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Supply Chain Reduction for WellStar Kennestone Sterile Processing Department

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SUPPLY CHAIN REDUCTION FOR WELLSTAR KENNESTONE STERILE PROCESSING DEPARTMENT

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EXECUTIVE SUMMARY

The WellStar Healthcare System provides world-class healthcare across 11 hospitals. One of those hospitals is Kennestone located in Marietta, GA. They are continuously implementing new technology to attend to their patients in the operation rooms (ORs). However, the hospital's Sterile Processing Department has seen an increase of unused supplies being returned after surgeries are completed. This results in certain supplies not being placed back in inventory immediately or accounted for. Upon discovering these process inadequacies, WellStar requested a project group to analyze and present a solution for decreasing its rate of returned supplies, quantify the cost of the current processes, reduce waste, and present findings to key stakeholders at Kennestone. Data analytics and research was performed focused on exploring opportunities for optimization within the Kennestone Hospital Sterilization Process Department's internal processes. Our findings from the research conducted revealed that the source of the excess waste of supplies was a combination of a lack of workforce, inadequate supply tracking system, workflow design layout. Our team developed a preposition comprised of three solution considerations that could address the above stated inefficiencies:

- Proposed Solution 1 – Temporary Hire

  Outsource the task by hiring a worker dedicated specifically to the SPD's inventory stocking through a Temp-Agency.

- Proposed Solution 2 – Retraining & SOP Implementation

  Retraining current staff by implementing a Standard Operating Procedure (SOP) for pulling supplies from inventory.

- Proposed Solution 3 – SKU Integration

Utilizing software to develop an electronic binning system to allocate supplies according to need and type to digitalize inventory tracking of surgical supplies.

Once our data findings were collated, we concluded that the facility has the capacity of improving the process of inventorying surgical instruments and supplies. Our team applied 5S methods to quantify the parameters of the problems and Lean management methods in our approach to determining the right recommendation from proposed solutions. With the goal of effective cost mitigation by eliminating excess waste, we determined each solution to be viable. However, once all implementation factors were considered, it was determined that solution 1 would have the highest ease of implementation with instant return on value and least disruption in other operations at the Kennestone Hospital. Our final recommendation to the WellStar Kennestone Hospital is to implement solution 1. We made this recommendation considering these factors:

- Solution 1 would did not have drastic requirements for implementation like the other two solutions would require.
- Solution 2 would require more supervisory oversight and tasks being added to current staffing duties in order to tackle the accumulation of returned supplies by increasing accountability of personnel by associating supplies list with persons who pull supplies from inventory within the SPD.
- Solution 3 would require the development and implementation of dynamic software for the inventory tracking system.

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CHAPTER 1- INTRODUCTION

1.1 INTRODUCTION

WellStar Kennestone Hospital is in Marietta, GA and holds the recognition of the Top 100 hospitals across the nation. Kennestone Hospital is one of eleven hospitals within the WellStar Health System. It currently holds a distinct Emergency Department as it is one of the three Level II trauma centers in metro Atlanta because on the usage of their advance technology [19]. It currently holds 633 beds and possess over 3,000 instruments in their surgical portfolio. Although innovative with their patients, the hospital has observed an opportunity for innovation in their internal processes. The facility has the capacity of improving the process of inventorying surgical instruments and supplies for when conducting surgeries. Within the last year, Kennestone Hospital has seen a high volume of sterile supplies being returned after surgeries are completed. This results in certain supplies being wasted and not accounted for immediate use again. Therefore, WellStar requested a project group to analyze and present a solution for decreasing their returned supplies, and reduce waste, and present findings to key stakeholders at Kennestone.

1.2 OBJECTIVE

The project's objective is to design a recommendation on how to decrease supplies returns for the WellStar Kennestone Sterile Processing Department and Supply Chain. The purpose is to decrease the waste involving returned supplies and analyze reverse logistics within hospital operations. The recommendation or method intended to be the most cost-beneficial and optimize the process of returning sterile supplies will be utilized. The project will define the shortfalls of the current process, measure, and collect data and us Industrial Engineering concepts.

