Improvement of Order-Processing Process at a Pharmacy

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Abstract — *This project explored an improvement in the time that pharmacy employees took to find medicines from the back of the pharmacy. The Six Sigma´s DMAIC method (Define, Measure, Improve, Analyze and Control) was employed in order to find a root cause and a proper solution to the question of why customers were not satisfied with the speed of the order fulfillment. This research project attempts to minimize the medicine retrieval time by pharmacist assistants in a pharmacy. This is important because it will reduce the overall prescription fulfillment time, increase customer satisfaction, improve the organization and structure in the pharmacy, and enhance audit results since auditors care very much about a facility's appearance. The pharmacy's improvement in this study will be crucial in meeting its two overarching business goals: increasing profits by expanding its customer base through greater performance and exceeding the expectations of the government auditors by maintaining a pristine appearance.*

Key Terms *— Customer, Layout, Pharmacy, Satisfaction, Waiting.*

INTRODUCTION

Community pharmacies, such as the one under study, face several challenges today. Chief among them is competition with national chain pharmacies such as CVS and Walgreens. In terms of attracting customers, these chains possess a few advantages such as greater name recognition and a larger inventory. Having a large inventory is sometimes desirable for customers since during an emergency patients may desire to obtain their medicine immediately instead of waiting a few hours or until the next day. In terms of managing inventory, chains also have the edge in possessing more expensive equipment and their own supply chain, which means buying drugs directly from drug manufacturers, which leads to internal cost reductions for them. In contrast, small pharmacies don't have their own supply chain, and instead buy their product from local drug distributors, such as Drogueria Betances. Community pharmacies try to compete with chain pharmacies by lowering their prices, not requiring a prescription for non-controlled drugs, and offering a more personalized service. An example of this personalized service is the willingness to advance a small sample of a drug for free while a long-time customer waits for their next paycheck. Thus, as they improve their customer satisfaction, they can expect to better compete with larger pharmacies, and consequently improve their profits.

The community pharmacy under study currently buys drugs in limited quantities using a "pull-system" in which they immediately place orders with drug distributors as they receive customer orders. Moreover, they only have a detailed inventory system for the Food aand Drug Administration (FDA) controlled substances, but not for all drugs. In addition, if they place an order in the morning, they can expect the order to arrive in the afternoon. Conversely, if they place an order in the afternoon, they can expect the order to arrive early in morning the day after. Therefore, this research project will focus on minimizing the drug retrieval time since this aids in finding drugs that are in-stock for the waiting customer, and increases the probability that the shipment for the out-of-stock drug will arrive as soon as possible. The expected result of this decreased waiting time for the customer would be a greater customer satisfaction, and greater probability that the customer will return to the pharmacy again.

PROBLEM STATEMENT

The service process in a pharmacy from beginning to end consists of receipt of prescription, verification of patient history and health insurance, contacting health insurance company, checking product availability, searching for the product, packaging and labeling the drug and, finally, handing it to the patient. There has been a long-standing sentiment that the retrieval time for medicines is not at a satisfactory level. There is also a noticeable variation in the time it takes different employees to find items in the back of the pharmacy. The longer it takes to retrieve drugs lengthens the time it takes to determine if a drug is available, delays the order of re-stocking of drugs, increases customer wait times, and decreases customer satisfaction. With the reduction in the product retrieval time, customer wait times can be minimized and customer satisfaction can be maximized. The DMAIC methodology will be employed to achieve this objective.

Research Description

The research project consists of minimizing the time between prescription receipt and drug delivery to patient by reducing the bottleneck of product retrieval time. The decision was made to reorganize the entire product storage areas of the pharmacy in order to speed up the retrieval of medicines. It is crucial to speed up this process since this will reduce customer wait times, thus, increasing customer satisfaction and maximizing customer retention.

Research Objectives

The sub-objectives of this project are to reduce the travel distance to retrieve products by 20% and the retrieval time for the pharmacy employee by a significant margin. The quickened process will reduce the time to completion of the overall order fulfillment time. The improved and better-organized layout implemented for the product storage area will also leave the benefit of impressing government auditors.

