse
☐	The report of group "A" of medicines with the highest turnover in relation to the highest monetary value is shown in the following table
☐	The report of the group "A" of medicines with the highest rotation in relation to the consumption of physical units is shown below
☐	The report of groups "B" and "C" of medicines with the highest turnover in relation to the highest monetary value is shown
☐	The report of groups "B" and "C" of medicines with the highest rotation in relation to the consumption of physical units is shown in the following table

2) Phase 2: Application of the Kaizen Method

In this phase, the Kaizen method was applied to train warehouse personnel. Initially, they will be trained on warehouse management practices, and then their correct application will be verified by means of a checklist. This approach will focus on improving staff knowledge, skills and attitudes regarding warehouse management using the Kaizen method. The head of the Pharmacy service will be responsible for developing a training plan that addresses the necessary knowledge and skills in inventory management with Kaizen approach. An expert in the field will be hired to support this process.

Finally, the warehouse manager will design indicators to periodically evaluate and monitor the efficiency of the warehouse personnel's performance, taking into account the training provided. The modifications made in this methodology is that a checklist has been incorporated to ensure compliance with the objectives established in the annual manual plan. This checklist will allow us to carry out an exhaustive follow-up of the tasks and goals set, making sure that each point is adequately reviewed and fulfilled.
These measures have been taken with the intention of improving overall management and achieving greater efficiency in stock management.
By introducing the checklist, we ensure that every important aspect is verified and completed properly. In summary, the implementation includes the use of a checklist to monitor and meet the objectives of the annual manual plan, as well as the incorporation of staff evaluations to improve stock management. These changes are intended to promote greater effectiveness and efficiency in the performance of tasks related to inventory management. The control of this implementation will be carried out with the checklist.

The Table III shows the cheklist that was used to monitor the use of the kaizen method

TABLE III

KAIZEN METHOD CHECKLIST

Check the box if the article is complete	Checklist for the Kaizen process
☐	Strengthening of knowledge in medicine warehouse inventory management
☐	Strengthening of knowledge in the optimal control of drugs to be expired
☐	Strengthening of knowledge on the identification of expired or deteriorated drugs
☐	Successful completion of the tests included in the annual training plan
☐	Check the use of the knowledge put into practice
☐	It was verified that all medicines dispensed are correctly recorded in order to have a real updated stock
☐	Review of the actual stock inside the pharmacy and the status of the drugs

3) Phase 3: Application of the Prescription Audit

The audit was applied in the dispensing area of the pharmacy service. This procedure will be performed immediately after the administrative assistant in the dispensing area receives the prescription from the patient. The medical audit instrument must necessarily contemplate the fields recorded in the prescription, in order to identify the elements of the indicator at the time of the quality control of the information: errors in the medical prescription.

The audit of the medical prescription will be used in the process of dispensing drugs in order to determine the percentage of incorrect prescribing of drugs. It has already been mentioned that the indicator of incorrect prescription of drugs involves two conditions: that the physician prescribes drugs that are not in stock; and the second condition is that the physician prescribes a drug that is not included in the National Pharmacological Formulary approved by the Ministry of Health [26].

The prescription audit in a Public Hospital involves a thorough review of the medical prescription, verifying legibility and the inclusion of necessary details. An exhaustive verification of the medicines dispensed is carried out, ensuring their correspondence with the prescription. In addition, a checklist was included for the verification of a correct process.

The Table IV shows the cheklist that was used to monitor the use of the prescription audit

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TABLE IV

PRESCRIPTION AUDIT CHECKLIST

Check the box if the article is complete	Checklist for the recipe audit process
☐	Correct prescription of medications in accordance with medical treatment
☐	Readability of the prescription
☐	Inclusion of all details such as patient's name, physician's name, dosage, frequency and duration of treatment
☐	Carefully reviews each medication to ensure that it corresponds to what is prescribed on the prescription
☐	Check drug name, strength, dosage form and expiration date
☐	Verified that all drugs dispensed are recorded correctly and that there are no discrepancies or errors in documentation
☐	Review of drug dispensing records

IV. VALIDATION AND RESULTS

The application of the 3 phases within the model will be shown through the pilot plan that was carried out for this research. In which, solutions to the root causes will be generated to modify the direct causes and in this way the elimination of the problem can be implied and, therefore, the consequences can be reverted. Each phase of the model executed will be explained in detail.