The project intents to reduce and eliminate the accumulation of supplies being returned after surgeries. The Sterile Processing Department currently has an increasing amount of returned supplies idling, awaiting to be returned to inventory, to be utilized again. Usually, hospital personnel will place supplies back in their designated location but there is no designated task force for placing returns in inventory.

1.3 JUSTIFICATION

Kennestone Hospital has the continuous problem of handling returned supplies especially surgical instruments. These supplies are shipped to the hospital, taken out of inventory, placed in route for surgery, and then are sent to be returned in hopes of being utilized. This can amount to supplies being damaged, broken, or lost in the process of returning. Furthermore, hospital personnel, such as nurses and techs, will place supplies back in their designated location but there is no designated task force dedicated for placing returns in inventory. Dealing with

supplies returned to inventory inquires an enormous cost to the SPD and Supply Chain. WellStar cannot present information to physicians for removal of unnecessary items in surgeries unless data collection takes place. There needs to be a reduction in the amount of times unused supplies are placed in surgical kits. The analysis of the kits and case carts becomes the reporting method, a communication tool, and a way for data and human factors to contribute to the analysis. Management is looking for methods to eliminate wasted time and effort, while optimizing the entire SPD. WellStar Kennestone Sterile Processing Department inquires the cost and has a result was over budget fiscal year of 2019. Supply and demand of surgical instruments to the OR will expose financial liabilities involved and demonstrate the root cause of the department's shortcomings.

1.4 PROJECT BACKGROUND

Kennestone Hospital has been conducting processes a certain way since the SPD was created 12 years ago, with very few to little revisions to alter the processes. It has been established that the hospital faces inconsistent supply numbers, a higher than necessary number of supplies returned, and as a result not enough sterile surgical instruments available at end of day for next day's OR demand. In addition, over budget performance, and a standard operating procedure that contains multiple unknown causes for their shortfalls.

To understand the scope of the problem, the flow of instrumentation and supplies is established. To initiate, as soon as surgeries are completed, instrumentation and multi-use supplies or tools, such as cameras and

scalpels, undergo decontamination [4]. Second, they move to prep and pack where certain items are prepped for sterilization. Finally, instrumentation and supplies are assembled or pulled form inventory and stored in case carts. Case carts are where all the necessary supplies and any instruments a surgeon will need for a scheduled operation is placed. Finally, a case cart will be taken to the operating room, where a surgeon and their team will have access to anything possibly needed to operate on a patient for a specific procedure. Once the surgery is done, the instruments then return to decontamination and undergo the process again. Meanwhile, sterile, and unused one-time use supplies will be placed in a designated cart for returned items and placed back into inventory for another surgery. However, it is too often that returned items occupy space and are not placed back into inventory immediately. This results in potential savings diminishing since returned items sometimes are not accounted for.

Like the Kennestone hospital, a general processing department is shown in Figure 1, below.

Figure 1 - Typical Processing Department [6].

1.5 PROJECT STATEMENT

Kennestone has an immense number of returned supplies after surgeries are completed. These supplies that are unused and sterile are placed in a bag and returned to an area where they await to be inventoried again. The project will analyze the process the Sterile Processing Department (STD) of WellStar Kennestone Hospital uses to ensure sterile instruments and surgical kits are available to the OR and their scheduled surgeries. The project's purpose is to reduce the high volume of returned associated with supplies that go unused in surgery and SPD for inventory.

CHAPTER 2 – LITERATURE REVIEW

2.1 LITERATURE OVERVIEW

The WellStar Healthcare System initiated the opportunity for the first time in their facilities and hospitals to have a project of this scope. Industrial and Systems Engineering concepts have not been previously designed or implemented at Kennestone Hospital. Currently, WellStar handles their return supplies and reverse logistic operations internally and are accumulating an increasing cost. Due to change and re-direction of management in their SPD and Supply Chain, Kennestone Hospital is being challenged to reduce the returned supplies and ultimately reduce costs and waste. Generated waste can cause significant loss of financial resources and environment damage [12].

