Analyzing and Improving the Inventory Management of WPI's Health Service Center

Destin Barboza

Alana Keating

Lindsey Stevens

Nicholas Wright

Advisor: Sara Saberi, PhD

WPI
HEALTH & WELLNESS SERVICES

Table of Contents

Table of Contents

Abstract

As the student population at WPI continues to grow, inventory management practices are a rising concern for the WPI Health Service Center. This project is focused on determining specific areas of concern, and providing the Health Center with solutions to its specific needs. This will be achieved through three phases: analyzing the Health Service Center's current processes, creating solutions, and educating staff on our research and recommendations.

Acknowledgments

This Major Qualifying Project Team would like to thank all of those who assisted us throughout the course of completing this project, including:

Professor Sara Saberi for advising, guiding, and assisting us throughout the project.

The Staff at the WPI Health Service Center for sitting through many interviews and meetings with the team as well as providing necessary data and information when needed.

Casey Morris at Medline for interviewing with us and providing necessary data and information when needed.

Executive Summary

This MQP Project was completed by a group of students in collaboration with WPI's Health Service Center. The intention of the project was to improve the center's inventory management practices. In order to do this, the team put together the following list of objectives in order to understand the center's current practices and find areas to improve.

1. The **first** objective is to assess and understand WPI Health Service Centers inventory needs.
2. The **second** objective is to come up with an inventory management system to address the people, processes, and technologies from end-to-end.
3. The **third** objective is to accurately forecast demand, depending on the Health Service Center's needs for reordering.
4. The **fourth** objective is to organize the stockroom using lean principles.
5. The **fifth** objective is to educate the employees of the Health Service Center (HSC) to replicate and sustain the practices we put in place.

The team analyzed the Health Center over the course of seven months, to determine the areas of improvement regarding inventory management practices. This was completed through observations, meetings, and interviews with the HSC staff and its inventory suppliers. Our team discovered that the problem with the HSC's inventory was mainly communication and organization between multiple entities. The remainder of this project included research and application of methods that will help resolve these main issues.

Table of Figures

1. Introduction

1.1 PROJECT MOTIVATION

The steady rise of students on campus requires the Health Service Center to ensure they have inventory on hand to treat patients. They currently do not have an efficient enough system to manage inventory outside of vaccines, which are administered by the Massachusetts Immunization Information System (MIIS). The HSC has already taken action toward their goal of improvement by making Medline its new medical supplies distributor. However, they still need an inventory system that will allow them to meet the fluctuating demand they receive from the WPI community. Our project will determine specific areas of concern and provide solutions that will enable WPI Health Services to meet its needs.

1.2 BACKGROUND

Today, healthcare systems are different from the health care systems of the 1980s and 1990s. Increased sophistication in medical technology, changes in healthcare supply management, customer-driven health care initiatives, and patient expectations have all contributed to the differences (Xu, Wermus & Bauman, 2011). As the cost and complexity of medical equipment increases, healthcare professionals find themselves more and more in need of tools to track inventory maintenance and location (Sherwin, 2013).

The WPI Health Service Center (HSC) provides students with a team of physicians, nurse practitioners, and nurses (Health Services & Resources, n.d.). The center concerns itself with the diagnosis and treatment of illnesses, evaluations, and treatment of injuries, immunization

clinics, referral services, and sports medicine. Additionally, the HSC dedicates their time to health education on campus in an attempt to create a knowledgeable community of students. The HSC recently began working with a new medical supplier, Medline and is still currently working with their usual lab supplier Quest Diagnostics. The HSC wants to improve its inventory management practices as its methods are not practical. Currently, the clinical coordinator is responsible for monitoring inventory and keeping a handwritten list of low stock items. The center must then wait until their providers call to order these products, making this process expensive and unreliable. Certain products in stock, such as care tests, necessary wound care supplies, immunizations, and laboratory supplies, are often overlooked, contributing to the inventory issue at hand. Our goal is to analyze multiple inventory management practices to improve the HSC's inventory management process, ultimately reducing costs and the likelihood of stockouts.

1.3 PROBLEM STATEMENT

Varying inventory levels in the Health Service Center are leading to disorganization, an unfulfillment of students' needs, increased inventory costs, flow complications, and inefficient use of time. The main problem is defined by the team as **a lack of organization** and **communication** when it comes to inventory processes. The HSC's inventory management shortcomings stem from the demanding schedules of the employees, as well as the many obligations these employees have to prioritize over inventory tracking. The personnel at the HSC do not have precise information on where their inventory is going. Such as, when items expire, when items are loaned out, and what items are used on a daily basis. This inaccuracy

makes it difficult for them to forecast the quantities needed and how much they waste. When the HSC discards expired products due to poor organization, they are increasing their inventory costs and inefficiently using allotted finances. The facility also experiences complications inflow. The process from supplier to students is more complicated than it needs to be, and can sometimes cause inaccuracy. In the realm of inventory management across any discipline, managers are faced with two significant challenges when trying to maintain supplies and customer satisfaction. The first challenge the HSC faces is knowing how much additional inventory is necessary to meet demands, and the second is knowing when to order these products. For the last several years, the Health Service Center at WPI has been experiencing inventory management problems as the campus population has grown. If the HSC were to implement effective inventory management practices, it would lead to better forecasting, improvements in the order process, stock levels, and allow for fewer products to get discarded due to their expiration. It is imperative that this Major Qualifying Project significantly improves the operations and supply chain of the WPI Health Service Center for the benefit of the entire campus. The challenge in this project is the lack of a centralized inventory system in the HSC. data and usage history for our team to work with. When accomplished, these improvements would make personnel's jobs easier at the Health Center in terms of orders and inventory. This new organizational system will benefit students because they will have more access to the things they need. Ideally, this change would be cost-effective because if forecasts were more accurate, fewer items would be discarded.

1.4 GOALS AND OBJECTIVES

1. The first objective is to assess and understand WPI Health Service Centers Inventory needs.
2. The second objective is to come up with an inventory management system to address the people, processes, and technologies from end-to-end.
3. The third objective is to accurately forecast demand, depending on the Health Service Center's needs for reordering.
4. The fourth objective is to organize the stockroom using lean principles.
5. The fifth objective is to educate the employees of the HSC to replicate and sustain the practices we put in place.

2. Literature Review

2.1 INTRODUCTION

Throughout the healthcare industry, many facilities face the problem of poor inventory management. Typically, one of the healthcare nurses is responsible for managing inventory, but due to the nature of their job, they are usually tied up with patient care (Frazier & Mccomb, 2015). This poor delegation often leads to a lack of attention and organization in facility inventory, causing employees to shelve items wherever they can. In more extensive facilities, lack of organization has also led to multiple employees ordering the same supplies. This confusion is due to the fact there is no designated employee in charge, resulting in increased inventory costs. To combat these issues, facilities began to adopt lean practices from the manufacturing industry (Frazier & Mccomb, 2015). In a healthcare setting, lean focuses on reducing costs, reducing the number of orders placed, and maintaining an organized facility to improve efficiency.

2.2 SUPPLY CHAIN AND SUPPLY CHAIN MANAGEMENT IN HEALTHCARE

A supply chain is a network between several entities involved in the flow of products from the supplier to the final buyer. When dealing with supply chains, there are three varying degrees: “direct supply chain, extended supply chain, and ultimate supply chain” (Mentzer, 2001). Direct chains involve only the customer, supplier and company; extended chains take it a step further and involve “the immediate supplier of the supplier and immediate customer of the customer”, and ultimate chains involve all organizations. For any of the given three types,

the respective involved parties are responsible for the supply and distribution flow of all activities, services, finances, information, products, and resources (Mentzer, 2001). Objects of a supply chain include producers, vendors, warehouses, transportation companies, distribution centers, and retailers (Kenton, 2019). The functions of a supply chain include product development, marketing, operations, distribution networks, finance, and customer service. Supply chain management (SCM), on the other hand, “requires traditionally separate materials function to report to an executive responsible for coordinating the entire materials process and also requires joint relationships with suppliers across multiple tiers” (Mentzer, 2001) . Due to differing views on the topic, SCM can be classified into three categories: management philosophies, implementation of management philosophies, and management processes. When these supply chain principles are used with proper management, supply chain management can reduce costs, increase profitability, and help companies to remain competitive in the business market . An essential aspect of a successful supply chain is reliable suppliers, meaning a supplier that produces a product that reaches the manufacturer's and consumer's needs while also creating it in a timely fashion (Kenton, 2019).

SCM consists of the information systems required to coordinate product development, sourcing, production, and logistics. Multiple organizations always make up SCM, and it doesn’t just include what goes on within the four walls of a company . These organizations that make up the supply chain are all related and linked to one another through both physical flows and information flows (Kenton, 2019). Physical flows are the most visible part of the supply chain. They include the transformation, movement, and storage of goods and materials. Information

flows are just as important as physical flows (NC State University [NCSU], 2017). They allow all the organizations in a supply chain to coordinate long-term plans for the product or company and control the day-to-day flow of goods and materials throughout the supply chain (Kenton, 2019).

Customers should be able to rely on the correct products to be delivered to them in the right quantity, on time, and at the correct location. They should also be confident that these products will be delivered in a timely fashion to the exact location they need it. Consumers of a product should also be able to rely on servicing their product as well as appropriate repairs if they are required. A company with an excellent SCM system will instill confidence in their consumers that all of these things will be true. SCM can also help to reduce operating costs for a company. An efficient SCM system will make sure items are provided when required to prevent material shortages and reduce the cost of storing those items. Supply chain managers are concerned with maximizing profits in accordance with minimizing costs. To accomplish this, supply chain managers design networks that meet customer service goals at the smallest total cost as well as improve a company's financial position by increasing profit leverage and decreasing fixed assets such as plants, warehouses, and vehicles (NCSU, 2017). Supply chain management is something that the healthcare industry should be relying heavily on to improve its inventory as technology increases. However, there are several challenges that they must overcome. In the healthcare field, there is a relatively conservative culture because of what they are trying to accomplish in taking care of human life. Because of this, the healthcare field is slower to adapt to new technology and management strategies (Chase & Roberts, 2018).

Another challenge healthcare faces regarding SCM is the government continuously reforms and develops new industry-wide healthcare policies. Supply chain management would be able to help increase productivity by reducing costs, enhancing qualities, shortening product/service cycles, and lowering inventory costs. Much of healthcare supply chain management has been adopted by the supply chain management systems used in commercial industries (Chase & Roberts, 2018). Based on what they have learned from that, healthcare SCM can be placed into five main categories: information technology and new technology in services, general aspects of strategy and objectives of operations in services, selection and design of the service delivery system, strategic quality issues in services, and capacity planning, scheduling, and control (Chase & Roberts, 2018). One of the main problems within Supply Chain management pertains to inventory management as improper management can lead to a larger problem within an organization's operations.

2.3 INVENTORY MANAGEMENT

2.3.1 ABC ANALYSIS

ABC analysis is a useful tool to classify inventory to find what is most important (Rusanescu, 2014). ABC analysis is based on a well-known principle called Pareto's Law, which applies to a situation where "20% of the total effort produces 80% of the total result" (Rusanescu, 2014). This 80/20 principle applies to healthcare inventory management in different ways, depending on what is essential. For example, if focused on cost, the analysis can show which 20% of inventory produces 80% of the price. Once the objective for the examination is determined, data must be collected and ranked according to the size of the impact, and then the cumulative

effect is determined. ABC analysis can help clinics determine which areas of inventory to focus their efforts on to have the most improvement.

2.3.2 SEASONALITY

A major challenge in managing inventory is to match replenishment with demand (Ehrenthal, Honhon, & Woensel, 2014). In a facility like the HSC with limited inventory space, having the right amount of inventory on the shelves to match the demand is crucial. One method to improve accuracy in forecasting demand is to incorporate seasonality. The seasons or periods can range from weeks, months, or calendar seasons (Chapman et al., 2017). Facilities that do not account for seasonality have consistent inequalities in demand and supply, leading to costs that are higher than necessary for the given period. Incorporating seasonality into the HSC's demand forecasts can therefore avoid higher costs and ensure the right items are in stock during different seasons.

2.3.3 ELECTRONIC INVENTORY MANAGEMENT SYSTEM

After thorough research of other organizations, it was determined that a great way to improve overall operations in inventory management is to implement an Electronic Inventory Management System (Micah, E., et.al, 2019). Inventory management is a component of supply chain management that oversees the flow of items. A key function of inventory management is to keep a detailed record of each new or returned product as it enters or leaves a warehouse or point of sale. In addition to streamlining traditional practices, this also greatly minimizes the risk of errors within these processes. An Electric Inventory Management System (EIMS) uses lean principles to improve competitiveness, productivity, efficiency and profitability of an

organization (Pontius, 2020). An EIMS is the computerization and automation of the processes of inventory control and management in any business concern. More specifically, this technology can oversee and monitor stock items, inventory, and supplies. There are many capabilities to this technology, whether these products are company assets, raw materials, and supplies, or finished products ready to be sent to vendors or end consumers (Micah, E., et.al, 2019).

Electronic Inventory Management Systems go further into organizing inventory and have more proficiency than traditional methods. The use of computerization in this system allows for more precise counting and monitoring of inventory items, recording and retrieval of item storage location, recording of changes to inventory, and anticipating inventory needs. Due to these grave improvements from typical inventory management practices, EIMS has become a significant investment in most companies (Pontius, 2020). That being said, every company or organization has some sort of system that controls and manages inventory to some degree, but these may be contained in separate subsystems. It is important to note that an Electric Inventory Management System integrates the various functional subsystems into one cohesive system. This includes, but is not limited to, purchasing, shipping, receiving, tracking, warehousing and storage, turnover, and reordering.

In different firms, the activities associated with each of these areas may not be strictly contained within separate subsystems. Still, these functions must be performed in sequence to have a well-run inventory control system. Which is why it is ideal to have these skills compiled into one system.

This Electric Inventory Management System is also referred to as a "One-Stop-Shop," meaning this system has everything necessary for inventory control and management. Having a clear and established inventory management system ensures that the process and documentation are as streamlined and efficient as possible.

Benefits of Inventory Management Systems

Without an inventory management system, the goods and products that flow through an organization will inevitably be in disarray. Because inventory often consists of movable assets, inventory management systems are critical for keeping tabs on current stock levels and understanding what items move quickly and which items are more slow-moving. This, in turn, enables organizations to determine when it's time to reorder with greater accuracy. Overall, a comprehensive inventory management system offers countless benefits to companies, including improved cash flow, improved reporting and forecasting capabilities, reduced storage costs (overhead), reduced labor costs, reduced deadstock, improved organization, enhanced transparency, and developed supplier, vendor, and partner relationships.

Challenges of Inventory Management Systems

Most of the problems associated with inventory management systems arise from failing to follow best practices or relying on outdated methods, such as manual documentation and inconsistent storage layouts and processes. In these cases, a complete inventory management overhaul may be to streamline inventory management and add both clarity and consistency to the process company-wide. A sound inventory management system reduces human error by

eliminating manual documentation through the use of barcode labels, barcode scanners, and inventory management software, reducing costly mistakes.

Some of the challenges include: slow-moving inventory taking up valuable storage space and eating into the company's bottom line, unexpectedly running out of essential stock items, inaccurate records (wrong part numbers, incorrect inventory counts) that arise from manual documentation errors, time wasted on tracking down items that are stored in the wrong locations, and unoptimized inventory due to inadequate warehouse or stock room layouts which also increases labor costs.

Best Practices for Inventory Management Systems

Clear Inventory explains that a sound inventory management system can help enhance productivity, but only if you set it up with some essentials including Location names, Easy-to-read location labels, Unique item identification numbers, Units of measure, A starting count, A software solution that effectively monitors and tracks activity, Clear, company-wide policies and processes, and People who know how to support these policies and processes. Implementing a comprehensive inventory management system can be complicated as it's not merely a matter of purchasing a suitable software program; an inventory management system must address the people, processes, and technologies from end-to-end.

Barcoding

Changes to recording methods include the use of different purposes of information collection and processing. Control methods are more computer-based and are becoming part of

increasingly integrated systems. Procedures are needed to bring one-off analyses of inventory to become part of routine operations, work needs to be done to produce performance measures which are consistent between different levels of the organizations, and the modeling of dynamic performance needs to become part of the design of inventory systems (Bonney, 1994).

Real-life Example

Cachon & Fisher (2000) described the advantages of the computerization of the inventory system. They explained that in traditional supply chain inventory management, orders are the only information firms' exchange. Still, information technology now allows firms to share demand and inventory data quickly and inexpensively. In their study, the value of sharing this data was shown in a model with one supplier, identical retailers, and stationary stochastic consumer demand. There are inventory holding costs and back-order penalty costs. They compared a traditional information policy that does not use shared information with a full information policy that does exploit shared information. Their study revealed that supply chain costs are 2.2% lower on average with the complete information policy than with the traditional information policy, and the maximum difference is 12.1%. A low rate of stock loss undetected by the information system can lead to inventory inaccuracy that disrupts the replenishment process and creates severe out-of-stock situations.Materials are the foundation of any system, and no organization can operate without them. They must be made available at the right price, quantity, quality and time to coordinate and schedule the production activity in an integrative way for an industrial undertaking. A manufacturing firm will remain shaky if materials are

understocked, overstocked, or in any way poorly managed (Jeruto, Keitany et al., 2014).