Phase 1: Application of the ABC Method

The results of the implementation of the ABC method were approached from two angles. The first angle was from the perspective of the economic value represented by the drugs, i.e., identifying Groups A, B and C according to their monetary value: group A contained the drugs with the highest economic value and the subsequent groups B and C correspond to those with medium and lower economic value, respectively. The second angle approached was from the perspective of consumption of physical units of drugs. In this case, Group A corresponds to the drugs most consumed by patients during a year. Group B corresponds to the medicines of average consumption after Group A, and finally Group C, i.e., the medicines with the lowest consumption over a year.

The production of reports with the information of the "A" groups, both the medicines that represent the highest monetary value, as well as the medicines that represent the highest rotation in physical units, should be verified. Finally, the reports of groups "B" and "C" of the medicines with the highest economic value, as well as groups "B" and "C" of the medicines with the highest consumption in physical units will be verified.

The Table V shows the indicators used in the ABC method.

TABLE V

INDICATORS FOR PHASE 1 - ABC METHOD

Indicators	
Control of medicines with the highest turnover by monetary value	$\dfrac{\text{Group "A" of medicines with the highest by monetary value}}{\text{Total medicines}} \times 100$
Control of high turnover drugs by unit consumption	$\dfrac{\text{Group "A" of medicines with the highest physical consumption}}{\text{Total medicines}} \times 100$
Percentage of drugs with substock	$\dfrac{\text{Number of drugs in substock}}{\text{Total medicines with highest turnover}} \times 100$

Three indicators were taken into account for the monitoring and analysis of this phase: control of medicines with the highest turnover by monetary value, control of medicines with the highest turnover by unit consumption, and the percentage of medicines with substock. The correct management of the information on the three indicators contributed to improving the supply of medicines in the Public Hospital's pharmacy.

The Table VI shows the metrics of the indicators used in the ABC method.

TABLE VI

MEASUREMENT INDICATORS FOR PHASE 1 OF THE ABC METHOD

Indicators	Initial Metrics	Final Metrics	% Improvement
Control of medicines with the highest turnover by monetary value	20.0%	35.0%	75.0%
Control of high turnover drugs by unit consumption	20.0%	37.0%	63.8%
Percentage of drugs with substock	12.5%	5.0%	60.0%

With regard to the indicator for the control of medicines with the highest turnover by monetary value, a 75% improvement was obtained. This obviously favored the hospital's economic profitability expressed in the economic reimbursements that the Comprehensive Health Insurance will provide to the hospital. The indicator for the control of medicines with the highest turnover by unit consumption also showed an improvement of 63.8%, which contributed to the supply of the most commonly prescribed medicines in the different medical offices. Finally, the indicator for the percentage of medicines in stock showed a 60% improvement.

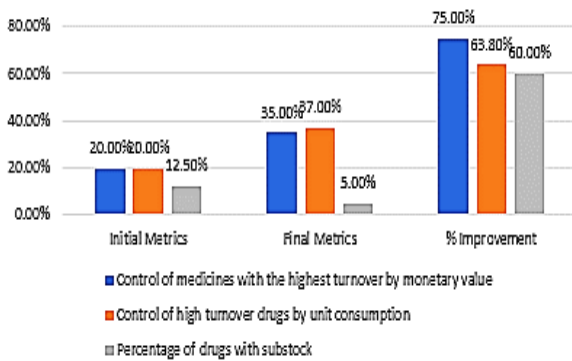The Figure 2 shows the percentages of improvement of the indicators applied in the ABC method.

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Fig 2. ABC Method Phase 1 Indicators

Phase 2: Application of the Kaizen Method

In the development of the validation, the Kaizen methodology was used to improve the level of service in the pharmacy, which is why the training provided in warehouse management was used as an indicator. This refers to the training provided to warehouse workers in the efficient and safe management of the drug inventory, as well as in the handling of the necessary equipment and tools.

This method was applied in the training program offered to the warehouse personnel (02 chemists and 08 pharmacy technicians) during the period from January 9 to March 24, 2023. One way to test the effectiveness of the Kaizen method would be to verify the progressive implementation of the 5 "S" in the drug warehouse, i.e. an improvement in order, cleanliness, hygiene, personal cleanliness and discipline. The Kaizen approach takes into account the training that will be programmed for the warehouse personnel, in which their performance will be measured with their competences in the management of the warehouse management.

The Table VII shows the indicators used in Kaizen.