Research Contribution

This research hopes to reduce customer wait times and augment customer satisfaction. This will have the effect of increasing both customer retention and the amount of new customers. If the company reduces patient wait times enough, it could reduce to zero the amount of patients who cancel their orders because they do not want to wait at all. Given that the amount of patients who cancel orders daily due to excessive waiting times is around three per day, then the pharmacy could increase their profits by more than $10,000 per year if all cancelations are eliminated.

LITERATURE REVIEW

Pharmacies in the United States are regulated by two bodies: the FDA and a local state agency. They are governed by the FDA's CFR Title 21 Part 1306. This regulation is generally divided into three parts: general information, controlled substances listed in Schedule II and Controlled Substances listed in Schedules III, IV, and V. [1] Controlled substances are drugs which generally have some potential for abuse and always require a prescription. In this context, "schedule" means the category of each controlled substance based on severity, potential for abuse, level of accepted medical use. This pyramid classification starts at Schedule I, which is the most stringently regulated and includes substances such as heroin. Meanwhile, the classification ends at Schedule V, which is the least stringently regulated and includes cough medicine such as codeine. [2] In general, the system works by having the federal regulatory body set the regulations and perform occasional audits. Meanwhile, state regulatory bodies mostly mimic those same regulations, and perform more detailed oversight of pharmacies.

In Puerto Rico, there are three kinds of pharmacies, national chains such as Walgreens and CVS, local, mini-chains such as Farmacia Caridad, and small community pharmacies. The arrival of Walgreens in 1960 [3], and more recently, the arrival of CVS in 2010 [4] has increased the competitive pressure on locally owned pharmacies in the island.

National pharmacy chains generally possess their own supply chain, which means they bring their drugs directly from their warehouses in the mainland United States. They possess the advantage of having a larger amount of inventory, which allows them to almost always have a drug available when a patient requires it. Their larger amount of profit margins permits them to have expensive drugs for rare diseases in-stock and expensive inventory-tracking equipment and software which further aids them in increasing customer satisfaction. Moreover, the national chains' name recognition allows them to attract customers who seek reliability especially when they are in an area where they lack knowledge of the local community pharmacies in the area. [5]

Meanwhile, small locally owned pharmacies buy their drugs from local drug distributors. They tend to buy their products in small amounts because of lower cash flows and profits. Their purchases are usually performed in a "pull" manner, which means that they tend to order more products according to demand and always keep low inventories. Also due to the expensive nature of inventory-tracking equipment, most of the small pharmacies do not track most of their products although some local chains do. The only drugs that they are required to keep a detailed count of are controlled substances. Since controlled substances are usually only 10% of the inventory then this further incentivizes owners of small pharmacies to not improve their inventory-tracking system. [5]

Small pharmacies try to compete with larger chains in two ways. First, they need to lower their prices in order to attract customers. They also usually do not offer services such as drive-through ordering and in-house delivery to cut costs depending on the circumstances. Most importantly, they offer a more personalized service that is very important for many customers. For example, they sometimes provide a small sample of a drug for free or at a reduced cost of a drug when a trusted customer assures that they can pay the remaining amount in a few days. They are also willing to provide non-controlled drugs without a prescription for patients who lack one on a case-by-case basis and sell drugs for a cheaper price to patients without a health insurance plan. Moreover, customers in tight-knit communities often prefer small pharmacies because employees there often know their name and their families, and are aware in detail of their medical history. [5]

A very important concept for pharmacies to perfect in such a competitive landscape is customer retention. According to Galetto, customer retention refers to the activities and actions companies and organizations take to reduce the number of customer defections. Customer retention starts with the first customer-company interaction and continues throughout the whole lifetime of the relationship. It has been demonstrated that customer retention is even more beneficial that customer acquisition since it costs significantly less and stabilizes profits. Thus, customer retention is a more sustainable growth model for a business because it is appealing to customers who already have an intrinsic interest in the business. [6]