When it comes to implementing new technology into a workplace, there is cost and resources that go into the project, and frequently a cost-benefit analysis is performed to gauge the return on investment. Below in figure 1 you can see the flow of items using a computerized system. This computerized system operation is expressed by this diagram. The benefits of inventory management are hard to measure, depending on the methods used. One thing the group would like to implement is barcoding technology, as it greatly benefits inventory management. For example, when a shipment of products is received, the barcode can be scanned, and when a product is used, it will be scanned, providing accurate inventory data.

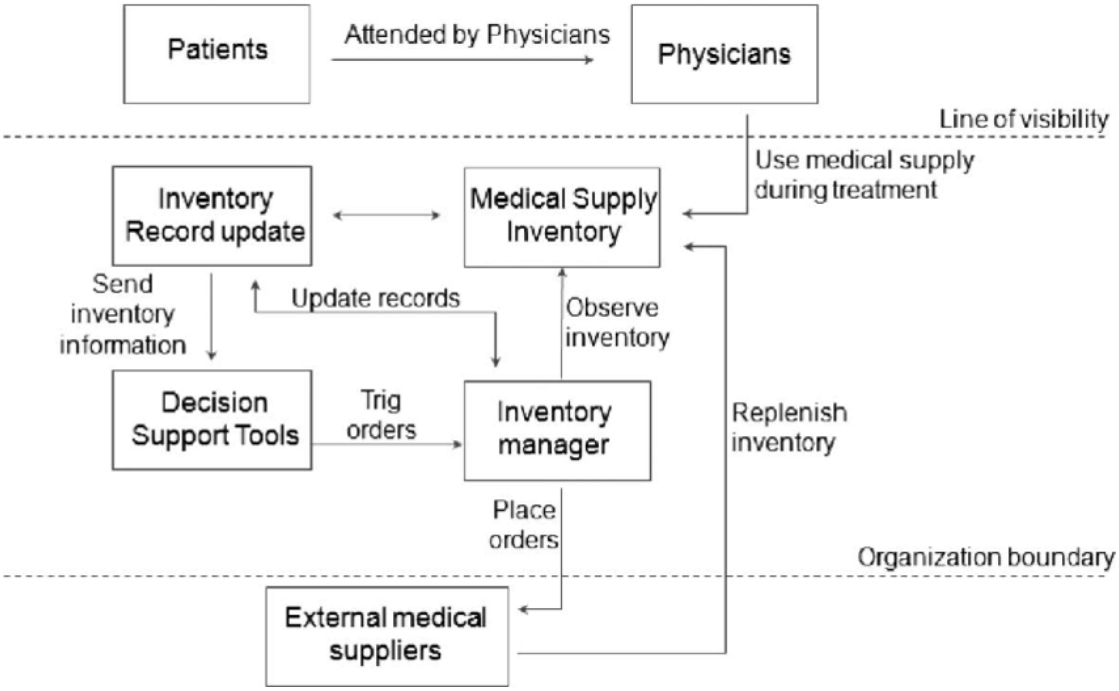


Figure 1: Medical Supply Information Flow (Bauman, Werman, & Xu, 2011).

The first and most prominent benefit to barcoding is the accuracy associated with it

(Chan, Choi, and Hui, 2012). When inventory data is manually entered into Excel spreadsheets or handwritten on paper, which is the HSC's current practice, it is subject to significant human error. The proposed error rates are 10 in 1000 for human-operated keystrokes and a mere 1 in 10,000 scans for a barcode scanner (Chan, 2019). Errors in inventory can have massive repercussions, including delays in shipments, missed orders, and over or under stocked items. Barcodes also would save the managers a lot of much needed time, and this system would overall simplify the process. There are simple and inexpensive ways to implement barcoding technology.

2.3.4 INVENTORY MANAGEMENT IN HEALTHCARE

Inventory control is also a significant concern in service industries, the health sector being one of them (Satir & Cengiz, 1987). In any business or service where the goal is to support clients, it is more simple to digitize some of the operations but becomes more complicated when physical assets are neglected and not appropriately managed. Since healthcare is imperative to a person's wellbeing, continued rises in medication costs make inventory management increasingly important, in regards to human health and mitigating risk (Labuhn et al., 2017).

As the cost and complexity of medical equipment increase, healthcare technology management professionals find themselves more and more in need of tools to track inventory maintenance and location (Sherwin, 2013). The primary operational goal of creating an inventory management system is to identify when, where and what kind of medical supplies are needed for delivering health care services, to improve the availability of medical supply, and to

minimize the number of drugs that pass expiration dates.

Data from multiple studies support the fact that a productive technology investment enables health care providers to achieve better cost and quality performance (Bauman, Wermus & Xu, 2011). There have been documented studies similar to our project, in the respect that professionals attempt to improve control of inventory costs in the central pharmacy of a large academic medical center. In this study, published in the American Journal of Health-System Pharmacy, the pharmacy department spearheaded a supply chain optimization project paired with the medical center's inhouse team of professionals. These experts assisted the academic health center on process improvement using industrial engineering principles (Labuhn et al., 2017). In this project, there were two main components. The first component regarded upgrading and implementing carousel technology. Carousel technology is used primarily in health care, and it involves the installation of either a horizontal or vertical inventory storing system. The benefits that come with carousel technology include improved efficiency and dispensing workflow, decreased medication space, reduced picking errors, and overall inventory management improvements. This expanded the ability to generate accurate floor-stock inventory replenishment reports, which resulted in inefficiencies within the medication-use system. The second component was implementing a technician workflow redesign and algorithm to move towards an Automated Data Collection inventory. Automated Data Collection, or ADC, is the idea of automating data. An example of this would be barcoding technology. Implementing ADC decreased inventory stockouts (i.e., incidents of depletion of medication stock) and improved user satisfaction (Labuhn et al., 2017).

In a study called "Development of an Integrated Medical Supply Information System," the authors detail a more robust and adequate infrastructure for more efficient health care delivery (Bauman, Wermus & Xu, 2011). This Medical Supply Information System (MSIS), includes eight components: a service demand module, an appointment module, a patient record module, a service supply module, a doctor record module, an inventory record module, an external medical supplier module, and a decision support module (Bauman, Wermus & Xu, 2011). To further clarify, the following will detail the four components most relevant to the project.

1. A service demand module would include historical data and forecasting equations to project demand at certain quarters. It would also determine quarterly budget requirements and required staffing.

2. The Inventory record module includes item names, category, item models, lot numbers, locations at the clinic, vendors, manufacturers, reorder levels, target stock levels, discontinued comments, transaction numbers, quantities, dates created, current on-hand inventory, transaction types, payment information, inventory manager, etc.

3. The External medical supplier module includes vendor company names, vendor's contact person, phone number, business ID, email address, address, vendor's web page, medical supply item number, medical supply item description, medical supply item cost, order quantity, etc.

4. Decision support modules have models for demand forecast, demand analysis, point-of-use, economic order quantity (EOQ), reorder point system, can- order system, ABC analysis,

safety stock, etc.

Another study regarding inventory management was performed at the Gujarat Cancer Research Institute in India. This method utilized IT-based control and integrated a system that was founded on IT-based purchasing and management systems (Bauman, Wermus & Xu, 2011). This new system used an ADC and helped the hospital lower costs by 8% the following year. This method also improved the availability of materials across multiple departments (Bauman, Wermus & Xu, 2011).

Adequate control of the stock levels of medicines and other medical supplies not only secures the smooth functioning of the health systems but also contributes to restoring and preserving the wellbeing of patients. The consequences of the lack of such control may prove to be fatal.

2.3.5 EOQ & REORDER POINT BACKGROUND

Controlling inventory in any scenario can be very difficult. Thankfully there are principles and equations to accurately forecast demand and other information that will lead to the company having greater control over their inventory (Hill, 2012). In trying to calculate forecasted demand, there are a lot of uncertainties that make this process difficult. The possibilities include Quantity Demanded, Max Daily Usage, Avg Daily usage, lead time, and other applicable variables. If demand spikes, it is possible to stockout before the new inventory arrives. Similarly, demand might be steady while lead time takes longer than expected, possibly still resulting in a stockout. The fact is, there is uncertainty in both the market and lead time,

and that has a significant impact on the overall performance of an inventory control system. One tool that can be effective is to calculate the Economic Order Quantity, or EOQ. According to Chapman et al. (2017), EOQ can be used when four conditions are met:

1. Demand is relatively constant and known
2. The item is purchased in lots, not continuously
3. Ordering cost and carrying costs are constant and known
4. Replacement occurs all at once

If the four conditions are met and the EOQ is found, that number represents the quantity of an item that should be ordered to minimize carrying cost and ordering cost.

When discussing operations and inventory management in healthcare, it is also important to focus on all management tasks, not only inventory. Tasks such as forecasting demand, developing simulation models, discussing quality management tools and techniques, and the management of projects within healthcare are also important. This brings light to helpful inventory forecasting equations. There are more ways of estimating demand, such as simple moving average, weighted moving average, and simple exponential smoothing, time series analysis, exponential smoothing with the trend, linear regression, and lastly, trend and seasonal models (Jacobs & Chase, 2018). There are many ways to forecast demand, but much like inventory management practices, the best equation for an organization depends on its inventory and historical data.

2.4 LEAN'S ROLE IN INVENTORY MANAGEMENT

2.4.1 LEAN

Lean production is the integrated activities designed to achieve high-volume, high-quality production using minimal inventories of raw materials, work in process, and finished goods. This process is designed to help eliminate waste, eliminate steps that are not needed, and eliminate excess inventory. Steps in the supply chain process should each bring value to the overall goal of the task. If this is not true of a step, Lean suggests that the step be deleted from the process as a whole. Non-value adding activities take up space, consume resources, and do not add any value to the consumer. Lean is designed to be standardized and repeatable in order to produce the best possible result for an organization, despite the uncertainties that come with inventory management. Some examples of these uncertainties are task times and uncertainty in demand (Jacobs & Chase, 2018).

In supply chains, Lean can affect six main segments: suppliers, procurement, manufacturing, warehousing, logistics, and customers. Lean suppliers focus on constant improvement. They should have an inept ability to adapt and adjust to change. Lean suppliers deliver on time, and the inventory that is delivered rarely fails inspection to the point where incoming inspection is not really necessary. The key to lean procurement is visibility. Suppliers should have transparent visibility into customers' operations as well as the customers having transparent visibility into suppliers' operations. This is vital to an inventory management system. Suppliers need to make their customers, such as a health service center, aware of how long items are going to take to be delivered from the time the order is placed. This affects the

reorder levels that an organization will set for ordering new inventory. Lean manufacturing truly focuses on cost reduction and quality improvement. This is done by producing what consumers want, on time, in the correct amount, and with a minimal amount of resources. Lean warehousing focuses on the idea of eliminating waste and non-value added activities in the SCM process. Lean Logistics prioritizes value-adding activities by focusing on the optimization of mode selection and pooling orders, combined multishop truckloads, routing, cross-docking, import/export transportation processes, and backhaul minimization. Lastly, Lean customers have a great understanding of the business they are purchasing from. They value the speed and efficiency that lean brings to an organization (Jacobs & Chase, 2018). Lean procurement and warehousing are the two main segments of Lean that will affect inventory management at WPI health services as it is a much smaller organization.

2.4.2 KANBAN

Kanbans, the Japanese term for “card,” are visual signals that tell production when and how much to produce. During the 1940s, Taiichi Ohno developed the kanban card system for Toyota, allowing him to connect its production processes. In Ohno’s system, there were two common types of Kanban used: withdrawal and production. Withdrawal cards signaled proceeding processes to pull a certain quantity of material while production signaled preceding processes to produce (Monden, 2011). The main drive behind Ohno’s system was to eliminate all non-value added time and waste.

The visual signals in a traditional manufacturing Kanban system display all information on a production system. Helping to control production flow, the cards are used to create a pull

system: producing goods based on actual demand rather than forecasted demand (Monden, 2011). Two key concepts of this type of system are “only produce product to replace product consumed by customers” and “only produce products based on signals sent by customers” (Monden, 2011). In effect, a kanban pull system has the potential to eliminate finished goods inventory in perfect conditions.

Despite Kanban being a great inventory management asset, it’s important to note its drawbacks. When implementing this type of system, managers must remember that suppliers and carriers cannot immediately provide the necessary raw materials. To combat this issue, some managers opt for a work-in-progress system (WIP), a system that partially finished goods with the purpose of reducing lead time and eliminating raw material inventory. Another potential problem in a traditional setting is the breakdown of production machinery. This particular problem results in delays, extra expenses, and lost sales.

In a kanban system, containers at production stations are replenished based on when the container is emptied, not when orders are made. This assumes that there are constant orders coming into the company to be produced. This also assumes that different orders will utilize the same raw materials in addition to a constant production rate. By replenishing the barrels in this manner, the workers do not have to stop production for large downtimes while switching orders.

2.5 INVENTORY MANAGEMENT: WPI HEALTH SERVICE CENTER

The WPI Health Service Center's inventory is managed by both the nurse practitioners and the facility's suppliers, Medline and Quest. Immunizations in the center have a formal system of inventory management. They are tracked online through the Massachusetts Immunization Information System. The remaining inventory in the center is not formally tracked. Faculty instead just communicate once certain inventory starts to run low. Once multiple quantities run low, one of the nurse practitioners is responsible for placing an order. The current practice is inefficient as the nurse practitioners must rely on each other to know when an order needs to be made. It is not uncommon for low stocked items to fly under the radar and go unordered.

Being organized is critical when tracking inventory in companies and organizations. This is one of the problems that the team sees in the HSC. The HSC could use a more efficient organizational system. Issues and mistakes are more likely to arise when inventory is not tracked properly. These problems can include inefficient and additional costs, supplies getting lost in the process, shrinkage going unchecked, stock-outs, critical equipment locations being unknown, inefficient billing, etc. (Oballah, Waiganjo & Wachiuri, 2015).

The WPI HSC reports that they have always had an issue managing their inventory, but only recently realized they need to take action to fix it. The main problems the facility faces are running out of supplies, losing money on discarding expired items, and not having a streamlined process to inform them when stock is low. Another problem the facility faces is a lack of data. There is no data currently tracking the number of materials discarded or used. This has led to

the nurse practitioner guessing the number of items needed rather than using data to back order quantities.

3. Methodology

3.1 OBJECTIVE 1

The first objective was to assess and understand WPI Health Service Center's inventory needs. The first step was to sit down and meet with Health Services. In our introductory interview, the team was informed on the basic information of how WPI's Health Services is currently handling inventory, and what day to day operations are like. In order to manage inventory, the center needs to know day to day patient flow, season peaks and lows, etc. The team was in the Health Service Center consistently throughout the three terms, sometimes going 3-4 times a week. A big portion of our understanding of the Health Center's current practices was observing how things were operating while we were there. Next, we conducted a formal self-assessment on the staff at the Health Service Center. This assessment had them rate themselves on a scale from strongly-disagree to strongly-agree on certain characteristics. These rated statements include things such as: "Health Services always has the right amount of inventory on hand, never over or understocked, etc." This understanding of WPI's Health Service Center allowed the team to determine where improvements needed to be made or recommended.

In addition to the self-assessment, the team completed a flow chart of the inventory management process at the HSC as shown in Figure 2. In order to complete this chart, the team met with the nurse practitioners at the HSC as well as a representative from Medline, Casey Morris.

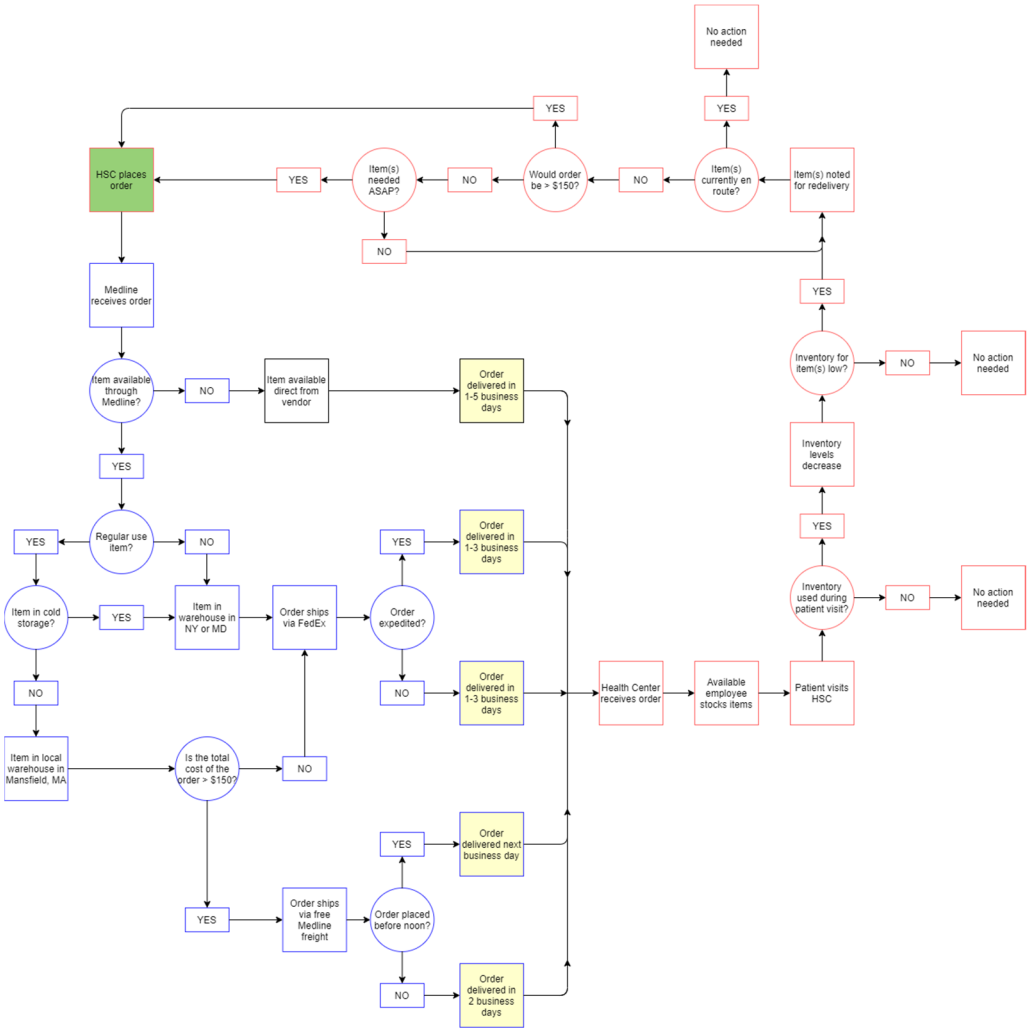


Figure 2: HSC Inventory Flow Chart

3.2 OBJECTIVE 2

The second objective is to come up with an inventory management system to address the people, processes, and technologies from end-to-end. Based on all of the research the team conducted, it was clear that Health Services needed some sort of efficient database to store inventory information. Initially, we discussed an excel sheet to keep track of inventory. We began with going to the Health Center and documenting inventory, but after a few weeks, it was determined that we would need an automated system– possibly barcoding to get an

effective solution for the health service center.