TABLE VII

INDICATORS FOR PHASE 2 - KAIZEN METHOD

Indicators		
Training in warehouse management	$\dfrac{\text{Number of trainings conducted}}{\text{Number of scheduled training sessions}}$	x100
Staff with warehouse management skills	$\dfrac{\text{Number of employees with warehouse management in warehouse management}}{\text{Total warehouse workers}}$	x100
Warehouse personnel who do not perform physical stock counts on an ongoing basis	$\dfrac{\text{Number of warehouse workers who do not do not perform physical counts}}{\text{Total number of warehouse workers}}$	x100

The measurement indicators of the Kaizen method are shown, such as training in warehouse management, personnel with skills in warehouse management and warehouse personnel who do not carry out physical stock counting on a permanent basis. The three indicators showed evident improvement percentages, the first two being in the increase mode and the third in the decrease mode. All of them are

oriented towards improvement. The following is an individual analysis of each indicator.

It is worth noting that there are only 10 employees with competences in warehouse management in the pharmacy warehouse, and in the end 8 employees managed to have the necessary competences, which represents 80%.

The Table VIII shows the metrics of the indicators used in the kaizen method.

TABLE VIII

MEASUREMENT INDICATORS FOR PHASE 2 OF THE KAIZEN METHOD

Indicators	Initial Metrics	Final Metrics	% Improvement
Training in warehouse management	33.0%	60.0%	81.8%
Staff with warehouse management skills	40.0%	80.0%	100.0%
Warehouse personnel who do not perform physical stock counts on an ongoing basis	60.0%	20.0%	66.6%

The progressive changes that can be evidenced correspond to the incorporation of the 5 "S", the basis of the Kaizen doctrine, as well as a progressive improvement of the processes inside the medicine warehouse. The instrument used was a training plan designed with thematic contents related to warehouse management and with conceptual bases of the Kaizen philosophy theory. The implementation was carried out according to the established schedule, that is, as of February 2023.

The Figure 3 shows the percentages of improvement of the indicators applied in Kaizen.
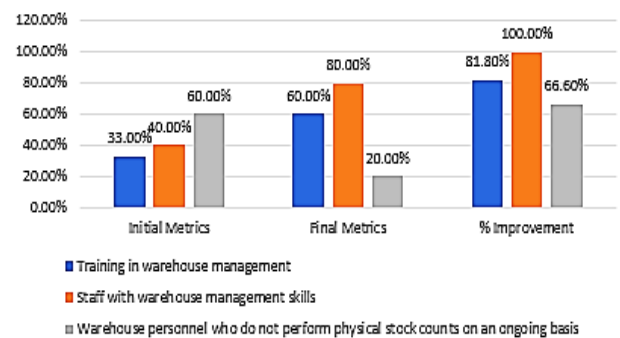

Fig. 3 Kaizen Method Phase 2 Indicators

The following table shows the indicator of the problem being addressed in the research; in which, at the beginning, the initial metric was 47.9%. Finally, after applying the 3 respective implementations in the pharmacy, the final metric was 60.5%, thus obtaining a result of 26.30% as a percentage of improvement.

Phase 3: Application of the Prescription Audit

When using the prescription audit, this necessarily contemplated the fields recorded in the prescription so that at the time of the respective quality control of the information, the elements of the indicator: errors in the medical prescription are identified. The respective indicators are shown in order to apply them and execute the development of the prescription audit process. The criteria of prescriptions

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dispensed, prescriptions partially dispensed, prescriptions not dispensed, prescriptions with errors (all of them in the numerator) and the total number of prescriptions issued (in the denominator) are taken into account. In addition, an additional indicator is added that includes the number of incorrectly prescribed drugs (numerator) and the total number of drugs prescribed (denominator).

The Table IX shows the indicators used in the prescription audit.

TABLE IX

INDICATORS FOR PHASE 3 - PRESCRIPTION AUDIT

Indicators		
Prescriptions dispensed in full	$\dfrac{\text{Number of prescriptions dispensed}}{\text{Total number of prescriptions prescribed}}$	x100
Partially dispensed prescriptions	$\dfrac{\text{Number of partially dispensed prescriptions}}{\text{Total number of prescriptions prescribed}}$	x100
Prescriptions not dispensed	$\dfrac{\text{Number of prescriptions not dispensed}}{\text{Total number of prescriptions prescribed}}$	x100

During the month of March 2023, the data and results of the medical prescription audit process were compiled on a sample of prescriptions from the outpatient clinics of the Public Hospital.

The Table X shows the dates indicated in which the kaizen method was applied.