There are several ways to increase customer retention. First, the business should set customer expectations early and lower that can be provided to reduce uncertainty and deliver on the service. It should also build relationships based on trust by providing reliable health consulting and even referring them to other business if they do not have the product the customer requires. The management of the business should also encourage friendliness, respect and good-listening skills of their employees when customers go off on a tangent about their personal issues. Finally, the company should employ a proactive approach to customer service by providing anticipatory services to prevent problems and seeking to "go the extra mile" for the customer. A more important way to maximize retention, however, is to improve customer satisfaction by always seeking to improve the business's operation. [6]

A continuous improvement mentality requires a shift to a concept called "lean thinking". Lean thinking is the best solution to "muda" or waste in a business's operations. According to Womack, it provides a way to specify value, organize value-

creating activities in the best sequence, execute these actions without interruption when necessary, and perform them in an increasingly effective manner. In short, lean thinking distinguishes itself because it charts a path to do more with less of everything while getting ever closer to exceeding the customer's expectations every time by always giving customers what they desire. [7]

One of the most important aspects of lean thinking, which is crucial in improving operations, is identifying the value stream of an enterprise. According to Womack, the value stream is the set of all the specific actions required to bring a specific product through the three critical management tasks of any business: the problem-solving tasks running from product design to product launch, the information management task, running from order-taking detailed schedule to delivery, and the physical transformation task from raw materials to a finished product in the hands of the customer. Value stream analysis shows that there are three types of activities in the business: value-added activities, non-value-added activities that are unavoidable and non-value-added activities that are avoidable. Therefore, tracing the value stream of a service is so important given that it often leads to the revelation of incredible amounts of waste in the enterprise. Consequently, the way to move forward for the business would be to immediately eliminate the avoidable non-value-added activities and to, in the long-term, redesign their processes to make obsolete and eliminate non-value-added activities that are currently unavoidable. [7]

The lean mentality has another tool, which is very helpful in improving a business's operations known as 5S. Per the American Society for Quality, 5S is a methodology that results in a work environment that is clean, uncluttered, safe, and well organized to reduce waste and maximize employee productivity. The 5S optimization of workplace is vital for a business due to the mental benefits it has on employees, and the positive first impressions it leaves on customers and regulators. [8]

The 5S quality tool comes from five Japanese terms that begin with the letter "S". First is "seiri" which translates to sort, and means to eliminate what ever is not needed from the work area. Second is "seiton" which means set in order, and implies that tools should be identified and organized according to ease and frequency of use. Third is "seiso" which translates to shine, and dictates that the workplace should be cleaned on a regular schedule. Forth is "seiketsu" which is equivalent to standardizing and dictates that the first three activities should be conducted daily and even once per shift depending on the business. The final "s" is "shitsuke" which translates to sustain, and this means that the business should ingrain these first four activities into the culture of the company so that they can be maintained on a long-term basis. [8]

Visual management is a tool that works hand in hand with 5S to aid in the lean transformation of an enterprise. In plain terms, visual management is a system that delineates expectations, performance, standards, and issues in a clear format that requires no time to comprehend. Visual management is able to quickly demonstrate to management and employees through indicators the status of the business's performance. It is crucial because it empowers employees to always be aware of the existing issues and motivates them to do something about it. The visual management display should be updated frequently in order to quickly address issues to come up and not permit that any issues slip through the cracks without being resolved. The heighted awareness among the employees is a great contributor to waste reduction since it leads to a revelation of issues that were not documented before. The connection between visual management and 5S is evident in the fact that it is visual management that guarantees that the gains made in 5S can be sustained by providing a constant reminded to employees of the goals and objectives of the enterprise. [9]

Another approach to continuous improvement, which is similar to lean thinking, is Six Sigma. It also, like Lean and 5S, has its roots in the manufacturing industry of Japan. This method uses a data-driven review to minimize defects in any business process. The name "Six Sigma" is derived

from mathematical fact that it would take a six-standard deviation event for an error to occur. This is because only 3.4 out of a million normally distributed events along a bell curve would fall outside of six standard deviations. [10]