After thorough research, we found an application that could help the team solve the initial problem. This led the team to an app called AppSheet. This application has the ability to store vital information on inventory management such as a picture of the item, the location of the item, the lot number, the barcode, the expiration date, how much is in stock, etc. The team consistently went into the Health Center to go through the inventory and input data into this application. Originally, the goal was to see what they had on hand and to get an understanding of how much they need to keep stock of all products. Each piece of inventory was scanned into the app with the information listed above, and more. As we began to implement the application in the HSC, the team noticed glitchiness in the App. Appsheet wasn't performing as it once was for the team, and in order to complete our project, we needed to find another way to track this data. After thorough research, the team found an application called Sortly. It was clear that we could transfer the data from the original application to the new application. To begin this process, the team had to research multiple system possibilities to satisfy the Health Center's needs. The juxtaposition of each app is listed below and explains why the team felt the need to switch platforms.

Appsheet

This app is able to scan the barcodes of the products and track inventory. There were many steps into making this app effective and work for the Health Service Center. To begin putting products into the application, we needed a compiled list of inventory, which was

initially difficult since the Health Service Center changed its medical providers from McKesson to Medline in the past year. In order to get a complete list of products, we gathered a list of everything purchased in the past year and began an excel sheet of products in stock that were not listed on any orders. This gave us an approximate list of all the products in stock. We then put the list in a corresponding excel sheet linked to the AppSheet Application. This application advertised the “capability to give accurate and smooth inventory counting and record, and frictionless communication between inventory manager and purchasing manager” (Appsheet, n.d.).

We presented this to the Health Center, and it was expressed as a great idea. The Health Center loved the simplicity of the application and the fact that there is a section of the application that highlights products in need of reordering. We spent months configuring the app to best meet our inventory needs and inputting data. See Figure 3 for the App template vs. Our Version.

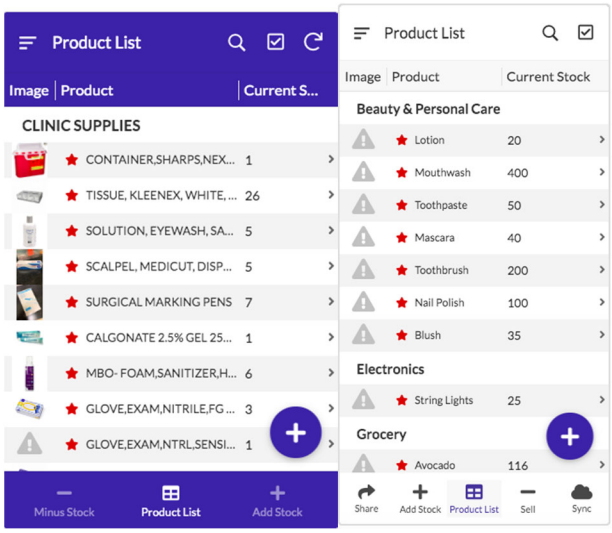


Figure 3: Appsheet Product List (Appsheet, n.d.)

Although this was a great addition, the application initially wasn't working as planned. After months of trying to perfect the app, the group began experiencing complications. The app began to glitch and wasn't performing as it previously was. Instead of adding to inventory, the app would subtract– and so on. After trying to fix the bugs in the application, it was clear we needed to begin another approach to satisfy the problem at the Health Service Center. This is where the group found the app Sortly.

Sortly

Sortly is a simple inventory and asset tracking system that enables one to visually track items and any of their details, including quantity, price, condition, notes, etc. for a more intuitive way for the HSC team to track inventory across the multiple locations.. Sortly allows one to decrease lost assets by eliminating spreadsheets and outdated, time-consuming practices.

It is easy to give multiple users different permission levels. (Eg. Admin access, Edit access, Read-only access). Easily keep track of user activity and what each user edits. In the team's initial search for software, Sortly wasn't an option for inventory management. After examining the app, it was evident that this was the solution for the Health Service Center. Sortly is a more specific app towards keeping track of inventory, compared to AppSheet.

In order to make Sortly an effective part of the Health Service Center, we transferred in the data from the past application. As a result, the team went back into the HSC and recounted inventory since data had changed since we last counted. Once Sortly had the Health Center's

data, it was crucial that folders and capabilities were formed around the Health Center. Below are the capabilities of the Sortly application and website, along with the team's customizations to the application.

Sortly's capabilities include:

Catalog

Sortly enables both PC, Tablet, and iPhone capabilities, making it easy for inventory to always be accessible. Figure 4 details the home screen of our application. Our team created four folders to ensure the application could benefit the Health Service Center and all of their needs. These folders are Available Inventory, Discarded Items, Used Items, and Loaned Items.

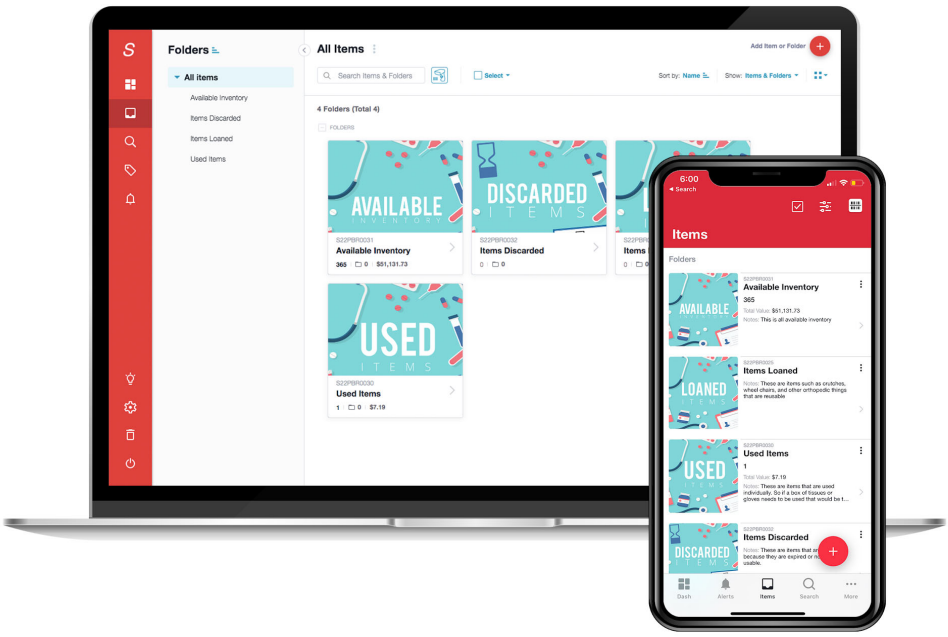


Figure 4: Sortly Main Interface (Sortly, n.d.)

Available Inventory

The Available Inventory folder is kept to date with the Health Centers' most updated inventory count. Items in this folder can be moved to any of the other folders depending on the action taking place by a Health Center Representative. This will be further explained in the next folder.

Items Loaned

Items in the Available Inventory folder will be moved into a respective folder based on their action. For example, if an item such as crutches or a wheelchair is borrowed from the Health Center, this item would be selected in the Available Inventory and moved to the Loaned Inventory. The steps are illustrated below in Figure 5.

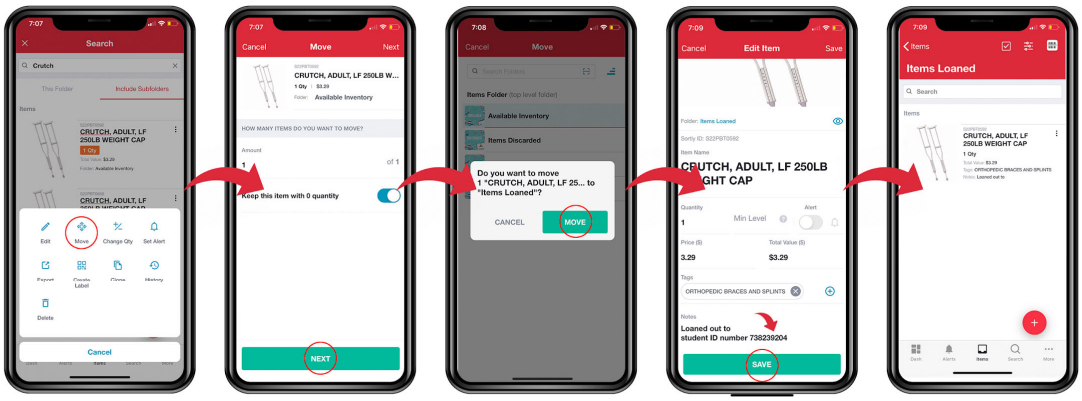


Figure 5: Sortly Items Loaned Process (Sortly, n.d.)

Step 1:

Search the item you are looking to loan out in the search bar. Once found, click on the three little dots to the right of the entry. Then select the "Move" button.

Step 2:

This screen will pop up and ask how many of the items you are moving from Available Inventory to Loaned Items.

Step 3:

This is where you select the desired folder. In this case, when we are loaning an item, it goes into the 'Loaned Items' folder.

Step 4:

Here is where we can edit the single item and add a note as to who the item was loaned out to. Here we would use an ID number. This allows Health Center Employees to keep track of where all of their inventory is at all times.

Step 5:

You will now see that single item in your loaned items folder.

Discarded Items

This folder allows the expired items to be tracked. Once this is performed, we will be able to see when things were discarded and why. We can also see the total value of discarded items. This will help us determine where there is waste and where waste can be reduced within these operations.

Used Items

The idea with the “Used Items” folder is to track when items are used from a day to day basis although, it is an unrealistic request to have the employees check out an item every time it is used on a patient. This folder can instead be updated weekly with inventory counts rather than daily.

Another capability Sortly has is barcoding and QR label generation. With just a click of a button, scannable labels can be placed inside of the stock cabinets. This allows employees to have easier access to barcodes to input the data. The graphic below (Figure 6) details the scanning aspect of the application as well as its other aspects.

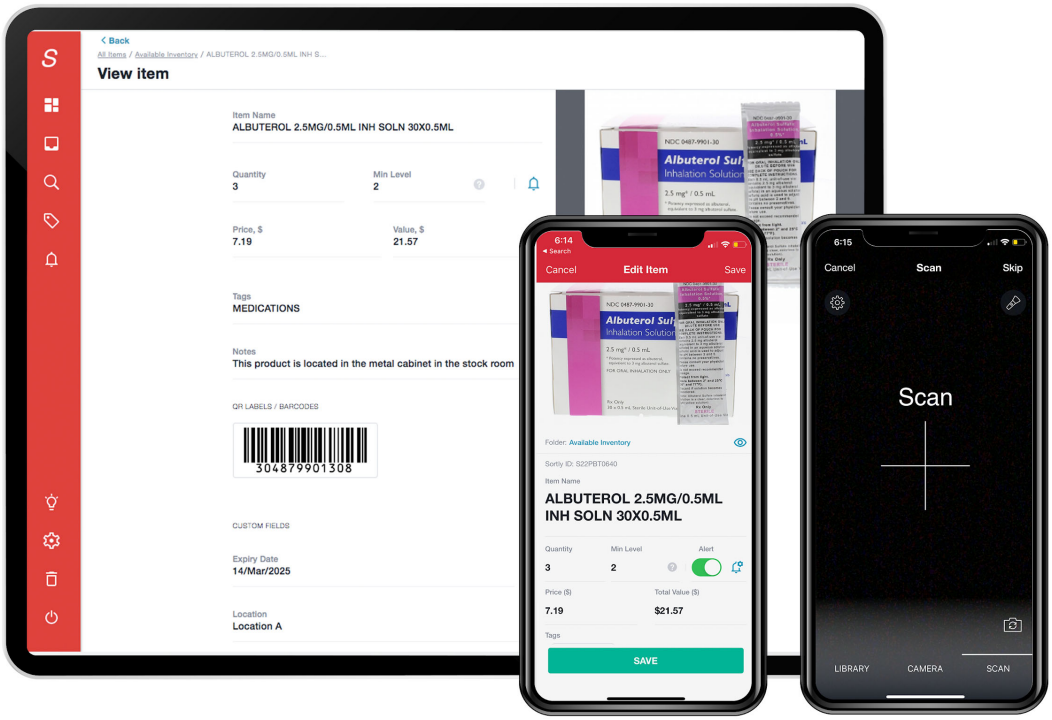


Figure 6: Creating Barcodes for Used Items (Sortly, n.d.)

Track

Sortly stays relevant with a QR- or barcode-powered inventory that can be accessed by any members. Different members can be given different capabilities on the website. As seen in Figure 7, Sortly allows one to:

- Search and update items using Barcodes/QR labels
- Give users access and assign permission levels
- Access your inventory on any device.
- Auto-sync data via the cloud or use offline mode

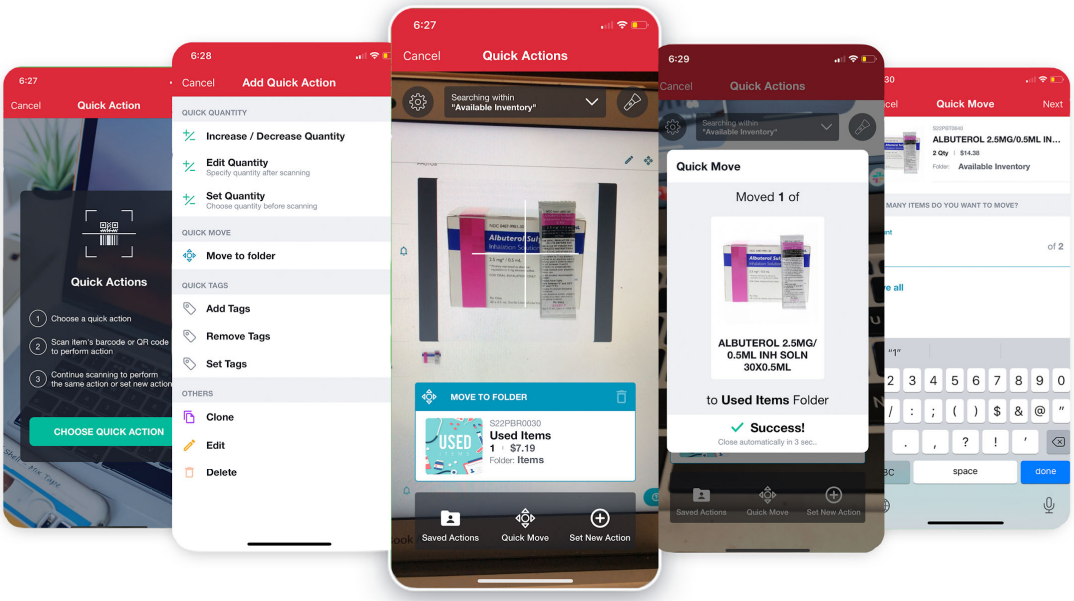


Figure 7: Sortly Tracking Inventory(Sortly, n.d.)

Manage

Reducing waste is a key part of improving an organization's operations. Sortly allows for alerts that notify certain users on the site when an item has low stock or is about to expire. These alerts are automatic and can help save money in the long run. Figure 8 displays an example of the alerts one would see as a user of the website.