TABLE X
TIMELINE FOR PHASE 3 - PRESCRIPTION AUDIT

ACTIVITY	MARCH 2023			
	01 - 03	06 - 10	13 - 17	20 - 24
Compilation of medical prescriptions	X			
Audit of collected prescriptions		X		
Analysis of audit results		X		
Construction of initial metrics		X		
Implementation of the Audit Pilot			X	
Construction of final metrics				X

For this purpose, 382 medical prescriptions were taken for March 01 and 02, 2023, all of them coming from the different medical and surgical specialties of the outpatient clinic. In order to organize the work appropriately, a schedule of activities related to the medical prescription audit and the subsequent implementation of a pilot intervention as a continuous improvement activity was designed.

The Figure 4 shows the percentages of improvement of the indicators applied in the prescription audit.
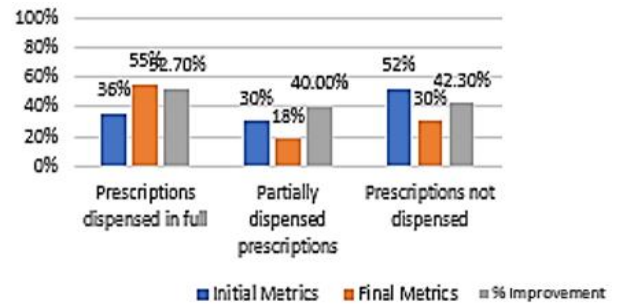

Fig. 4 Phase 3 Prescription Audit Indicators

The initial metric showed a value of 36%, while the final metric showed a value of 55%, leading to a percentage improvement of 52.7%. The initial metric means that of the total number of prescriptions that arrived at the outpatient pharmacy of the public hospital (post pilot), 52.7% of them would have been dispensed with all the drugs prescribed by the specialist physicians from the different medical offices, which is an improvement compared to the initial metric.

The Table XI shows the metrics of the indicators used in the prescription audit.

TABLE XI
MEASUREMENT INDICATORS FOR PHASE 3 OF THE
PRESCRIPTION AUDIT

Indicators	Initial Metrics	Final Metrics	% Improvement
Prescriptions dispensed in full	36%	55%	52.70%
Partially dispensed prescriptions	30%	18%	40.00%
Prescriptions not dispensed	52%	30%	42.30%

With respect to the implementation of the prescription audit, the prescription audit tool had to be applied to optimize the delivery of information on the existing drugs in the pharmacy so that a solution could be found to the first root cause, which is the wrong choice of drug or drugs for the patient's diagnosed problem.

Problem:

The following table shows the indicator of the problem being addressed in the research; in which, at the beginning, the initial metric was 47.9%. Finally, after applying the 3 respective implementations in the pharmacy, the final metric was 60.5%, thus obtaining a result of 26.30% as a percentage of improvement.

The Table XII shows the indicator used to measure the percentage of improvement in the problem covered by the entire investigation.

TABLE XII

PROBLEM INDICATOR (MEASUREMENT OF THE LEVEL OF
SERVICE IN THE PHARMACY

Indicators	Initial Metrics	Final Metrics	% Improvement
% of service level measurement in the pharmacy	47.9%	60.5%	26.30%

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After the application of the 3 tools in the model, an artifact was made to survey the workers on the improvements carried out during the implementation.
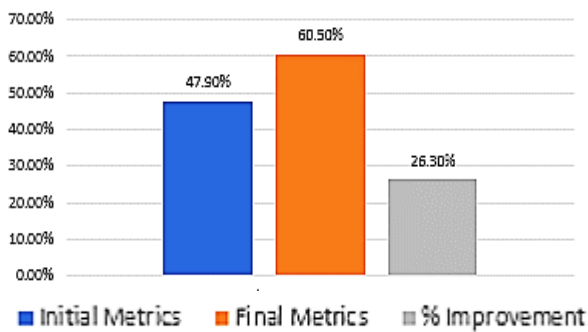

Fig 5. % Of service level measurement in pharmacy

The Table XIII shows the artifact created to measure the competencies or characteristics that should prevail for the correct functioning of the model for the benefit of the service level of the pharmacy of a Public Hospital

TABLE XIII

MEASUREMENT ARTIFACT CREATED – CHECKLIST

Check the box if the article is complete	Warehouse Control Checklist
☐	The worker has to prove his technical skills in warehouse management
☐	The worker must be trained in the use of computerized warehouse techniques
☐	This time, the employee must give a detailed assignment, work hours and completion time
☐	Workers have to allocate separate hours for each task
☐	When rating employee performance, use the agreement and the benchmark standard
☐	Always check or verify employee availability
☐	Verify a correct order and format in the disposal of medicines
☐	Verify that the indicators are correct

The survey was conducted among the 10 workers of the medicine warehouse of the public hospital. The survey was conducted, according to the schedule of activities, between April 3 and 5, 2023. The results were as follows:

- 100% of the workers tested their technical skills in warehouse management. The Good Warehousing Practices Manual was used as a verifying instrument.
- 90% of the workers were trained in the use of computerized warehouse techniques. The hospital's computerized warehouse system was used for this purpose.
- 100% of the employees recorded their working hours and the time they finished their workday in an official warehouse book.