In recent, Six Sigma has been adapted as a management ideology, which emphasizes statistical improvements with sound data to a business process. More broadly, it promotes a shift in focus from qualitative markers of success to quantitative markers of success. This measured approach is essential for a business undergoing a lean transformation since it brings about the discovery of hidden inefficiencies and helps in sustaining breakthroughs in the quest to approach lean perfection. [10]

PROJECT METHODOLOGY

Derived from the previously discussed Six Sigma method, there exists an approach called DMAIC, which is ideal to improve any process. DMAIC stands for define, measure, analyze, improve and control. It is proposed that the chosen pharmacy employ this tool in order to optimize one of the activities in their operations. DMAIC distinguishes itself because of its flexibility, repeatability, and statistical nature. [10]

The work on the DMAIC project is not conducted by a single person, but by a team that is composed of members of different departments of an enterprise. If a small business runs a DMAIC project, it is important that it integrates employees who do different tasks so it can be equipped with people with varying viewpoints and perspectives. The company management appoints the team and a team leader, hands out a project budget, and lays out possible limitations. Moreover, management should provide Lean Six Sigma training to all employees in the company and greater in-depth training to the team leader. The team should be concentrated on identifying waste, finding the best ways to eliminate it, documenting the gains and exploring ways to sustain these improvements. [10] Now, we will transition to explain every step in the DMAIC process in greater detail.

Define

The first step in this process, known as define, starts by defining a problem, project goals and customer requirements. Moreover, there will be a discussion with management regarding the authority of the team leader, and the budget and limitations they have to work within to execute the project. The team will produce a project charter, which will contain a project statement, a mission statement, and metrics under study. A well-drafted project charter is essential for a process improvement project since it serves as a reminded during the project lifecycle of its objectives, structure, and direction. [11]

Measure

The second step in the process, known as define, seeks to measure the existing baseline state of the process. In other words, it aims to have a better picture of the present process performance of the system under study. One of the ways the team does this is by collecting various types of data from the system. Other tools the team will use in this step is a flowchart to document the process, and a root cause analysis in the form of a “5-Why’s” to examine causes of delays in customer orders. [11]

Analyze

The third step in the process, known as analyze, consists of analyzing the process to ascertain root causes of variation and defects. When scrutinizing the process, the project limitations must be taken into account, in order to pursue, the most viable root cause to tackle. During this step, a “deep-dive” analysis of the system is executed in which the sub-step is examined, and possible inefficiencies are determined. In addition, a graphical analysis, such as a study of a drawing of the process area, is helpful to give further clues as to what might be going wrong in the system. [11]

Improve

The fourth step in DMAIC, known as improve, serves to improve the process by solving the root causes of waste in the system. It is a step of direct action and implementation. Moreover, it requires the documentation of the changes made and of the performance of the improved process according to the chosen metrics. Visual representations such as drawings and graphs can also be used to demonstrate the changes implemented and the positive impact that the changes had on the process. [11]

Control

The fifth and final step in this methodology, known as control, sets the organizational framework that guarantees that the improved performance is maintained well into the future. Hence, concrete actions have to be laid out so as to sustain the gains made in this process improvement project. There could also be future agreed-upon dates during which the improvements made could be evaluated and it can be determined if they still work for the process at hand. A 5S/Visual Management-styled poster could be constructed to remind all employees of the changes made and to follow the new policies. [11]

RESULTS AND DISCUSSION

In the following section, the results, obtained as part of the DMAIC investigation, will be presented and discussed.

Define – The project charter tool, presented in Table 1, will be used to lay out the project statement, the mission statement, and the metrics under observation. Since it has been determined that the product storage layout is a strong predictor of the medicine retrieval time, adjusting the pharmacy layout would be the means to reduce the patient wait time. Therefore, we will be discussing at great length the pharmacy product storage layout; often times, substituting this term for the patient wait time, in terms of what has to be addressed.

Table 1
Project Charter

Project Charter
Problem Statement: Many community pharmacies have a product storage layout that has been left untouched for years.
Mission Statement: For this project, I would like to explore a possible product storage layout alternative and suggest the best approach for the pharmacy under study.
Metrics: Distance Travelled during Search, Time Elapsed during Search

Measure – The first tool used in the measure step is a process flowchart that documents the medicine ordering process from the customer's request for a specific medicine to the output of the medicine to the patient.