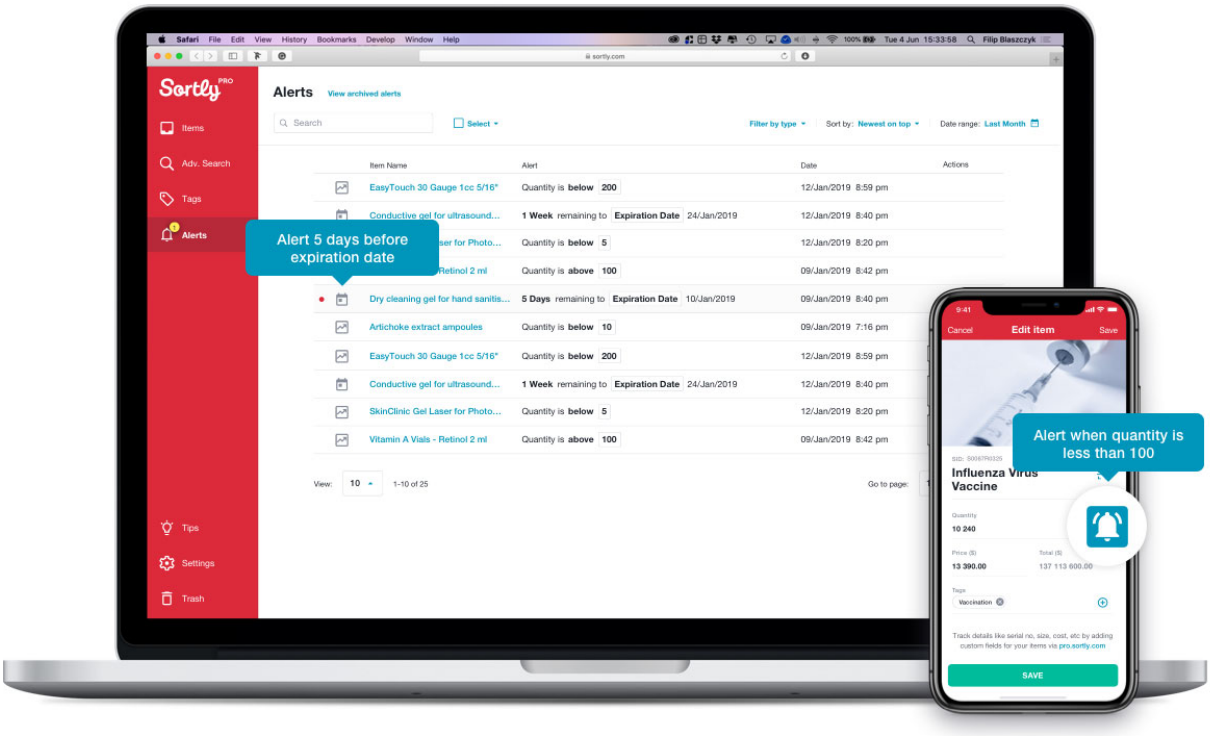


Figure 8: Sortly Product Management Interface (Sortly, n.d.)

Report

Sortly allows businesses and organizations to print out customizable PDF inventory reports. This is beneficial for weekly inventory, and Sortly has the capabilities to:

- Generate current status or activity-based reports

- Sort & filter inventory to create custom lists
- Export reports via CSV, PDF or Dropbox

Figure 9 is an example of an inventory list and how to export data on this application.

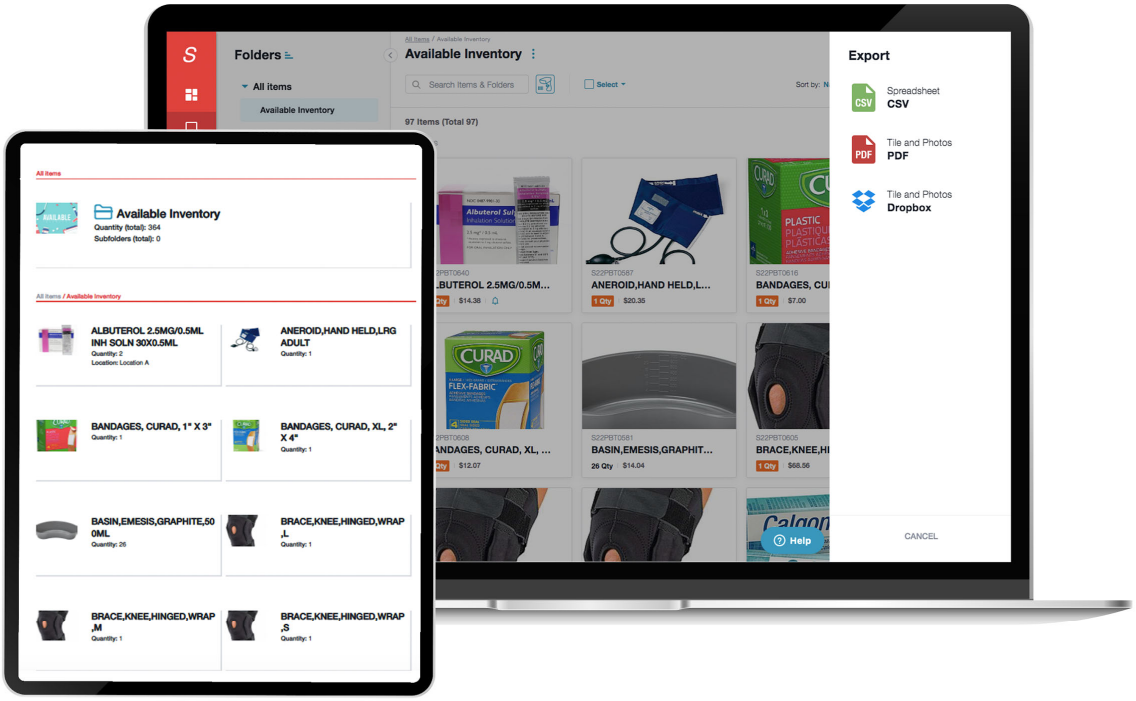


Figure 9: Sortly Reports(Sortly, n.d.)

Inventory

In order to keep consistency with Sortly, items that are used more frequently should be counted weekly using inventory lists. These inventory lists can be exported on Sortly. This inventory can be conducted by anyone in the department and shouldn't take more than an hour out of someone's day. An example of an inventory list is expressed in Figure 10 below.

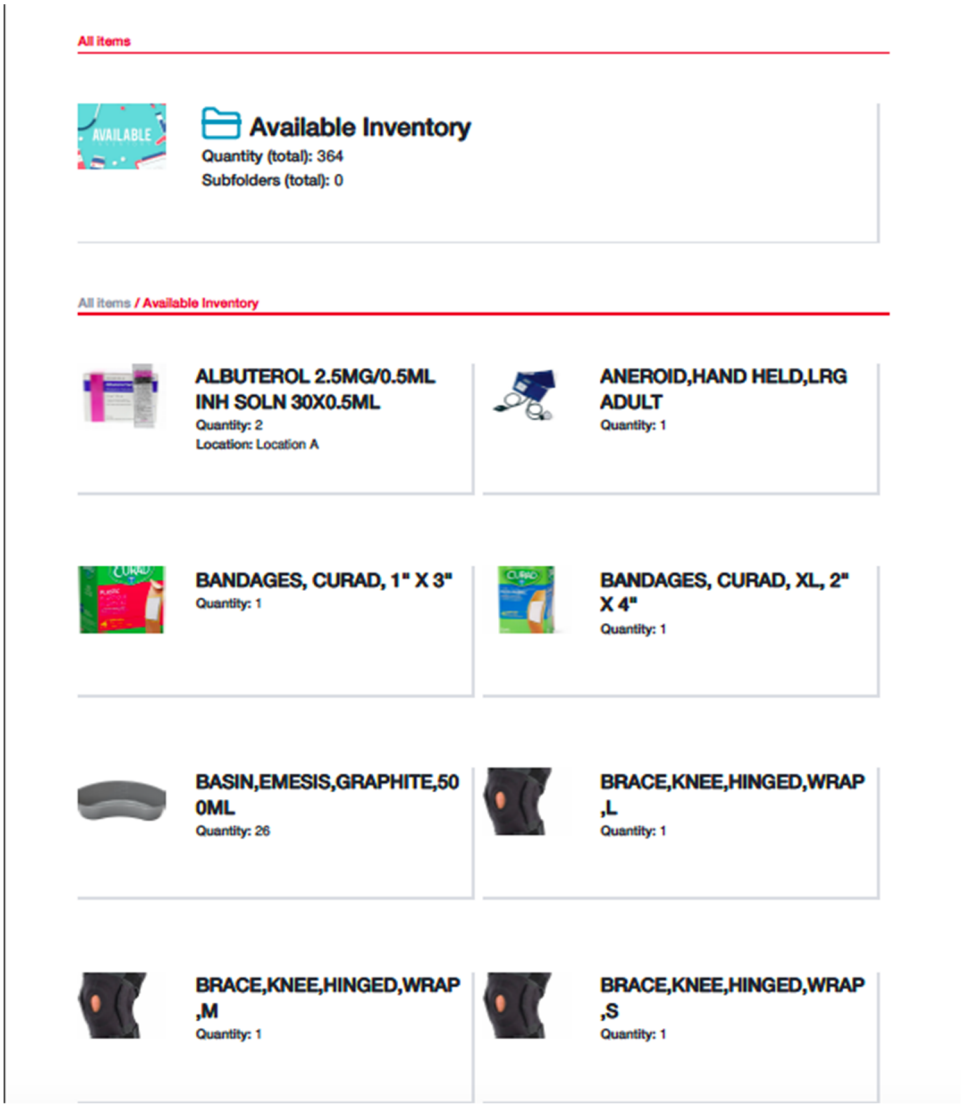


Figure 10: Sortly Inventory Levels (Sortly, n.d.)

3.3 OBJECTIVE 3

The third objective was to accurately forecast demand, depending on the Health Service Center's needs for reordering. In order to achieve this objective, the team needed to gain an understanding of the historical demand of products in the HSC's inventory. We reached out to Medline's account representative and received a list of all orders from August of 2019 through February 2020 to analyze the HSC's demand for an approximate seven month period. This time period covers from when the HSC switched to Medline as a distributor to the most current orders when the analysis was done.

Using the Appsheet (now Sortly) application from the previous objective, the team recorded the current inventory level of each Medline item on hand at the HSC. It was important to track inventory using the same units that each particular item is sold in. For example, hydrogen peroxide is sold per bottle, while ibuprofen is sold per box with each box containing 100 two packs. With the seven months of order data and the current stock at the time of the analysis, the team was able to estimate the usage for each item. There were some limitations to our analysis because there was no historical data on which items were used versus discarded due to expiration or other reasons. Based on conversations with the HSC, the team determined that the number of items discarded without being used was low, so we assumed in our analysis that all items taken out of inventory were actually used.

The team's next step was to calculate reorder points for the Medline inventory the HSC uses. To do this, the team conducted an interview with the Medline account representative,

Casey Morris, that works with the HSC. During the interview, the team learned about Medline's process for receiving orders and delivering them to the HSC. Most importantly, the team learned that the lead time for almost all Medline products is between one to three days. That information was an important component of the reorder point analysis. Using data, estimations, calculations, and a new method of tracking discarded items, the team was able to accurately calculate reorder points for all of the Medline inventory using historical data and estimation. The team created a spreadsheet to achieve this objective that included:

1. Total Quantity Demanded - This number was taken from the previous spreadsheet of all Medline orders.
2. Total Ordering Cost = Costs associated with placing an order. The HSC only pays for shipping and mostly qualifies for free shipping. Estimated ordering cost is $5 per order.
3. Holding Cost - Risk costs associated with discarded inventory. This number was estimated by the HSC.
4. EOQ = $\sqrt{\frac{2 * Total\ Demand * Total\ Ordering\ Cost}{Unit\ Cost * Holding\ Cost\ Percentage}}$
5. Maximum Lead Time - This number was determined to be three days during an interview with Medline
6. Maximum Daily Usage - This number was estimated for each item based on conversations with the team
7. Number of Operating Days - Our data is from an approximate seven month period. The HSC is open six days out of the week.

34 weeks * six days/week = 206 days - 26 days off = 180 operating days

8. Average lead time = estimated between 1-3 days = 2 days
9. Average daily usage=Total Quantity Demanded / Number of Operating Days
10. Safety Stock = (Max Daily Usage * Max Lead Time) - (Avg Daily Usage * Avg Lead Time)
11. Reorder Point = (Average Daily Usage * Average Lead Time) + Safety Stock

Number four on the list, EOQ, was useful because it tells the HSC the exact number to reorder to minimize carrying and holding costs. Also, number 11 was important because the reorder point tells the HSC that for each item, once the inventory reaches that reorder point, that item should be added to the list to be reordered. This number takes any guessing out of the process and provides a consistent threshold to always have available.

In addition, the team wanted to include seasonality as part of the forecasting for future demand. As there was not enough data of previous years to calculate seasonal forecasts now, an example was done and a template was created to be used in future years. First, for the given item, four years of usage history was categorized by season. The five seasons chosen represent A, B, C, D and summer terms but can be modified. Then, the seasonal average was calculated by dividing the sum of the demand for each season by the number of years. Next, seasonal indices were found by dividing the seasonal averages by the average of all of the seasonal averages. Before finding seasonal forecasts for 2024, we first needed to forecast total demand for that year. We used a four year simple moving average by dividing the sum of the total demands by the number of periods, in this case four. Once the total estimated demand was found, we divided that by the number of seasons to get a baseline forecast for each season. The baseline

forecast was multiplied by the seasonal index for each season, resulting in seasonal forecasts for each season in 2024. For years past 2024, a four year moving average can be used again to find the total estimated demand for the forecast year. Also, the previous year's actual demand for each season can be updated and factored into the updated seasonal average for the new forecasts.

3.4 OBJECTIVE 4

The fourth objective is to organize the HSC's stockroom using lean principles. In a manufacturing setting, the following formula is used to determine the number of kanbans needed in each line: the number of cards equals the expected demand during lead time plus safety stock, all divided by the size of the container (Xu, Wermus & Bauman, 2011). Figure 11 provides a numerical example of the Kanban formula, the last column displaying the number of Kanbans needed in each product's production line.

$k = DL(1 + S)/C$

k = Number of kanban card sets

D = Average number of units demanded over some time period

L = Lead time to replenish an order (expressed in the same units as demand)

S = Safety stock expressed as a percentage of demand during the lead time

C = Container size

Demand	Lead Time	Safety Stock	Container	((D*L)*(1+S))/C
161	2	0.2	500	0.77

Figure 11: Example of Calculating Kanban Cards

After evaluating the HSC's current organization practices, the team found that the facility would benefit from a reorganization of inventory and lean principles. Occasionally, newer items are used before older ones in the facility. To alleviate this problem, the team planned a Kanban binning system to organize items according to their expiration dates. The front of each bin displays the items name and reorder point. Using the listed reorder point, staff are given a visual representation of when items must be reordered. In the wall cabinets where bins will not be feasible due to space, the team planned to physically mark the cabinets indicating each item's reorder point. This system will save HSC staff valuable time as they will not need to guess when to reorder items.

3.5 OBJECTIVE 5

The fifth objective is to educate employees of the HSC to replicate and sustain the practices we put in place. In order to improve inventory management, our team is focusing on the barcoding phone application, the organization of inventory in the center, and an excel sheet of all inventory to help with tracking. A major step in all of this will be to walk the Health Center staff through all of this, and its importance. This has been done throughout the entire MQP process, as we are closely collaborating with them on what they need. Additionally, the team will give them all of the important information in a brief presentation. It is vital that the staff at

the Health Center keeps up with these practices we are providing them to ensure future success. For instance, with the phone app, they will need to input inventory when it arrives in order to keep the information up to date and relevant for them. If they have continuous tracking, it is easier for them to keep making improvements along the way.

4. Results

4.1 OBJECTIVE 1

The first objective was to assess and understand WPI Health Service Center's Inventory needs. Upon our initial interview with them, we learned the basic process of their inventory management. Health Services currently relies on a running list of inventory. They wait until several items of inventory are running low, and then they place an order. All of their items besides immunizations are ordered through their medical supplier, Medline. Once they receive a shipment, whoever is available puts it away in the storage closets. One flaw with this system is that they don't always check what is already in storage, so items expire there. The staff's responses self-assessment were as follows:

Health Services always has the right amount of inventory on hand, never over or understocked.					
Strongly Disagree	Somewhat Disagree	Neither Agree Nor Disagree	Somewhat Agree	Strongly Agree	
I never worry about finding recalled or expired products on my shelves.					
Strongly Disagree	Somewhat Disagree	Neither Agree Nor Disagree	Somewhat Agree	Strongly Agree	
Health Services sccurately anticipates product demand based on trends (e.g. seasonality, physician utilization and/or consumption).					
Strongly Disagree	Somewhat Disagree	Neither Agree Nor Disagree	Somewhat Agree	Strongly Agree	
Health Services actively usees data and analytics to improve our inventory management practices.					
Strongly Disagree	Somewhat Disagree	Neither Agree Nor Disagree	Somewhat Agree	Strongly Agree	
Health Service staff can easily and quickly do routine inventory maintenance tasks (e.g. counting inventory and/or making purchasing decisions).					
Strongly Disagree	Somewhat Disagree	Neither Agree Nor Disagree	Somewhat Agree	Strongly Agree	
Health Services uses paper and pencil methods for either documentation or purchasing of inventory.					
Strongly Disagree	Somewhat Disagree	Neither Agree Nor Disagree	Somewhat Agree	Strongly Agree	
Nurses and clinicians at Health Services can easily and quickly find the proper supplies.					
Strongly Disagree	Somewhat Disagree	Neither Agree Nor Disagree	Somewhat Agree	Strongly Agree	
What would you say is the most important?					
Finding Inventory	Purchasing Inventory	Forecasting Demand	Reducing the amount of expired products		

Figure 12: HSC Self-Assessment Responses

The responses in Figure 12 painted a clear picture of what health services themselves thought needed improvement. Throughout our observations, self-

assessment, and initial interview, we realized that the main improvements that Health Services needed were with organization and communication.