To analyze the root causes of the increasing return rate in the Sterile Processing Department (SPD), it was important to know more about the following areas: sterile processing and lean improvement. The literature review concludes with a discussion of how work on this project compared to similar sterile processing improvement projects that have been previously undertaken, in other healthcare organizations and how they compare to WellStar Kennestone Hospital.

Furthered in SPD, reprocessing returned supplies for inventory is like an example of waste when a tool does not pass decontamination inspection [17]. These tools need to be rewashed because it is still contaminated after going through the decontamination process. It becomes waste to reprocess or a supply is pulled from inventory and goes unused in the OR during surgery [21].

In addition, lean concepts require continuous thinking about improvements, problem solving, and questioning the status quo. Therefore, this project challenges the status quo in a hospital environment and how Kennestone improves the reduction of returns. [21]. By implementing the methodology of 5S in lean concepts, it resulted that 49.5% of medicines were reconciled within 24 hours of the hospital admitting patient [16].

Another tool implemented across organizations is standard work, which is written descriptions on how to complete task in the most efficient and safe way possible, to reduce variation. In the Australian Hospitals

it was found that due to medicines being reconciled at a much faster rate, it increases operations in 4 services. [16]. Kennestone Hospital can have the opportunity to focus on reducing their returned supplies and a domino effect will result in having optimized operations in the SPD and supply chain, since less supplies will have to be re-processed for inventory.

2.2 CASE STUDY I

Furthermore, Sterile processing begins at the completion of a surgery, and includes rinsing instruments, reassembling kits, and sterilizing them for future operations. Sterile Processing Departments (SPDs) within hospitals are responsible for cleaning instruments used during surgeries and preparing them for future usage [9].

In this case study, lean methods were applied to improve sterile processing efficiency for an academic medical center, focusing on inventory management, facility layout and process flow [1]. The major objective was to reduce the rate of defects and the cost of inventory control for operating instruments. Defects were defined as an observed problem in an operating instrument kit that resulted from SPD. The 5S lean tool focuses on workspace organization to increase efficiency, following five steps including Sort, Set in Order, Standardize, Shine and Sustain. The case studied the causes of the missing instruments that occur in SPD by applying lean process improvement methods including root cause analysis and 5S.

Kennestone Hospital has some kit variety and repetitive items that are in a case cart. For example, a surgeon's list of necessary items includes a certain kit and another supply on their list is a 25gauge needle. However, that needle is already included in his kit. Therefore, 2 same size needles are pulled from inventory. Someone who is new to the Kennestone facility would not know to not pull the needle on the list because is already included on the kit. This will result in one of the needles being returned and may or may not be placed back into inventory for use. This demonstrates the importance having a consistent inventory management system and how human knowledge causes an increase in returned supplies.

2.3 CASE STUDY II

In 2011, BC Children's Hospital (BCCH) found that the number of defective surgical kits coming from their sterile processing department was increasing over time [5]. The hospital created a task force to analyze the equipment assembly unit and recommended ways to stem the rise of defects and ultimately reduce them.

The hospital was trying to track defects. Defects originating in the operating room included instruments being placed in the wrong kits by surgical technicians, sets of surgical kits sent to the sterile processing department on separate carts, and kits not being brought to the sterile processing department in an acceptable span of time. Serious defects originating in the sterile processing department included instruments not being loosened and unassembled, unused equipment not leaned, biomass not loosened from instruments in the ultrasonic leaner.

In the operating room, technicians were asked to coat instruments with enzymatic gel after use and reduce time between using the kits and sending them to sterile processing department. Both departments were physically altered to allow better access to kit storage areas and sterile processing department specifically rearranged its decontamination layout team recommended a series of changes spanning from the operating rooms to the sterile processing department.

In hope of learning this case study, WellStar has the capabilities of accommodating their facility to ease the process of returned supplies. Whether that is considering an alteration in SPD just as the BCCH hospital did when there was an increasing number of defects from their surgical kits.