- 100% of the employees performed the segmented scheduling of hours for each task of the procedures involving warehouse management.
- 70% of the employees performed adequately. The reference standards set out in the Good Storage Practices Manual were used for this purpose.
- The availability of warehouse employees was checked 100% of the time.
- It was verified that 85% of the drug items were in the correct order and in duly registered formats (kardex).
- There was 70% effective compliance with the warehouse management indicators.

It can be seen that most of the warehouse management verifiers had satisfactory results. Obviously, the satisfactory achievement of 100% of the verifiers is an ongoing process.

DISCUSSION

The study carried out in a MINSA public hospital in Peru shows that the prescription audit made it possible to improve deficiencies in prescriptions and compliance with health regulations. The ABC methodology also allowed for efficient management of the medicines warehouse, prioritising the control of medicines according to their economic value. The Kaizen approach strengthened staff competencies, favouring continuous process improvement. Taken together, these business tools proved to be effective in the public sector, optimising medicines management and overall efficiency.

Alternative technologies that complement this study include Kardex Remstar, which is a vertical storage system with mobile shelving that allows medicines to be organised and stored [27]. Another technological innovation, but with respect to inventory management, is BD Pyxis™ Logistics, which is software to control the inventory of medicines in real time, optimising stock and preventing stock-outs or overstocking of medicines [28]. It should be noted that these technologies would only be applicable with the approval of the hospital's management.

There are other places where the efficacy of the proposed model can be validated in different healthcare settings. Category I-1 health posts can help to assess its applicability in primary and community care settings. Another setting to validate the model is polyclinics where its effectiveness could be evaluated and analysed in outpatient settings where a large number of patients are seen in an efficient manner. Finally, in Maternity Centres is another option to validate the model, as it could help determine the efficiency of pharmaceutical services in the unique context of maternal and child care, thus helping to contribute to safer and more effective patient care for pregnant women and new mothers receiving care [29].

The Table XIV shows a detailed timeline including long-term monitoring to assess the sustainability of improvements.

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TABLE XIV

LONG-TERM MONITORING TABLE FOR SUSTAINABILITY OF IMPROVEMENTS

Follow-up period	Evaluation Activities
6 months	Review of pharmaceutical performance indicators.
	Patient and staff satisfaction surveys.
	Analysis of prescribing and dispensing accuracy.
	Evaluation of the implementation of Kaizen improvements.
	Comparison of results with the initial implementation period.
	Identification of areas of success and opportunities for improvement.
12 months	Continuous evaluation of performance indicators.
	Follow-up of implementation of recommendations and changes.
	Additional surveys to assess satisfaction and perception of change.
	Analysis of the consistency of improvements over time.
	Review of the sustainability of improved practices and processes.

CONCLUSIONS

The study conducted in a pharmacy of a MINSA Public Hospital in Peru revealed that the prescription audit technique provided relevant information on the behavior of prescriptions made by physicians in outpatient clinics. This information made it possible to correct deficiencies in prescriptions by providing feedback to prescribing physicians. In addition, it was possible to exercise greater control over prescription behavior by ensuring that they comply with the guidelines and regulations such as prescribing drugs using the international nonproprietary name instead of trade names.

The ABC methodology was used as a valuable tool for managing the drug warehouse. This methodology divided the medicines into three groups (A, B and C) according to their economic value, using the Pareto principle. This allowed stricter controls to be applied to group A, due to its higher monetary value, without neglecting attention to groups B and C. The Pareto principle was also applied to analyze the rotation of drugs according to their physical consumption. These combined perspectives led to greater efficiency, flow optimization and improved inventory control.

Strengthening the competencies of warehouse staff through courses in warehouse management with a Kaizen approach was also a relevant factor in the improvement of processes. These courses reinforced the technical knowledge of warehouse management and incorporated aspects of the Eastern culture of the Kaizen method, known for its focus on the continuous improvement of the organisation's processes.

In conclusion, it can be stated that tools such as the ABC method and the Kaizen approach from business experience can be successfully applied in public organisations. This study in a public hospital of the Ministry of Health demonstrated the advantages and favourable results of using these tools in medicines management, improving efficiency and inventory control.

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