WPI Health Services will require an update of its inventory management system. The team had a basic understanding of their current process but needed to walk through it step by step and identify the main areas of improvement. After completely evaluating the health center, the team identified organization and communication as the major issues facing the facility. Another major issue that was pinpointed was a lack of data and usage history. These issues have all played a part in the near stockouts that the HSC has been recently experiencing.

The first objective the project team completed was a self-assessment of the Health Service Center. According to Supply Chain Management Process Standards Edition 2, there are best practices within Planning, Sourcing, & Delivery. Our team used this self-assessment to determine where the Health Service Center needs to make improvements in their processes. There are many sections within this self-assessment that culminate to evaluate the Center's overall inventory plan. Each section in the self-assessment gets a score between 1 and 5. A score of 1 indicates that the center's practices are below the minimum standard; a score of 3 indicates that the center's practices meet the standard, and a score of 5 indicates that the center is practicing the best system. The team went through each section and produced scores (Figure 13) based on prior conversations and observations with Health Services. The team is also had HSC staff evaluate themselves to see what their opinions are as well (Appendix A).

HSC Assesment

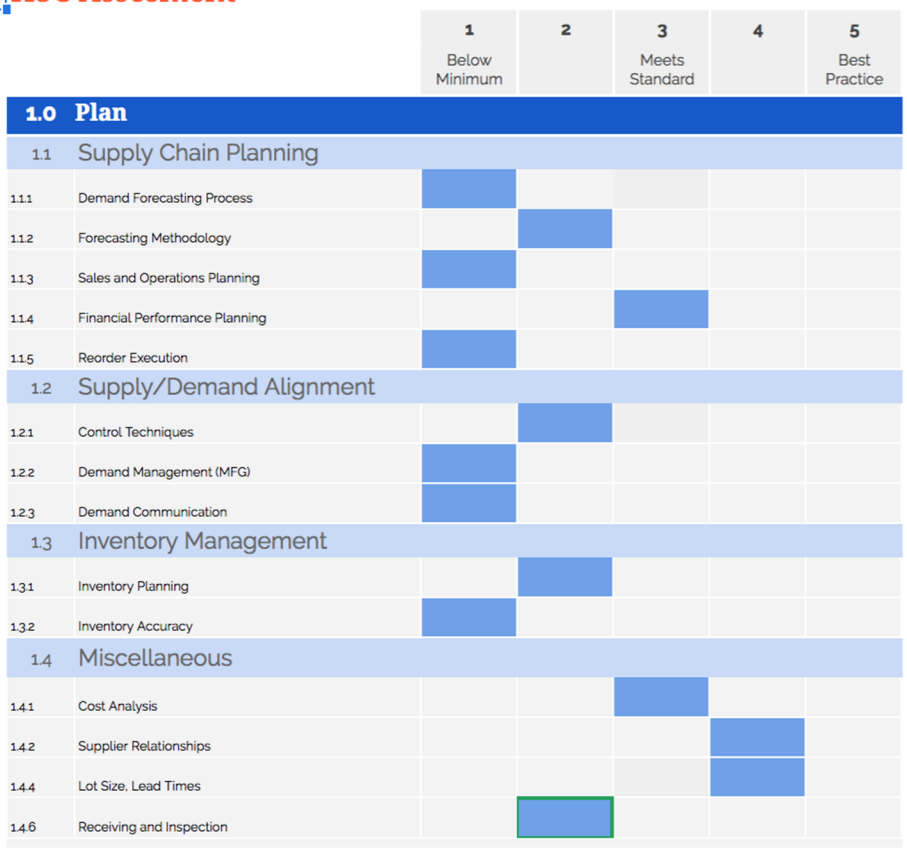


Figure 13: HSC Assessment Scores

1.0 Plan

1.1 Supply Chain Planning

1.1.1 Demand Forecasting Process

The Health Service center was given a score of 1. Based on the team's observations thus far, it does not seem to be extremely clear whose responsibility it is to take care of inventory. This includes demand forecasting. It seems as if their process is more based on reacting versus planning ahead.

1.1.2 Forecasting Methodology

The Health Service center received a score of 2. The Health Center has no real process of forecasting inventory currently. They have very little information on usage history, which would be what they use to predict demand. Based on our conversations with them, it is also difficult for them right now to predict when they would need to adjust

inventory based on demand. This means, for instance, if an item needed to be stocked more or less heavily throughout a certain season.

1.1.3 Sales and Operations Planning

The Health Service center received a score of 1. It seems that it is very little to no collaboration on inventory planning. There appears to be very little communication at all about inventory, let alone designated meeting times to discuss it. This issue stems from the fact that the staff has other responsibilities that also need their attention. Often times, even these other responsibilities have to be prioritized over inventory practices.

1.1.4 Financial Performance Planning

The Health Service Center received a score of 3. The service center looks into their financial planning. For example, they switched one of their medical suppliers to Medline about a year ago because financially, they are more efficient. However, it could definitely be looked at as more of a priority. For instance, they have a major issue of expiring items being thrown out. They have not made any immediate steps to try and solve this issue.

1.1.5 Reorder Execution

The Health Service Center received a score of 1. The center does not have any formulaic way of reordering items based on demand or lead times. The center currently only orders new inventory based on reacting to what they currently have and noticing when items are running low. This is one of the major issues that has caused multiple close calls with stockouts.

1.2 Supply / Demand Alignment

1.2.1 Control Techniques

The Health Service Center received a score of 2. The center does not seem to regularly evaluate delivery processes and lead time. By talking to the suppliers of Health Services, the team gathered this information. However, the staff at the center only had estimations. The control techniques also seem to remain the same versus changing with the seasons of demand.

1.2.2 Demand Management

The Health Service Center received a score of 1. This is not something that they seem to really manage. After conversations with their suppliers, it does not seem like they are aware of any demand changes. For instance, if demand for certain inventory changes within a certain season. Medline bases what they have readily available off of frequent usage and order history. If all of a sudden demand was to spike, the team is not confident right now that the center would be prepared. The staff also does not all seem extremely knowledgeable of what is currently in stock.

1.2.3 Demand Communication

The Health Service Center received a score of 1. Throughout the supply chain process for inventory, demand is not something that seems to be communicated. Again, it seems that the staff does more reacting than planning ahead. They don't seem to have demand in their minds all that frequently.

1.3 Inventory Management

1.3.1 Inventory Planning

The Health Service Center received a score of 2. The center plans as far as trying to order as many products at once as possible but, again, there is a theme where not much planning seems to be going on. Stock levels are mostly estimated based on what the staff believes will be sufficient.

1.3.2 Inventory Accuracy

The Health Service Center received a score of 1. There is no ABC (class system) or directory that holds where all inventory is located. This is something that the team will look into for them.

1.4 Miscellaneous

1.4.1 Cost Analysis

The Health Service Center received a score of 3. The staff makes efforts to save as much money as they can when it comes to ordering inventory. For example, the HSC recently switched suppliers from McKisson to Medline in order to save thousands of dollars. They have also expressed that, at times, they will order certain items from other suppliers if it

is significantly cheaper for them and will not affect efficiency. They could still improve in analyzing their process of expired products.

1.4.2 Supplier Relationships

The Health Service Center received a score of 4. They seem to have good relationships with both of their two main medical suppliers: Medline and Quest. When having meetings with the suppliers, no major issues were brought up as far as interactions with the Health Service Center.

1.4.3 Lot Size, Lead Times

The Health Service Center received a score of 4. Lead times and lot sizes do not seem to cause any major issues for the center. The staff informed the project team that inventory almost always arrives within a couple of weeks. There are a few instances when things are late, but overall, this is not one of the major issues the team sees.

1.4.4 Receiving and Inspection

The Health Service Center received a score of 2. When suppliers bring in items, there is no formal process for storing these items. Whichever staff member has free time first puts the inventory that was delivered away where he or she is pretty confident that it goes. This causes slight inconsistencies in placement. There is also no formal inspection process, at least for regular use items.

In addition to the self-assessment, the team completed a flow chart of the inventory management process at the HSC. In order to complete this chart, the team met with the nurse practitioners at the HSC as well as a representative from Medline, Casey Morris. The complete flow chart can be found in Figure 6. The shapes in blue represent steps in the process that involve Medline, while the red shapes indicate involvement from the HSC. The flowchart represents the initial process the team observed and helped to determine steps that contribute to the challenges at the HSC. Two steps, in particular, were areas that need to be addressed. First, after inventory is used on a patient, there is no formal method to determine when

inventory is low enough to reorder. The nurse practitioners use their judgment to decide when an item needs to be reordered. Once a nurse practitioner has established that reorder is necessary, there is no universal method for tracking which items will be included in the next order. The HSC must rely on the nurse practitioners communicating with each other about which items are ordered. The nurse practitioners have busy schedules with multiple responsibilities, and the lack of formal procedures leaves an opportunity for necessary items to be left off of the next order. The team recognized those issues as areas for improvement within the inventory management process.

4.2 OBJECTIVE 2

The second objective was to come up with an inventory management system to address the people, processes, and technologies from end-to-end. We used our knowledge of the Sortly app and demonstrated the actions to the respective HSC staff. The previous and following objectives are all based around or used in this universal application. This application was imported with all the inventory information and reorder points. When a HSC item is used, discarded or rented, the item is deducted from available inventory into their respective folder. When these items reach the reorder quantity, chosen users of the app are notified via notification and email. Although the application is not fully integrated into the Health Center's system, it has already been beneficial in tracking items leaving the Health Center's available inventory. The Health Service Center now has an effective and cost beneficial way to manage their inventory and other management practices.

4.3 OBJECTIVE 3

The third objective was to accurately forecast demand, depending on the Health Service Center's needs for reordering. The team had information from all Medline orders from August 2019 to February 2020. Each item on the order forms had information including the stock-keeping unit (SKU) number, name, unit ordered in, quantity ordered, and price. The team compiled all of this data in a spreadsheet that also separated each item's orders by month and counted the total quantity of each item ordered over the seven month period. The team created another spreadsheet to calculate the economic order quantity (EOQ) and reorder point for each Medline item. The spreadsheet included the 11 numbers that were explained in the methodology section 3.3.

After speaking with HSC staff, we concluded that discarded inventory sufficiently represents the holding cost (associated risk cost) in the EOQ formula. As shown in Figure 14, an excel sheet has been created as an alternative to Sortly for the purpose of tracking all future discarded inventory and producing the necessary holding cost. The sheet displays the facility's total budget and year-to-date (YTD) loss. To calculate the YTD loss, staff enter the discarded item's name, the date it's being discarded, the item's price per unit, and the quantity being discarded. With this information, the sheet calculates the net loss from each listed item and compiles the data into a separate graph (Figure 15) displaying net monthly loss for a given year. This provides staff with a visual of their yearly expenses on discarded inventory items, further showing the potential for cost savings.

Health Center Yearly Budget	$10,000.00
Total YTD Loss	$ 369.42

Discarded Items				
Date	Item	Price per Unit	# Units Discarded	Calculated Loss
3/2/20	SUPER SANI CLOTH GERMICIDAL WIPES	$ 17.51	2	$ 35.02
3/15/20	HAND SANITIZER 9 OUNCE FOAM	$ 3.92	9	$ 35.31
3/28/20	HAND SANITIZER 12 OUNCE GEL	$ 4.03	6	$ 24.20
4/4/20	HAND SANITIZER GEL PACKETS	$ 1.99	7	$ 13.96
5/25/20	HYDROGEN PEROXIDE	$ 0.98	19	$ 18.62
9/13/20	CEFTRIAXONE	$ 21.38	1	$ 21.38
11/5/20	DOXYCYCLINE	$ 32.01	3	$ 96.04
11/23/20	AZITHROMYCIN	$ 19.62	1	$ 19.62
12/9/20	LIDOCAINE	$ 105.27	1	$ 105.27
				$ -
				$ -
				$ -

Sum Loss By Month		
Start Month	End Month	Loss
Jan-20	1/31/20	$ -
Feb-20	2/29/20	$ -
Mar-20	3/31/20	$ 94.53
Apr-20	4/30/20	$ 13.96
May-20	5/31/20	$ 18.62
Jun-20	6/30/20	$ -
Jul-20	7/31/20	$ -
Aug-20	8/31/20	$ -
Sep-20	9/30/20	$ 21.38
Oct-20	10/31/20	$ -
Nov-20	11/30/20	$ 115.66
Dec-20	12/31/20	$ 105.27

Figure 14: Calculated Discarded Inventory Values

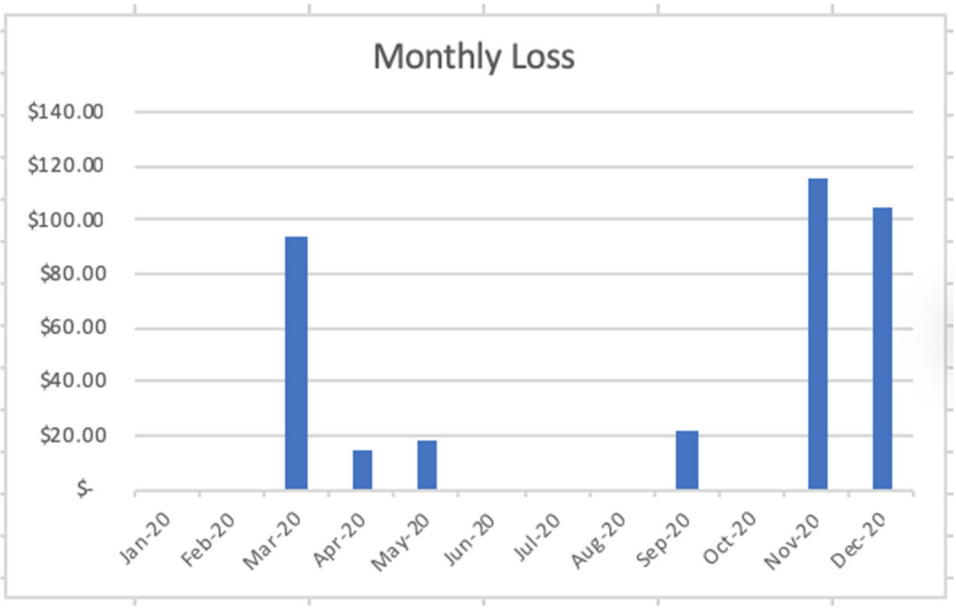


Figure 15: Plotted Discarded Inventory Values

After the team collected all available order history data, it became clear that we lacked enough data to forecast demand using seasonality. However, we believed seasonal forecasting would be a useful method for the HSC once they have data that includes multiple years for each season. Figure 16 displays a template the team created for the HSC to follow to complete a seasonal forecast and included example data from 2020 to 2023 to be replaced by actual data once it is available. The team explained how the calculations were made in methodology section 3.3. Once all of the calculations were done, the example results were shown in the

tables below. The seasonal indices are important because they show mathematically the changes in expected demand for each season. The higher the seasonal index, the more demand is expected for that season compared to other seasons with lower seasonal indices. In our example calculations, seasons two and three have the highest seasonal indices. When those indices are multiplied by the average expected forecast, it can be seen that those two seasons also have the highest estimated seasonal forecasts. This template will be a useful tool for the HSC to use to prepare for changes in demand based on different seasons.

Season	2020	2021	2022	2023
1	7	9	8	5
2	12	10	9	12
3	13	14	16	15
4	8	6	5	10
5	3	5	4	6
Total Demand	43	44	42	48

Season	Seasonal Average	Seasonal Indices
1	7.25	0.819
2	10.75	1.215
3	14.5	1.638
4	7.25	0.819
5	4.5	0.508
Average of Seasonal Averages	8.85	

Forecasted Demand 2024:	44.25		
Forecasted Seasonal Demand 2024			
Season	Forecast	Seasonal Index	Seasonal Forecast
1	11.063	0.819	9.063
2	11.063	1.215	13.438
3	11.063	1.638	18.125
4	11.063	0.819	9.063
5	11.063	0.508	5.625

Figure 16: Seasonality Formula Template

4.4 OBJECTIVE 4

The Fourth objective was to organize the stockroom using lean principles. After further deliberation and testing of the initial kanban system, the team and HSC faculty agreed that a more tailored Kanban system that was low cost and made better use of the HSC's limited space would be beneficial. Using the calculated reorder points, the team has placed bright colored cards on all inventory items as shown in Figure 17. This provides staff with a visual representation of when items must be reordered, saving valuable time, and potential stock outs as they will not need to guess when to reorder items.

Figure 17: Implemented Visual Kanban System

4.5 OBJECTIVE 5

The Fifth objective is to Educate Employees of the HSC to replicate and sustain the operations of Sortly. These improvements will have no benefit if these operations can't be sustained. In order to ensure the success of this implementation, we sat down with the staff of the Health Center and talked through the app with them. This included showing them the steps for inputting inventory as well as all of its features once inventory is inputted. Figure 18 displays some of the applications features.

Secondly, the team put together a manual (Appendix B) for this app. In this manual, all operations necessary are detailed, from importing a new product, printing barcodes, how to conduct inventory, moving items to their necessary folder, and how to calculate the reorder points of items. This manual can be used when the staff need's a refresher on certain functions of the app. It can also be referenced when new employees are hired in order for them to use the app and continue efficiency.