2.4 CASE STUDY III

In this case study, a team of individuals with experience using lean six sigma in production were enlisted to address problems in a sterile processing department. Implementing value stream analysis, process flow analysis, implementation plan, and problem solving, the team successfully saved the hospital $8,852 a month in replacement tool costs, as well as $31,360 per month in transportation of instruments cost. The sterile cycle time was reduced from 21.6 hours to 12.8 hours, and errors were reduced from 32% to

17.7%[6]. Kennestone has opportunity to reduce the amount in transportation of supply costs. Currently, when supplies are sent for return, they idle in the return area as seen in the Figure 2 – "Return Area Image".

Figure 2 – Return Area Image

The supplies are in plastic bags, as seen above, these items idle until staff has time to place them back on the shelves. Meanwhile, the WellStar Supply Chain personnel come to Kennestone and fill the shelves that are empty. However, little do they acknowledge that the items they restocked are items that are already in the return pile and at the hospital. This results in leaving no room for the returned items.

This previous case study mentioned allowed the team to implement a change in process to study the facts of the change. This project will focus on recommending change and propose savings to WellStar Kennestone basis on using data analysis. This case study affirmed the justification for use of lean tools for optimization of the SPD.

CHAPTER 3 – APPROACH

3.1 APPROACH

Our group collected data on returned supplies that is going to analyze factors that will lead to the department's shortcomings. Our group is using the six Sigma approaches to analyze different characteristics of our project to meet the consumer needs [3]. There are also some other tables, charts available to identify different solutions.

3.2 REQUIREMENTS

The project requirements include collecting the number of returned supplies data and the cycle of returned items so the project team can be able to provide a recommendation on decreasing the supplies coming back from surgery. In addition, it is necessary that communication is maintained among the WellStar Kennestone stakeholders. Further project requirements may include software integration, hiring, alternation of design layout, and/or revised lists of supplies for each type of surgical procedure. This suggests that implementation of decreasing current returned supplies is not possible.

3.3 MANAGEMENT & RESPONSIBILITIES

Our responsibilities include researching other processes from peer reviewed documentation of other sterile processing departments in the medical industry. Research peer reviewed documentation on the software currently being used for inventory and explore alternative solutions. Communicate with John Clark and Denise Adams to ensure field visits and data collection can collection be conducted and this tool will take place. With intentions to analyze methods and present results to management.

3.4 SCHEDULE

Our Group meeting on weekly basis to meet our task assignment so other team members are aware of team work all together. Our team was visiting Kennestone SPD on weekly basis to collect data and team used to meet once a week to update plan for week and go over our next week plan. See Table 1 – "Schedules and Task Completed"(next page).

Dates	Schedules and Task Completed
8/15/2020	Meet and Discuss Project and Designated Roles
8/20/2020	Project Goal and setting Schedules
8/27/2020	Visit Facility, Tour Facility
9/18/2020	Collect Data on weekly Basis
10/15/2020	Analysis of Data
11/12/2020	Pre-Review of Final Review
12/2/2020	Final review

Table 1 – Schedules and Task Completed

This is the group's Gannt chart (Figure 3 – "Gannt Chart") that was used to accomplish the tasks involved and stay on schedule to complete the proposal in time.