In order to examine this process in more detail, a type of root cause analysis, called a "5-Why's", will be performed. It is expected that this type of analysis will help in finding out the cause that is more directly responsible for the problem at hand.

After looking at the fourth step in the process in Figure 1, the step where the assigned employee looks for the medicine, and the root cause analysis in Figure 2, it is determined that the medicine-searching step will be the one that will be further analyzed.

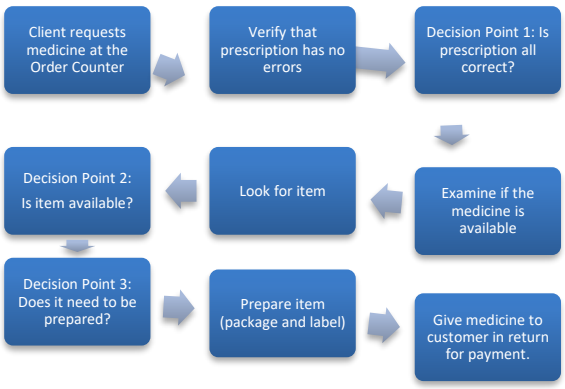

Figure 1
Process Flowchart

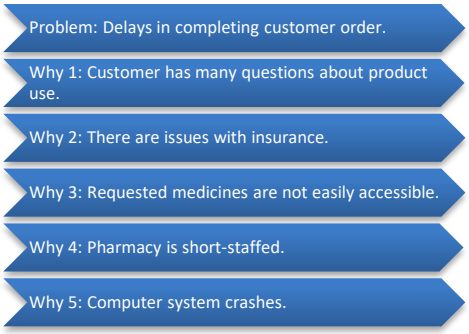

Figure 2
Root Cause Analysis – "5-Why's"

There were two main alternative solutions for the related issue of medicines not being readily accessible which caused a delay in looking for the item. The first proposed alternative was to invest in an inventory-tracking system that would automatically register the state of the inventory after products were either added to inventory or delivered to customers. This idea would have helped alleviate the delays in finding items since it would notify employees when items were not available, instead of having to waste time looking for them. However, management denied further study of this alternative due to the enormous amount of capital investment that its implementation would require.

Consequently, the simpler option, which consisted of exploring a change in the layout of the product storage area to ease the search of the items, was pursued. The metric for this alternative would be initial distance between the employee and various items. Another way to explore the layout would be to graph the layout of the back of the pharmacy on software called R Studio. There were several considerations taken to graph the pharmacy layout in R. First, the dimensions of the behind-the-counter area of the pharmacy will be measured in feet. Also, the dimensions of the major areas that take up space in the pharmacy will be measured such as shelves and counters. Smaller items such as computers or low tables and shaves sticking out from the wall will be omitted from simplicity. Finally, the pharmacy product storage area is currently organized such that there are only two product categories: frequently used items at the front and everything else at the back.

There were other intricacies involved in planning for this distance analysis. Among them was that to quantify the potential improvement of a new design versus the current design, the rectilinear distance will be measured. The specific distance to be analyzed is between the most leftward point in the receiving window, the middle point of Shelf 2, and the most rightward point in the dispensing window. Only this distance will be analyzed given that this Shelf is the bottleneck in the process because it contains a class of medicines of medium-use that is equally far from the windows as medicines that are rarely used. Also, it bares to note that distance was chosen as the basis of comparison instead of retrieval time for simplicity.

Analyze – The analyze phase of the study begins by showing the product storage area of the pharmacy in Figure 3, and the longest distance and shortest distance to retrieve a product in Figure 4, as graphically depicted in R Studio.