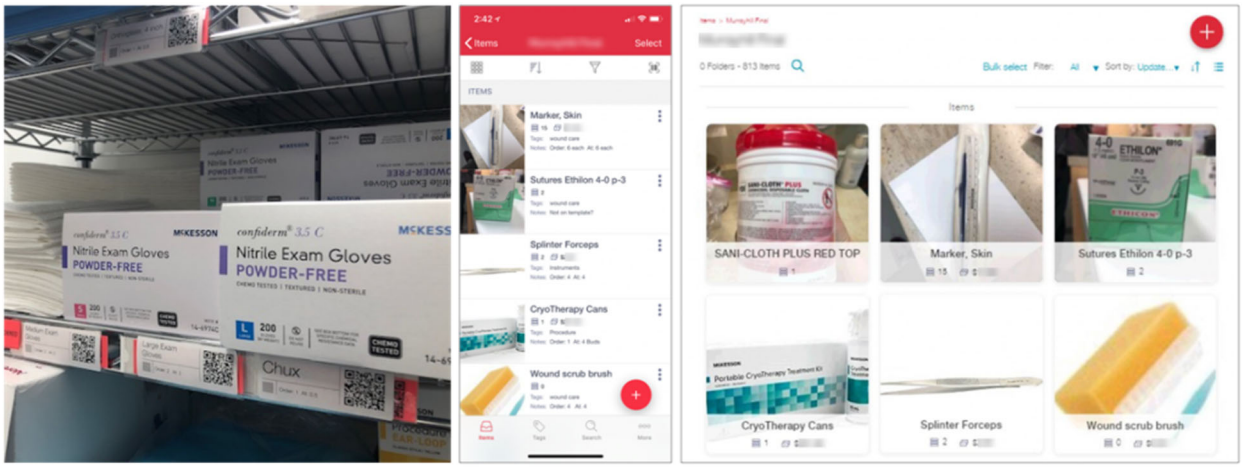


Figure 18: Sortly Functionality (Sortly, n.d.)

5. Conclusion

In conclusion, the team has made great strides in improving inventory management practices within WPI's Health Service Center. The team originally came into the project with five main objectives:

1. Assess and understand WPI Health Service Centers Inventory needs.
2. Develop an inventory management system to address the people, processes, and technologies from end-to-end.
3. Accurately forecast demand, depending on the Health Service Center's needs for reordering.
4. Organize the stockroom using lean principles.
5. Educate the employees of the HSC to replicate and sustain the practices we put in place.

To spearhead this project we began meeting with the Health Center. Our meetings, self-assessment, and observing enabled the team to determine the Health Center's core problems. The problems the team observed involved varying item quantities leading to disorganization, an unfulfillment of students' needs, increased inventory costs, flow complications, and inefficient use of time. We defined that these issues were due to a lack of organization and communication. Before the project, the Health Center didn't have a proper way to track their inventory. This led to items being discarded and lost. Items were discarded based on expiration dates, but this was due to the fact that the newest items were usually placed in front. Items have been lost due to not checking out pricier items to students such as crutches.

In order to fulfill all of our goals and objectives, aside from consistent meetings with the Health Center, we integrated an inventory management application into the HSC's current practices. The application we used, Sortly, allows for items to be imported into the system with ease. Sortly uses barcoding technology and allows for staff to easily add/subtract quantities, loan items to students, etc. This app also has the ability to quantify the value of each folder. Meaning the HSC can see how much the items loaned out are worth, and how much value the discarded items were worth. This visual will assist staff members in not over purchasing or using newer stock items. We also used our reorder point data in this application. This capability allows the app to notify members which items are expiring soon and which items are low in stock. As soon as the staff member who orders items sees this alert, they can order a new product.

This innovation will improve the operations of the Health Service Center drastically and improve their overall operations.

6. Recommendations

6.1 Track Flow of Inventory

The Health Service Center will benefit from utilizing the new integrated application Sortly. Sortly will provide the HSC with a streamlined process for tracking the inflow and outflow all inventory. Moving forward, the faculty responsible for unpacking and shelving incoming inventory will need to scan in each new item to accurately update the center's inventory levels. To maximize efficiency, the HSC should strive to scan out all inventory as it is used. However, we recognize that doing so is not feasible due to the nature of work being performed in the Health Center. To balance out this problem and continue properly managing inventory, the team recommends performing weekly inventory checks to update all stock levels.

6.2 Tracking Discarded Inventory

To further maximize the Health Center's budget and operational efficiency, the team recommends that all discarded inventory be tracked. We have created a designated folder within the application which allows all expired items to be tracked. Additionally, the team is proving the HSC with an alternative measure to the application. We have created a separate excel sheet which provides the same capabilities of the Sortly folder. With either of these methods, the HSC will have the ability to start producing historical data on discarded inventory, providing the facility with more accurate usage rates and a new cost savings method.

6.3 Track Usage & Seasonality

Initially, a limitation of our project was the lack of historical data over a multi-year timeframe. After speaking with Medline representative, Casey Morris, and the Health Center's Registered Nurse Clinical Coordinator, April Childs, the team received access to the center's order history from August 2019 to February 2020. This data proved to be an integral part of our project and we see the value in manipulating it to the HSC's advantage. We recommend that the HSC annually requests all order data from Medline for the purpose of identifying trends and calculating seasonality based on the provided template located in results . By accumulating seasonality and usage data alongside discarded inventory data, the HSC will ultimately gain the ability to forecast daily, weekly, monthly, quarterly, and yearly demand, further contributing to operational efficiency and cost savings.

6.4 Barcoding

As another source of improvement, we recommend the HSC to investigate adopting barcoding as an inventory management practice. The Sortly application gives users the ability to create printable barcodes for each inventory item. With this, barcodes can be placed on the shelving units under each corresponding inventory item. Using the in app QR reader, the HSC will be able to effortlessly scan items in and out of inventory. This can significantly save staff valuable time and prove to be highly efficient.

6.5 Future MQP

Once the HSC has successfully gathered enough historical inventory data, we believe that it would be beneficial for the center to have a future MQP team analyze the data. Using this data, the team would have the ability to calculate seasonality, usage rates, and forecast demand over multiple years. Having done so, the MQP team can further elevate the HSC's inventory management practices and identify new problem areas.

References

Bonney, M. (1994). Trends in inventory management. International Journal of Production Economics, 35(1-3), 107-114. doi:10.1016/0925-5273(94)90070-1

Brue. (2015). Six Sigma for managers. NY, NY: McGraw-Hill Education.

Chan, H., Choi, T., & Hui, C. (2012). Rfid versus bar-coding systems: TRANSACTIONS errors in health care Apparel inventory control. Decision Support Systems, 54(1), 803-811. doi:10.1016/j.dss.2012.08.004

Chan, M. (2018, July 23). How can barcoding benefit inventory management? - unleashed. Retrieved from https://www.unleashedsoftware.com/blog/barcoding-benefits-inventory-management

Chan, M., & Melanie. (2018, July 23). How can barcoding benefit inventory management? - unleashed. Retrieved, from http://www.unleashedsoftware.com/blog/barcoding-benefits-inventory-management.

Chapman, S. N., Arnold, J. R., Gatewood, A. K., & Clive, L. M. (2017). Introduction to materials management. Harlow: Pearson Education Limited.

Desai K. (2010). Six Sigma. Himalaya Publishing House.

Drouillard, J., & Hill, S. D. (2012). Encyclopedia of management. Detroit: Gale, Cengage Learning.

Ehrenthal, J., Honhon, D., & Woensel, T. V. (2014). Demand seasonality in retail inventory management. European Journal of Operational Research, 238(2), 527-539. doi:10.1016/j.ejor.2014.03.030

Frazelle, E. H. (2015). Inventory strategy: Maximizing financial, service and operations performance with inventory strategy. New York: McGraw-Hill Education.

Frazier, S. (2014). Designing A Sustainable And Transferable Inventory Management System For Small Healthcare Facilities (Unpublished doctoral dissertation). Purdue University. Retrieved from https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1351&context=open_access_theses

Handfield, R. (2020, February 19). Supply chain resource cooperative. Retrieved from https://scm.ncsu.edu/scm-articles/article/what-is-supply-chain-management-scm

Hayes, A. (2020, February 05). The ins and outs of inventory management. Retrieved from https://www.investopedia.com/terms/i/inventory-management.asp

Interview with health services [Personal interview]. (2019-2020).

Jacobs, F. R., & Chase, R. B. (2020). Operations and supply chain management: The core. New York, NY: McGraw-Hill Education.

Kenton, W. (2020, March 15). How supply chains work. Retrieved from https://www.investopedia.com/terms/s/supplychain.asp

Kim, S., & Kwon, I. G. (2015). The Study of Healthcare Supply Chain Management in United States: Literature Review. Management Review: An International Journal, 10(2). Retrieved from https://www.researchgate.net/publication/334223774_The_Study_of_Healthcare_Supply_Chain_Management_in_United_States_Literature_Review.

Labuhn, J., Almeter, P., Mclaughlin, C., Fields, P., & Turner, B. (2017). Supply chain optimization at an academic medical center. American Journal of Health-System Pharmacy, 74(15), 1184-1190. doi:10.2146/ajhp160774

M., N., Michael, E. E., Adekunle, K., Akinwunmi, & Adeboye. (2019). Assessment of electronic inventory management systems in the healthcare system in Abuja, Fct nigeria. European Journal of Business and Innovation Research, 7(6), 1-17. Retrieved from

https://www.semanticscholar.org/paper/ASSESSMENT-OF-ELECTRONIC-INVENTORY-MANAGEMENT-AND-Nigeria.-Micah/6baedcce5d16a7d0076912ba5d891aaf8d3a04ae.

Mentzer, J. T., Dewitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). Defining supply chain management. Journal of Business Logistics, 22(2), 1-25. doi:10.1002/j.2158-1592.2001.tb00001.x

Monden, Y. (2015). Toyota production system: An integrated approach to just-in-time. Boca Raton: CRC Press.

Oballah, D., Wachiuri, E. W., & Waiganjo, E., Dr. (2015). EFFECT of inventory management practices on Organizational performance in public health institutions IN kenya: A case study OF Kenyatta national hospital. International Journal of Education and Research, 3(3).

Pontius, N. (2020, January 18). What is an Inventory Management System? Definition of Inventory Management Systems, Benefits, Best Practices & More [Web log post]. Retrieved from https://www.camcode.com/asset-tags/what-is-an-inventory-management-system/

Rosseti, M. D., Marek, D., Prabhu, S., Bhonsle, A., Sharp, S., & Liu, Y. (2015). Inventory management issues in healthcare supply chains. Retrieved from https://pdfs.semanticscholar.org/3aaf/c7c59614075672f6e6de42b0e76b57ba8b94.pdf.

Rusănescu, M. (2014, February). Abc analysis, model for classifying inventory. Magazine of Hydraulics, Pneumatics, Tribology, Ecology, Sensorics, Mechatronics, 2(14). Retrieved from http://hidraulica.fluidas.ro/2014/nr2/17-20.pdf

Satir, A., & Cengiz, D. (1987). Medicinal inventory control in a University Health Centre. The Journal of the Operational Research Society, 38(5), 387. doi:10.2307/2582728

Sherwin, J. (2013). The essentials of medical device inventory tracking. Biomedical Instrumentation & Technology, 47(5), 382-386. doi:10.2345/0899-8205-47.5.382

Whitson, D. (1997). Applying just-in-time systems in health care. IIE Solutions, 29(8), 32-37.

Williams, B. D., Waller, M. A., Ahire, S., & Ferrier, G. D. (2014). Predicting retailer orders with pos and order data: The inventory balance effect. European Journal of Operational Research, 232(3), 593-600. doi:10.1016/j.ejor.2013.07.016

Xu, E., Wermus, M., & Bauman, D. B. (2011). Development of an integrated medical supply information system. Enterprise Information Systems, 5(3), 385-399. doi:10.1080/17517575.2011.566630

Appendix

Appendix A

How positive or negative are your interactions with other members of your department?

1. How effective is the leadership of your department?
2. How valued do you feel your input and opinions are to department leaders?
3. How effectively are your talents being utilized by the department?
4. How satisfied or dissatisfied are you with the senior administration at this University?
5. For fair or unfair are the administrative procedures at this University?
6. How fairly are you compensated for your work at this University?
7. Overall, how satisfied or dissatisfied are you with this University as a workplace?
8. IS there any improvement that you would like to see that would improve workplace satisfaction?
9. How manageable or unmanageable is your workload requirement at this University?
10. Does Health Services always have the right amount of inventory on hand?
11. Do you worry about finding recalled or expired items on the shelves?
12. Does Health Services use per-and-pencil for either documentation or purchasing of inventory?
13. Can nurses and clinicians at Health Services easily and quickly find the proper supplies?
14. Which would you say is the most important?
    a. Finding inventory
    b. Forecasting demand
    c. Reducing waste and expired products

Appendix B

USER'S MANUAL

Health Service Center

The WPI Health Service Center is located in Worcester, Massachusetts and is happy to offer its expertise in inventory management. Our tried and true system of Sortly is based off on the cumulative experience shared between our team.

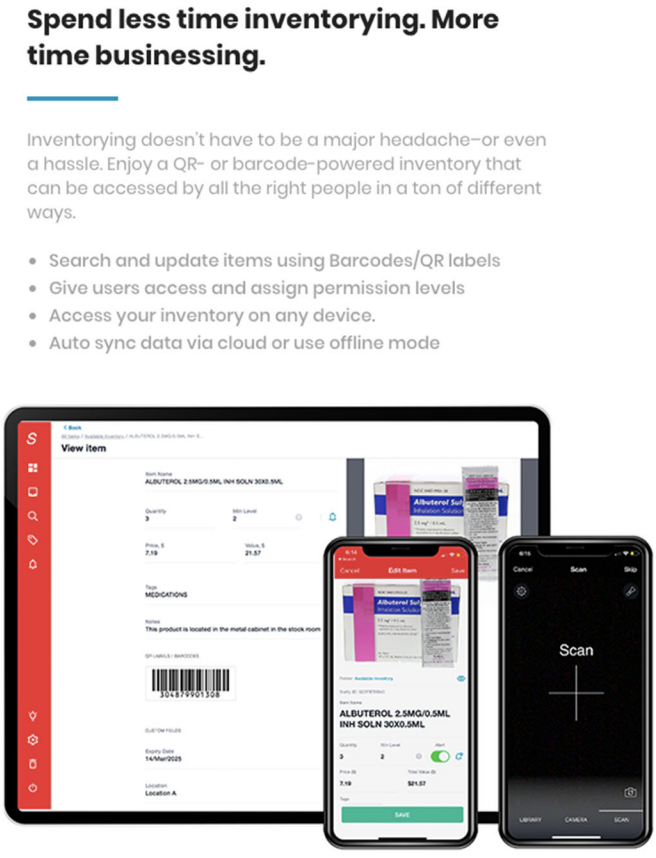
Table of Contents

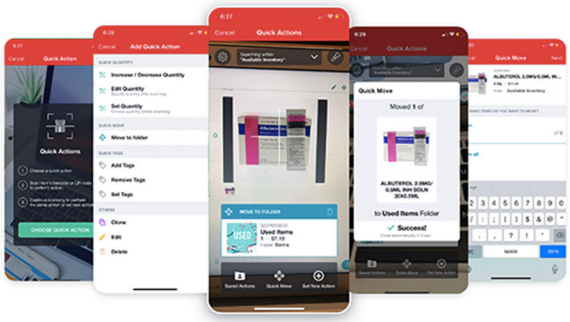
1.0 What is Sortly

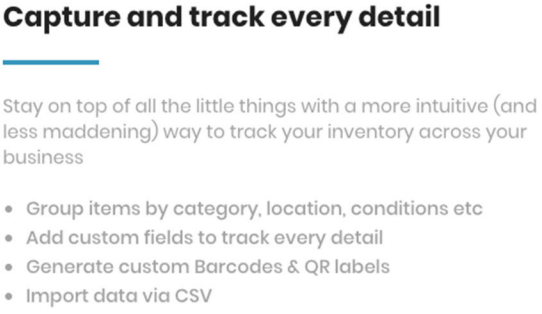
Sortly is a simple inventory and asset tracking system to visually track your items and their details including location, price, condition, etc for a more intuitive way to track your items. Key Features: - Access via any Mobile, Tablet or Computer - Check-in/out items with a in-built scanner - Create or connect to any barcodes or QR codes - Give team members or customer access This App will greatly benefit the Health Center in tracking items

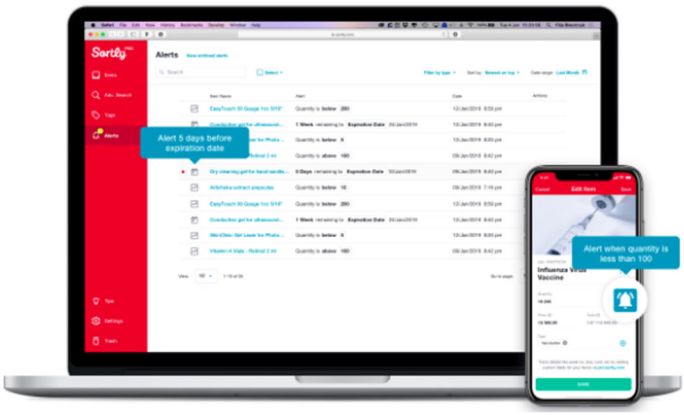
1.1 Capabilities of the app

This app has **barcode** scanning capabilities, can organize items into specific **folders** and greatly improve inventory planning. **Inventory reports** can be printed which makes inventory much easier to complete.