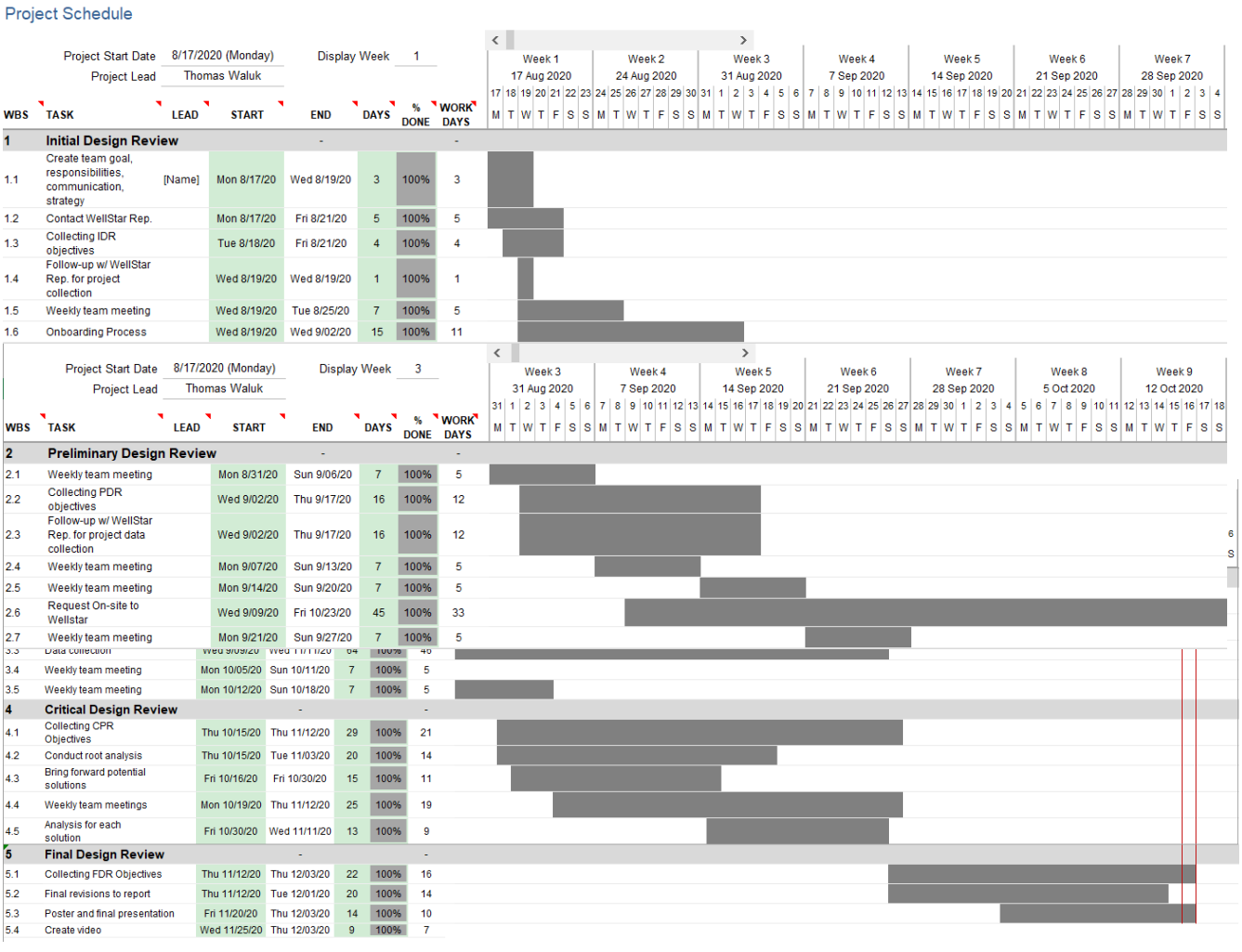

Figure 3 – Gannt Chart

3.5 BUDGET

This project group analyzed the budget from the year of 2019 for the SPD. The budgeted overtime cost was $203,147. However, actual overtime costs were $255,185. Therefore, resulting in a deficient of a total of -$52,038. Therefore, the budget must stay less than $203,147.

3.6 AVAILABLE RESOURCES

- Our project group utilized Microsoft excel for collecting and analyzing data.
- In addition, we used Microsoft Word, Power BI, Google Scholar, and had internet access at our disposal.
- Other resources included, WellStar Kennestone Staff, John Clark Sterile Processing Director, Denise Adams Clinical Coordinator, and Ayako Prince, Value Analysis Process Improvement Specialist.

3.7 MINIMUM SUCCESS CRITERIA

In order to achieve minimal success criteria, we hope to identify the bottlenecks in each of the three solutions that we can examine and find at least one potential solution. We hope to have a solutions for the improvements of Sterile processing Department.

CHAPTER 4 – DATA COLLECTION

4.1 CURRENT LIMITATIONS

There is currently an overspend due to overtime. Since staff is spending time during at the end of shifts to place returns into inventory, it is consuming an enormous amount of the budget. Through time study, it was found that it takes 2 minutes and 6 seconds on average to place an item back in its proper inventory place. Another aspect that is currently an issue and limits the hospital is that the number of instruments idling in the returns section are not being recorded and quantified.