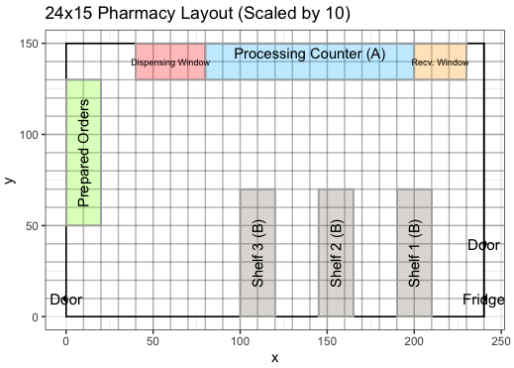

Figure 3
Current Product Storage Area Layout

As shown in Figure 3, in the current layout, all medicines in the pharmacy are divided into two classes based on frequency of sales: A and B. Class A is located right behind the processing counter for quick dispatch to the customer. All other products are grouped into a Class B, which is located in three shelves in the behind-the-counter area of the pharmacy. Each shelf is double-sided and organized in alphabetical order from front to back.

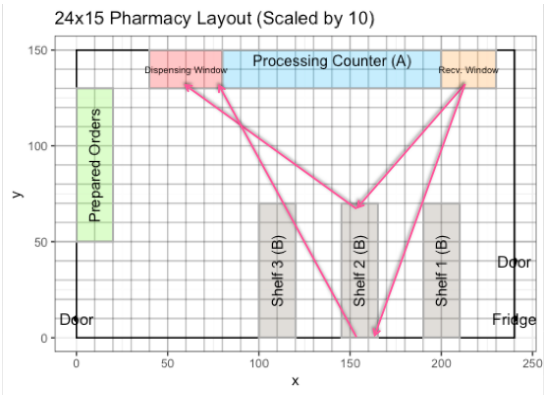

Figure 4
Movement in Current Layout

However, as is evident in Figure 4, this current layout has a major downside. Shelf 2 contains the items that are the second-most frequently sold. However, since Shelf 2 is vertically-oriented then it can take almost double the time retrieve an item from the front of Shelf 2 than from the back of the same shelf as the arrow in Figure 4 show. We also see in Figure 4 that it takes around the same amount of time to retrieve an item from any given shelf (1,2,3). This approach is not the most appropriate given that Shelf 2 medicines are sold more frequently and thus, should be easier, e.g. quicker, to retrieve.

Improve – The improve phase of this methodology will initiate by showing the new, improved layout in Figure 5, and by demonstrating how the movement during product search would be optimized in Figure 6.

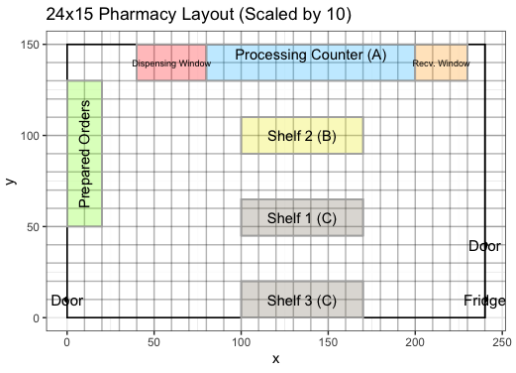

Figure 5
New Product Storage Area Layout

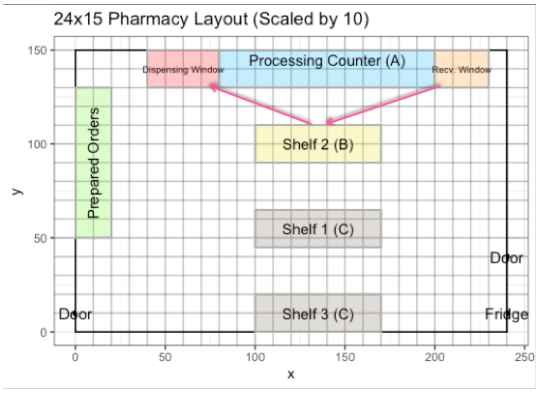

Figure 6
Movement in New Layout

Therefore, as can be seen in Figure 5 and Figure 6, we propose a new approach where instead of having 2 product classes, we have 3 classes ranked by frequency of sales. First, Class A would stay by the front counter. Then, the new Class B would be Shelf 2 oriented horizontally. Finally, shelves 1 and 3 are oriented horizontally and consolidated into a Class C of products. The impact of placing Shelf 3 last is negligible since items placed on this shelf are rarely sold. Therefore, there is very little monetary value lost in delays in those items since they are searched very infrequently.