Intuitively stay informed and up to date

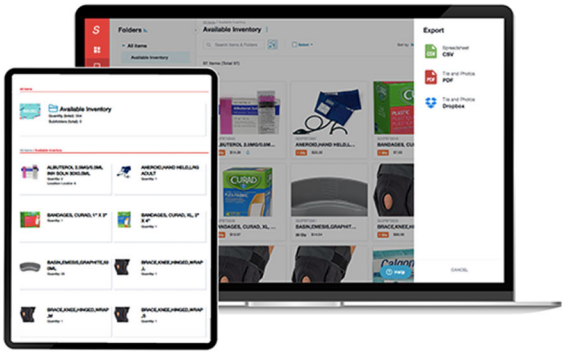
The days of over-ordering expensive inventory and then watching it get wasted are over. Sortly offers intuitive, automated alerts, reminders and dashboards that'll put you back in control of your business.

- Get automatic low stock alerts
- Set up date based reminders
- Create custom dashboards to stay informed

Effortlessly generate reports

Better understand your business and its inventory with customizable, beautiful reports that are easy to generate.

- Generate current status or activity based reports
- Sort & filter inventory to create custom lists
- Export reports via CSV, PDF or Dropbox



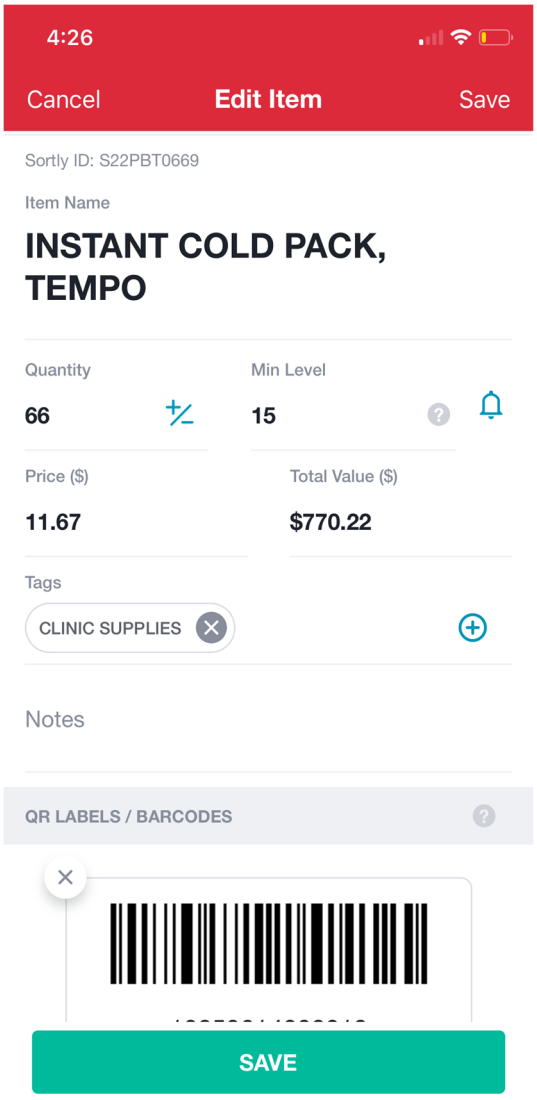
2.0 How to use

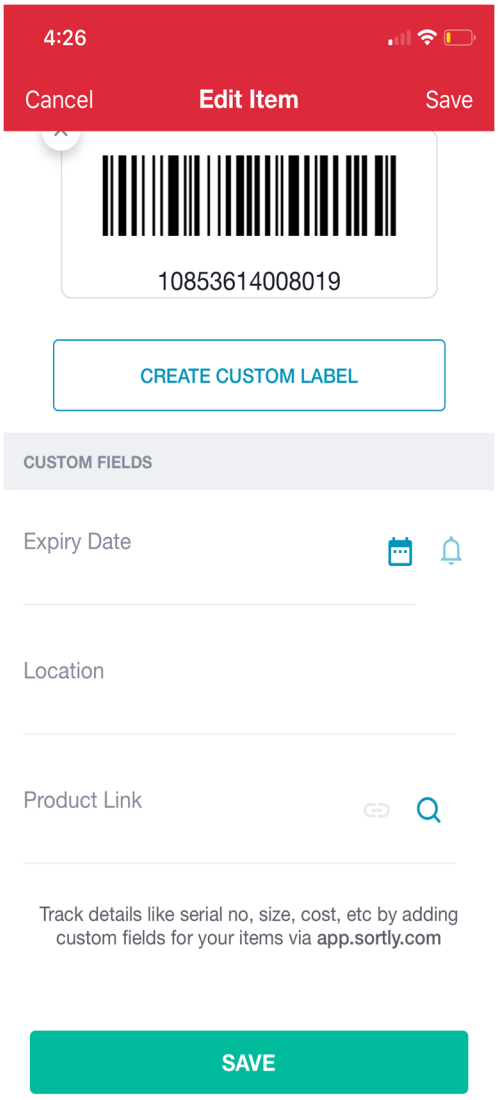
2.1 Steps once items are received

1. A shipment is received
2. Items are unpackaged and organized by kind
3. Items are scanned in
4. If the item is in the system already the application will pick it up and you can adjust quantities
5. Quantities of the item are recorded into the application
6. Update any other information on the sheet

Photos attached below

a





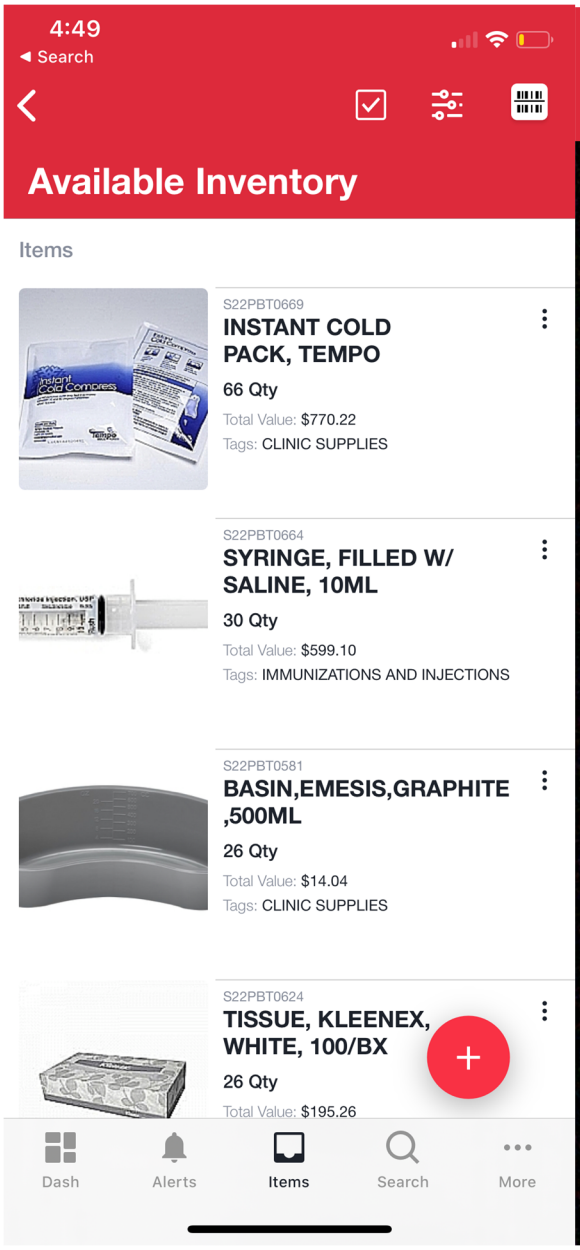
2.2 How to Scan in an Item

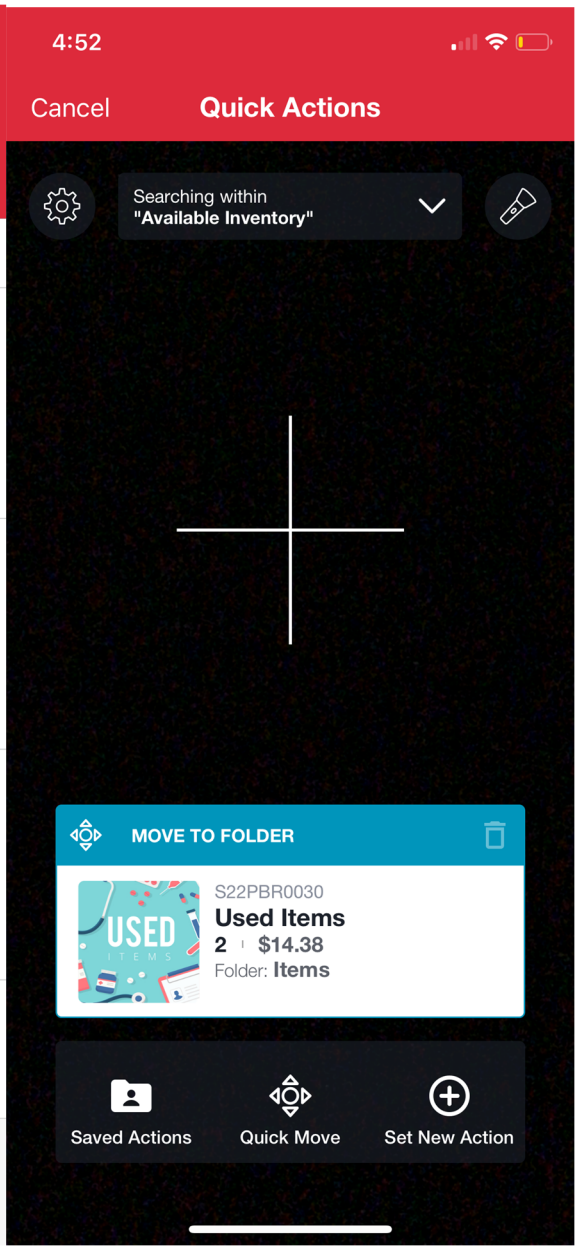
You just got a shipment of an item– now what?

Scan

How to use Quick Action

1. In order to use a quick action to input an item, click this symbol  the top right corner in order to open up the quick action scan page

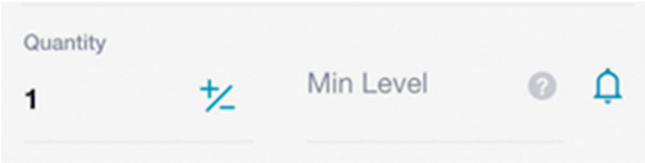




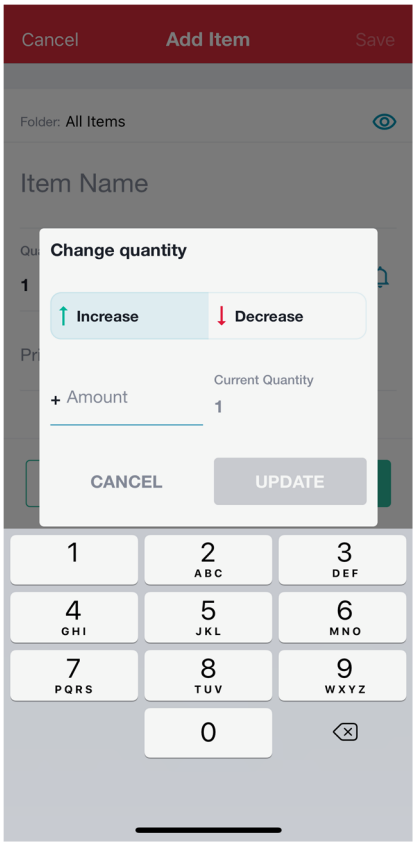
2. Once the screen to your right is opened the item being input can be scanned. The folder can be changed from **Used Items**, **Items Discarded**, and **Items Loaned**. This can be used to quickly input items from a new shipment.

Quantity

When adding an item the quantity button looks like this. Here the unit count is determined by the item we are inputting. For example if a box of 300 gloves comes in the quantity would increase by one, not 300. For things like needles, knee braces, or other orthopedics, the quantity is added or subtracted by one.



When a person tries to adjust the quantity this next pop-up will show up and allow the person to adjust the quantity however they see fit.



Minimum Level

The minimum level is also referred to as the reorder point. This data is usually based on seasonal data but in this case, minimums should be adjusted in the excel files we use as an alternative or a rough estimate of when you would like to be notified when a product gets low.

Price

In the price section, it is important to include the unit price. This will keep track of the amount in dollars where all of the inventory items are going.

Tags

It is important to tag the item with its appropriate sub-category. The categories listed are **Clinic Supplies**, **Immunizations and Injections**, **Medications**, **Orthopedic Braces and Splints**, **Testing**, **Women's Health,** and **Wound Care.**

Notes

The notes section is especially helpful for items loaned or discarded items. In this section, you can write the student number and name of the student that an item was loaned to or any other information about where an item is going.

Expiration Date

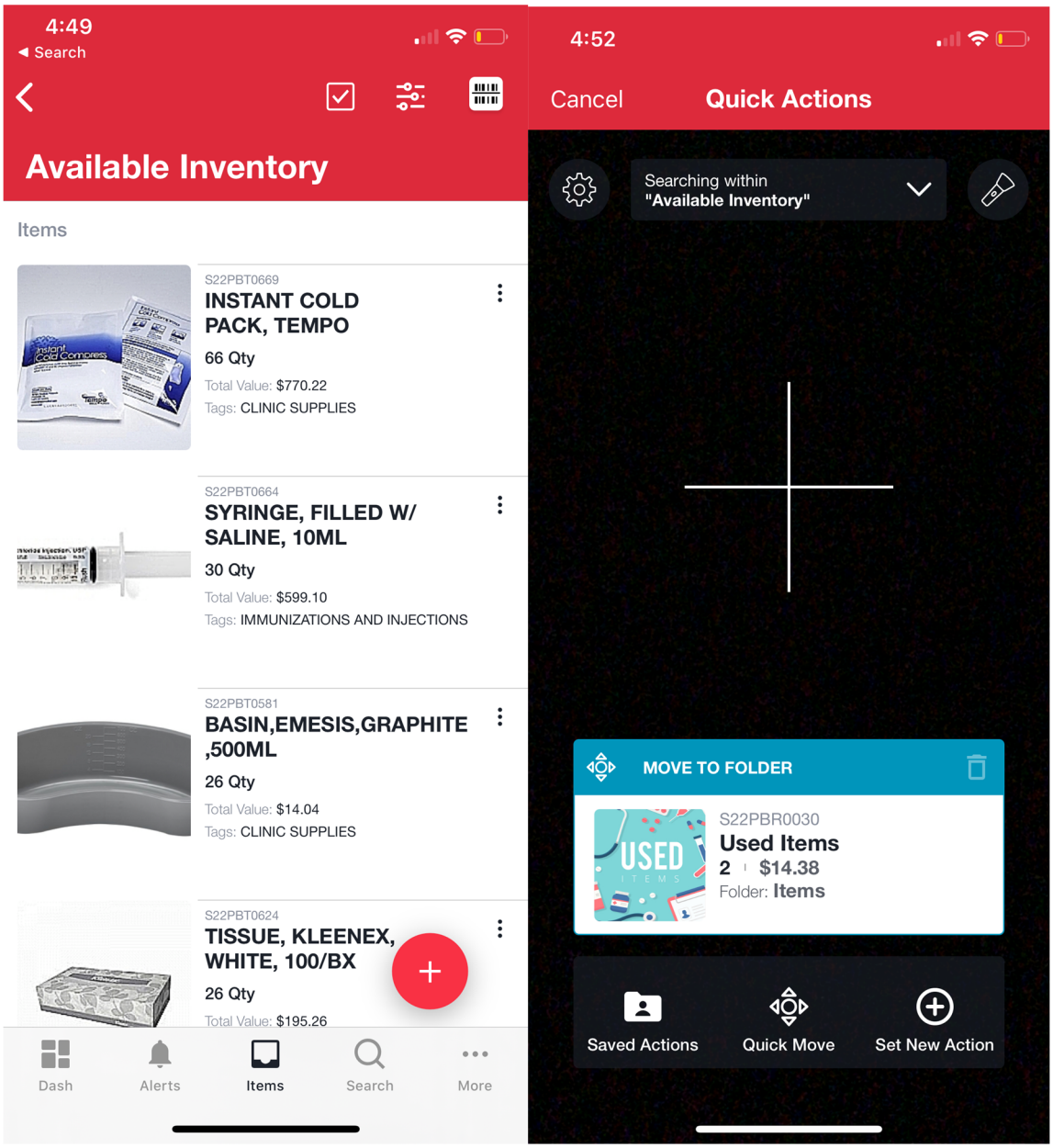
In this section, it is important to write the expiration date if an item has one. This will allow the application to notify users of the application to use these products or organize them so they are better utilized.

Location

The location aspect of the app is helpful when trying to find an item in storage. There are four storage locations within the health service center. There's the backroom, the lab room, the metal cabinet, and the stock room cabinets. These locations are understood by the Health Service Center Staff and are helpful when locating items.

2.3 Quick Actions

In order to use a quick action to input an item, click this symbol the top right corner in order to open up the quick action scan page



Once the screen to your right is opened the item being input can be scanned. The folder can be changed from **Used Items**, **Items Discarded**, and **Items Loaned**. This can be used to quickly input items from a new shipment.