4.2 AMOUNT OF RETURNS

To quantify the amount and cost that returned and idle supplies have on the Sterile Processing Department, instruments were counted. Each item in the hospital has a reference number, which is like an ID number. This reference number is allocated in their system called Lawson, which keeps track of the costs allocated to the SPD and the surgeries used in each patient's surgery. Information of the description of the returned item, the manufacturer, the size, the price per unit, and the reference number were collected. The surgical instrument returns will be the means for measurement and analysis. Currently, on average, there is an estimated $56,080.71 worth of items being returned per week; these supplies are idle in the SPD and are waiting to be placed back into inventory. Data was collected concluding there is an estimated $210,302.66 worth of supplies being returned and re-processed for inventory per month.

4.3 SUPPLY QUANTITES

Supplies were grouped into categories for ease of analysis. There were 619 different Instruments in the SPD's return area, idle not inventoried. In Table 2 - "Supply Overview" shows the highest quantities of supplies were in the "Sharps", "Other", and "Pads, Wraps, & Sponges". Next the cost of these supplies **errs** analyzed. There were 1,031 instruments sitting idly in returns on average per day.

Supply Overview

Category	AVG Cost per Unit	Quantity	Total
Catheters and Related	$7.54	40	$301.42
Connectors	$0.74	10	$7.36
Drapes, Gloves,	$3.54	903	$3,199.48
Kits, Sets, & Trays	$37.79	104	$3,930.19
Other	$14.51	2,647	$38,398.56
Pads, Wraps, & Sponges	$6.75	1,139	$7,690.14
Sharps	$0.72	3,340	$2,411.84
Tapes	$3.20	41	$131.37

Table 2 – Supply Overview

4.4 SUPPLY COSTS

The average price of the highest value by supply quantity found in the returns was a syringe at an $0.11 average cost per unit, totaling $265.52 of lost value while not in inventory. The "Sharps" category yielded a total cost (or loss due to inactivity in inventory) of $2,411.84, and an average per item cost of $0.72 a week. Figure 4 - "Supply Groups by Total Cost", displays groups and then descriptions of supply categories

Figure 4 – Supply Groups by Total Cost

based on cost. Assigning a value to each item was allocated during data collection, and it was found that the "Other" category $38,398.56, yielding an average per item cost of $14.51 per unit per week.

In total $56,080.71 per week is lost or idle in inventory due to no staff for returns. This translates to $210,302.66 loss of billable supplies per month, and over $2.5 million for the year. Figure 5 – "Supplies by Unit Price", shows the breakdown of supplies by cost.

Figure 5 – Supplies by Unit Price

CHAPTER 5 – PROPOSED SOLUTIONS

5.1 PROPOSED SOLUTION 1 – TEMPORARY HIRE

Compensation is an aspect involved when analyzing their annual budget. Based off the fiscal year of 2019, the SPD at Kennestone Hospital was overbudget due to overtime involved. When analyzing the cost involved, there were personnel placing returned items whose job descriptions did not require the tasks involved. Furthermore, their job responsibilities were more focused on providing world-class healthcare to their patients and the aiding the OR teams for when surgeries are conducted. However, once the surgeries are complete there is not designated personnel dedicated only to returning supplies. Observational experiments were concluded and the task of returning supplies back on the shelves for inventory was tedious and repetitive.

A recommendation is to allocate resources to creating a job with the responsibilities of collecting and returning supplies to inventory. Job agency who specializes in temporary job positing would be the best cost analysis versus having current personal staff return supplies to inventory. There is several supportive researching stating repetitive tasks lead to high turnover rate and require less compensation than jobs that more difficult tasks.[20]. A study conducted in 2008 came to the finding that turnover is negatively related to performance for output characterized by a lower task difficulty while a higher task difficulty will result in a non-linear, inverted u-shaped relationship. They attribute this difference in turnover's effect to the fact that the performance of difficult tasks requires greater creativity (i.e. exploration) than simpler tasks requiring repetition [25]. Since returning supplies is a repetitive task this can result in high turnover rate. In the Metro-Atlanta area, jobs that involve responsibilities of repeated tasks are compensated between the range of $9.00 - $17.00.