However, this layout does have a disadvantage in that we now have below average aisle space between Shelf 2 and the front counter. The space between Shelf 2 and the front counter is frequently used given that it is where some employees spend most of their time processing orders. It is also regularly busy space because employees often have to move between the receiving and dispensing windows, which are on either ends of this space. Thus, this change might upset some employees, and it might have to be revisited in the future depending on general employee feedback.

The team also compared the average distance to reach an average point in Shelf 2 for the old and new layouts. While we previously compared the layouts graphically, this comparison will allow us to see numerically if we achieved a significant reduction in the distance employees have to travel to search for products.

As we show in Figure 7, the rectilinear distance to reach a middle point in Shelf 2 was 31 steps and

21 steps for the old layout and the new layout, respectively. This translates into a reduction in distance traveled of 32%, which is very impressive. Consequently, since we know that there is a correlation between the distance traveled to search for an item and the time elapsed searching for an item, then we can infer that the time to search for an item went down by an equally significant percentage.

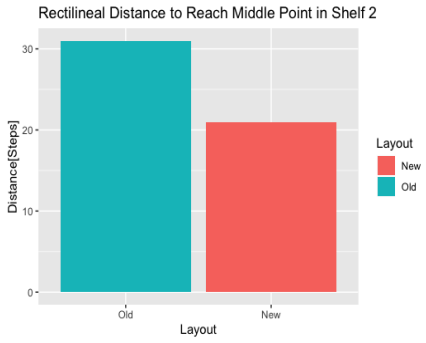

Figure 7
Comparison between Distances to Reach Average Point in Shelf 2 for Old and New Layouts

Moreover, this new layout is a vast improvement since now medicines in Class B are guaranteed to be retrieved quicker since Shelf 2 is now, on average, closer to the receiving and dispensing windows. Additionally, the new horizontal alignment for the shelves reduces the variation in the retrieving process since all points in the shelf are approximately the same travel time for the item picker. The reduction in variation is significant since it reduces the variation in the overall process. Therefore, customers' satisfaction will increase as they see consistency in the time they have to wait instead of seeing wild variations in their waiting time. This is particularly advantageous for customers since it allows them to better plan out their day since going to the pharmacy may be one errand of many that they have to complete on that particular day.

Control – There are a few steps that management will complete in order to sustain the gains of this improvement project. First, there must be a periodic examination of whether products need to be reclassified between product classes. There must also be an occasional evaluation of whether a fourth product class needs to be created given that, at the moment, the sales frequency of the products in Shelf 1 and Shelf 3 is approximately equal. In order to raise employee awareness, the business will also open an hour later than usual one day, to conduct a training seminar. This training seminar will be crucial in explaining to employees the changes made and the reasons for those changes. The final mechanism the team will implement in order to control the new process will be to design a weekly checklist following the 5S / Visual Management model. The weekly checklist will task an employee to once a week verify that all items in the inventory are placed into their correct category and location in the product storage area of the pharmacy. An example worksheet is laid out in Table 2.

Table 2
Weekly Checklist to Verify Proper Organization of Product Storage Area

Employee Name	Employee Signature	Are all items correctly? Y/N
A		
B		
C		

CONCLUSION

During this process improvement project, the team was able to identify the root cause of the delay in processing customer orders, which was the layout of the product storage area. The layout was changed from one employing only two product categories with vertically aligned shelves to one employing three product categories with shelves that were horizontally aligned instead. This change was proved effective given that the reduction in average distance traveled was reduced by 32%, which exceeded the project goals. Since the distance traveled to search for an item is correlated with the time elapsed to search for an item, we can conclude the work was successful in speeding up the process under study. Consequently, a shorter turnaround time between order receipt and order completion

means that customer wait times are reduced which meets the project objectives. Finally, this increase in satisfaction due to superior process performance can be sustained in the long run by means of Visual Management tools and a continuous improvement mentality.

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