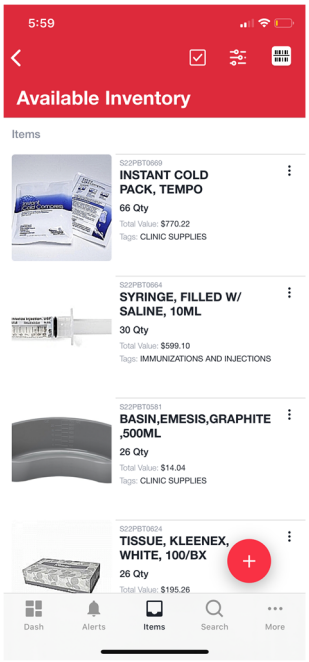
This can be done by selecting the quick move button.

2.4 Folders

Available Inventory

The available inventory folder is pretty self-explanatory. It is the overall list of what is available at the health service center. Items are taken from this inventory list and moved to their respective folders based on where the item goes.

To your left one can see the Available Inventory folder. To use one of these items without using the quick action option, an item can be moved to their respective folders depending on what transaction is taking place.

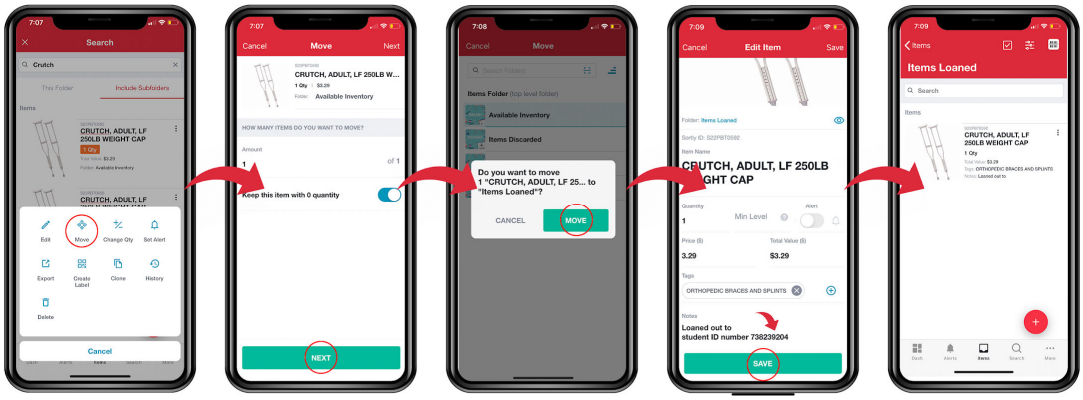


Used Items

This folder is used for items that are used on a general basis. It is understood that as employees come in and out that they won't be tracking every item they use. When an item is used a person can use this button and quick-add it using the directions previously stated.

Loaned Items

This section is for items loaned such as orthopedic equipment, crutches, and items of that sort of nature. Below is a description of how this folder can be utilized in the health service center. With the corresponding steps listed below.



Step 1:

Search the item you are looking to loan out in the search bar. Once found, click on the three little dots to the right of the entry. Then select the "Move" button.

Step 2:

This screen will pop up and ask how many of the items you are moving from Available Inventory to Loaned Items.

Step 3:

This is where you select the desired folder. In this case, when we are loaning an item, it goes into the 'Loaned Items' folder.

Step 4:

Here is where we can edit the single item and add a note as to who the item was loaned out to. Here we would use an ID number.

This allows Health Center Employees to keep track of where all of their inventory is at all times.

Step 5:

You will now see that single item in your loaned items folder.

Items Discarded

This folder is used for items that get discarded due to expiration. The same rules follow for moving items into the discarded folder.

Step 1:

Search the item you are looking to discard in the search bar. Once found, click on the three little dots to the right of the entry. Then select the “Move” button.

Step 2:

This screen will pop up and ask how many of the items you are moving from Available Inventory to Discarded Items.

Step 3:

This is where you select the desired folder. In this case, when we are discarding an item, it goes into the ‘Discarded Items’ folder.

Step 4:

Here is where we can edit the single item and add a note about why the item was discarded. This allows Health Center Employees to keep track of where all of their inventory is at all times.

Step 5:

You will now see that single item in your discarded items folder with the corresponding value.

2.5 Dashboard Buttons

Dashboard

On this page, you can see how much value your things add up to, how many items are logged and how many items you have in total.

Alerts

When a person clicks on this tab a list of items that need to be restocked or that are about to expire.

Items

This is a list of all items and folders. This is where you can access all folders and products.

Search

The search tool can be used to find a product you're looking for. It can be used by searching for one of the tags Clinic Supplies, Immunizations and Injections, Medications, Orthopedic Braces and Splints, Testing, Women's Health, and Wound Care. Another thing you can use to find an item is by name or product number.

3.0 Inventory and Tracking

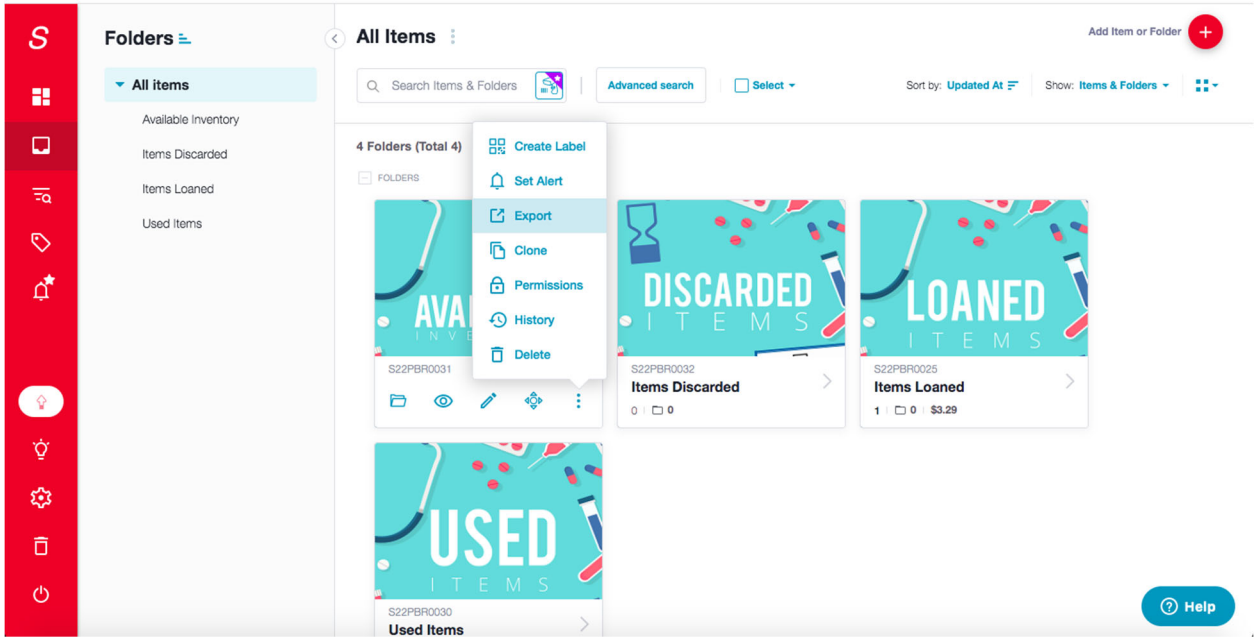
Steps to take Inventory

Step 1:

Go to Sortly on your Desktop Computer

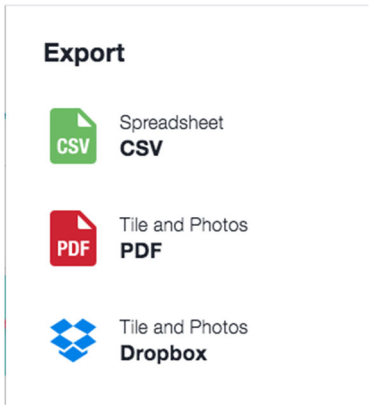
Step 2:

Go over the Available Inventory folder where you want to take inventory and go over the three dots. Then select the export version labeled below.



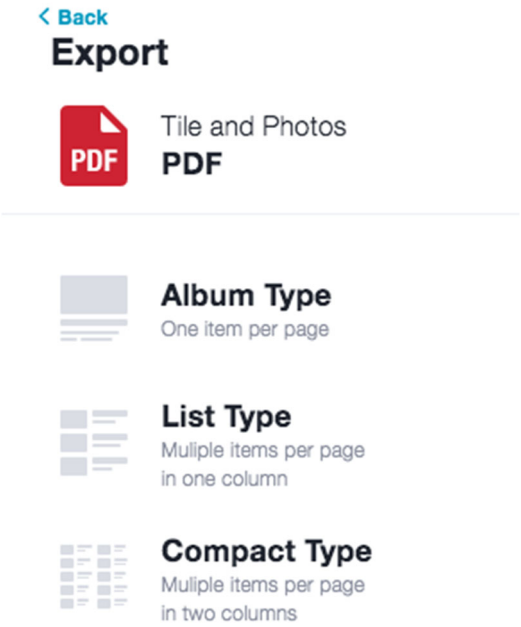
Step 3:

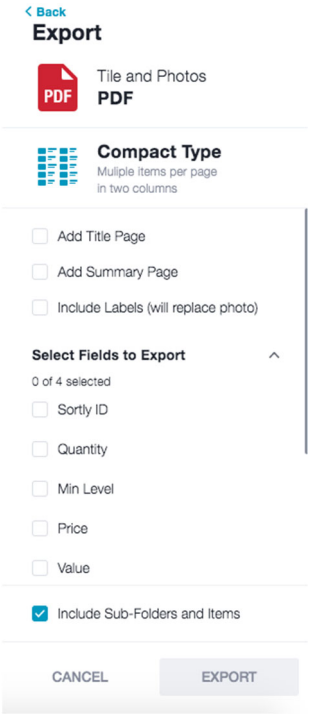
Select if you want to export the inventory list in a CSV, PDF, or via dropbox.

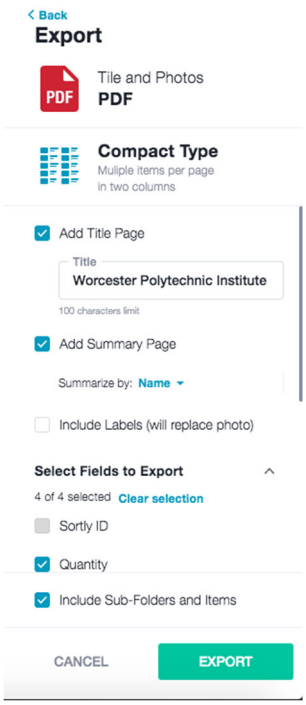


Step 4:

Then select how you would like the inventory list to be displayed. All steps are in the images below.

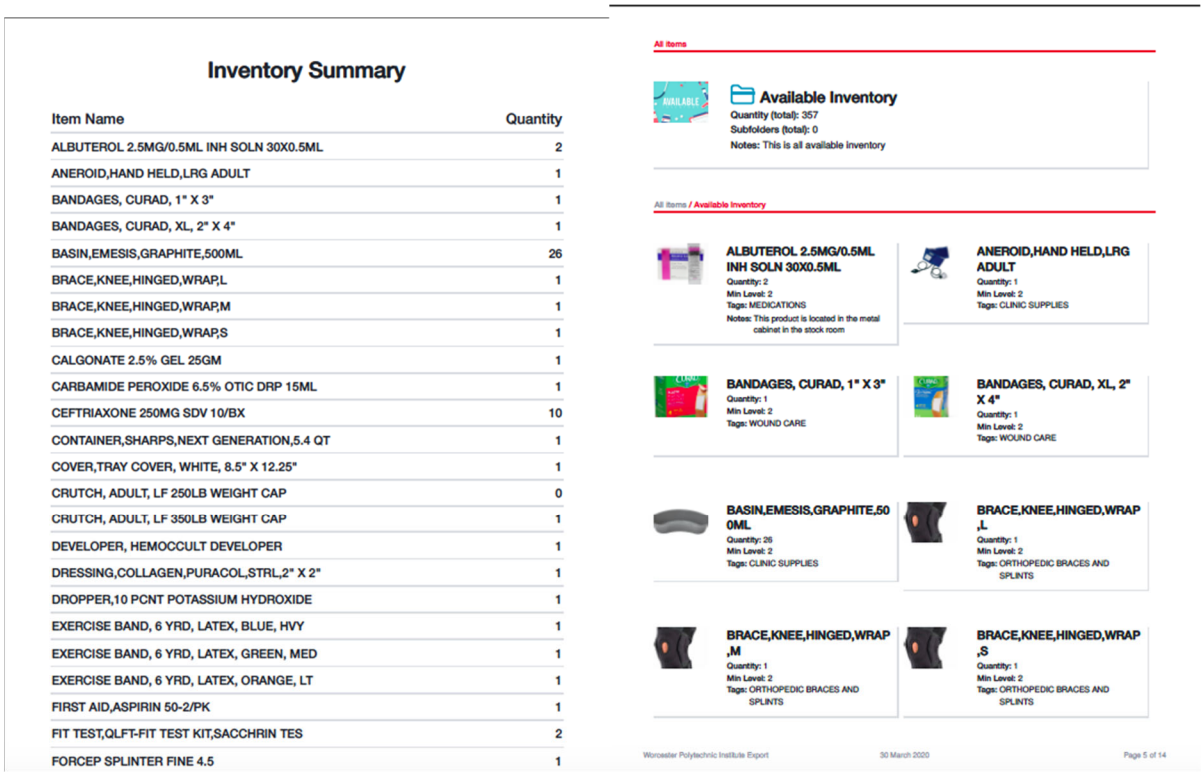






Step 5:

Then when you export the file you will get a document depending on the things you would like on your inventory report.



Inventory Summary

Item Name	Quantity
ALBUTEROL 2.5MG/0.5ML INH SOLN 30X0.5ML	2
ANEROID,HAND HELD,LRG ADULT	1
BANDAGES, CURAD, 1" X 3"	1
BANDAGES, CURAD, XL, 2" X 4"	1
BASIN,EMESIS,GRAPHITE,500ML	26
BRACE,KNEE,HINGED,WRAP,L	1
BRACE,KNEE,HINGED,WRAP,M	1
BRACE,KNEE,HINGED,WRAP,S	1
CALGONATE 2.5% GEL 25GM	1
CARBAMIDE PEROXIDE 6.5% OTIC DRP 15ML	1
CEFTRIAXONE 250MG SDV 10/BX	10
CONTAINER,SHARPS,NEXT GENERATION,5.4 QT	1
COVER,TRAY COVER, WHITE, 8.5" X 12.25"	1
CRUTCH, ADULT, LF 250LB WEIGHT CAP	0
CRUTCH, ADULT, LF 350LB WEIGHT CAP	1
DEVELOPER, HEMOCCULT DEVELOPER	1
DRESSING,COLLAGEN,PURACOL,STRL,2" X 2"	1
DROPPER,10 PCNT POTASSIUM HYDROXIDE	1
EXERCISE BAND, 6 YRD, LATEX, BLUE, HVY	1
EXERCISE BAND, 6 YRD, LATEX, GREEN, MED	1
EXERCISE BAND, 6 YRD, LATEX, ORANGE, LT	1
FIRST AID,ASPIRIN 50-2/PK	1
FIT TEST,QLFT-FIT TEST KIT,SACCHRIN TES	2
FORCEP SPLINTER FINE 4.5	1

All items

Available Inventory
Quantity (total): 357
Subfolders (total): 0
Notes: This is all available inventory

All items / Available Inventory

ALBUTEROL 2.5MG/0.5ML INH SOLN 30X0.5ML
Quantity: 2
Min Level: 2
Tags: MEDICATIONS
Notes: This product is located in the metal cabinet in the stock room

ANEROID,HAND HELD,LRG ADULT
Quantity: 1
Min Level: 2
Tags: CLINIC SUPPLIES

BANDAGES, CURAD, 1" X 3"
Quantity: 1
Min Level: 2
Tags: WOUND CARE

BANDAGES, CURAD, XL, 2" X 4"
Quantity: 1
Min Level: 2
Tags: WOUND CARE

BASIN,EMESIS,GRAPHITE,500ML
Quantity: 26
Min Level: 2
Tags: CLINIC SUPPLIES

BRACE,KNEE,HINGED,WRAP,L
Quantity: 1
Min Level: 2
Tags: ORTHOPEDIC BRACES AND SPLINTS

BRACE,KNEE,HINGED,WRAP,M
Quantity: 1
Min Level: 2
Tags: ORTHOPEDIC BRACES AND SPLINTS

BRACE,KNEE,HINGED,WRAP,S
Quantity: 1
Min Level: 2
Tags: ORTHOPEDIC BRACES AND SPLINTS

Worcester Polytechnic Institute Export 30 March 2020 Page 5 of 14

Inventory Recommendations

We recommend conducting inventory on a weekly basis to keep track of what is in stock in the Health Service Center.

Creating Labels

This application also allows the ability to create labels to make scanning in and out much simpler. It's the same instructions as exporting the inventory sheet but click "Create Labels" these labels can be printed using any printer and ink and can even pair with stickers.

Conducting Inventory

Print out an inventory sheet and go through each item to determine if the number to the right is accurate. If not, mark it on the paper and then change it in the system using the directions above.