Counting the returned supplies equated to 36 hours a day, with potential of over 1,000 hours monthly needed to return all the supplies to their proper inventory locations. The department has gone over budget with the current staff, and still has returned supplies waiting in the return area. Table 3 - "Budget Required for Returns"), displays the daily, monthly, and annual budget required to ensure there are no items left idly in

the return area. The table uses an average rate of $40 per hour for current staff, and $17 per hour for hiring staff specifically for the task.

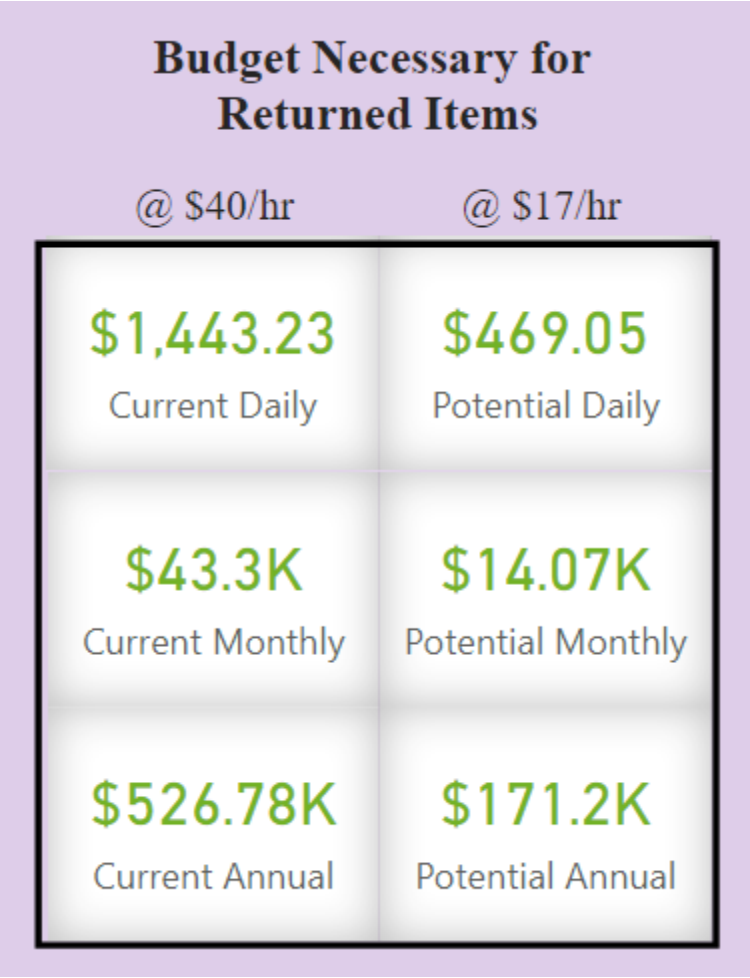

Table 3 – Material Handler Compensation Report

Temporarily hiring staff to eliminate the returns would save the department $974.18 daily, $29,230 monthly, and $355,580 annually. This is assuming the current staff would be used to put away all returned supplies regularly. This is not currently happening, and the department has gone over budget using current staff. It was found that $2,558,682.41 was the potential waste of billable supplies sitting idly in the return area.

5.2 PROPOSED SOLUTION 2 - RETRAINING

Accountability for personnel to allocate returned supplies up completion of surgery. Kennestone Hospital can complete the cycle of returned goods and place back into inventory if the supplies list is associated with the person who pulled supplies from inventory. This would eliminate the need for staff to just allow the accumulation of returned supplies increase at the SPD. This would also decrease the overspending concern, therefore alleviating the budget.

5.3 PROPOSED SOLUTION 3 – SKU INTEGRATION

Another method which could be integrated by Kennestone hospital would be very similar to a manufacturing facility. For example, in manufacturing settings, SKUs or certain products, have a certain bin and location in which they belong to. Often manufacturing facilitates keep up with locations by using 5S methodology. Similarly, the surgical supplies can have this same system to allocate supplies according to need and type in bins in order to inventory adequately.

CHAPTER 6 ANALYSIS

6.1 ISHIKAWA DIAGRAM

When initially visiting WellStar Kennestone Hospital, several observations were made in their current process for returning supplies. As seen in figure 6, the people, WellStar Staff, currently retrieve returned supplies and place back into inventory. If there is new hires, there takes a learning curve to get accustomed to knowing the general area of each items or general categories of supplies. Also, due to the high volume of returns, staff usually places return items at their ends of shifts and can work overtime. Another concern is the method when returning items into inventory. The supply chain team re-stocks the shelves while several of the returned items are awaiting to be placed back, therefore leaving no room on shelf for returned supplies. In addition, there is no reliable method to measure and collect data for items being returned. Since WellStar's software EPIC and Lawson are have no integration and do not communicate, tracking returns and their prices is nonexistent. This results in materials or supplies not accounted for. Lastly, the environment is not optimized for returned inventory.

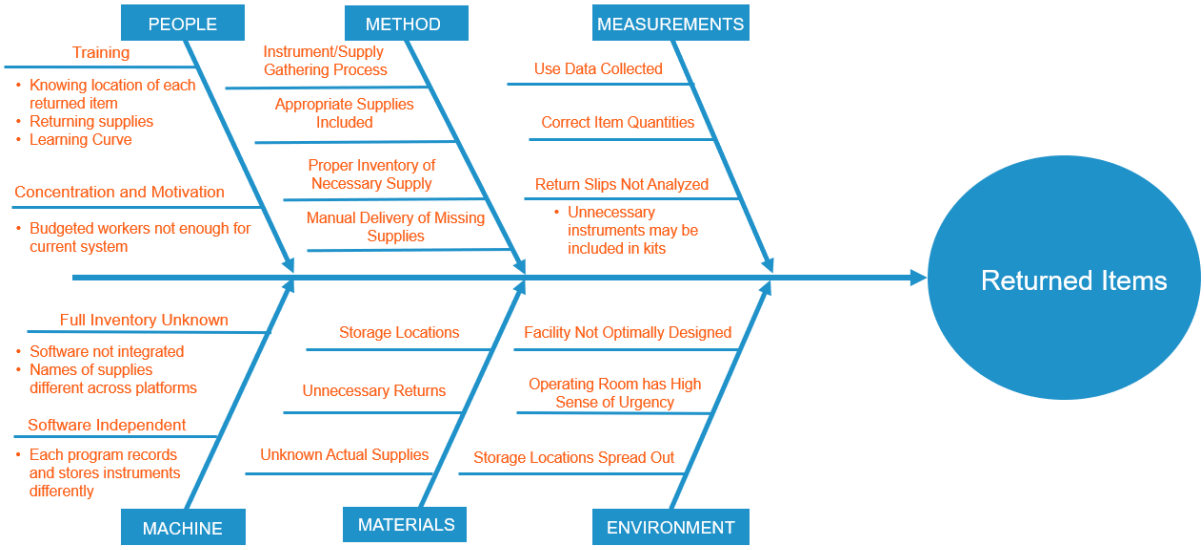

Figure 6 – Completed Fishbone Diagram

6.2 ANALYSIS OF PROPOSED SOLUTION 1

Performing a Cost-Benefit Analysis presented further support towards presenting the right solution. Taking the average hourly rate of current department staff of $40, choosing the average hourly rate for hiring a dedicated staff at $13 per hour to perform the returns, and comparing those to the most recent over budgeted amount of $255,185[10]. There are 13,855 hours needed annually to return the idle instruments. Comparing the ratio of total benefits to total costs will provide a cost-benefit ratio to support the proposed solution (in Table 4 – Cost Benefit Analysis). The selection with the highest cost-benefit ratio would be hiring a dedicated return staff, with a ratio of 14.21, much greater than 4.62. Spending $180,114.48 falls under the overtime budget of $203,147.

	Hospital Staff ($40 per hour)	Dedicated Return Staff ($13 per hour)
Cost of Putting Away	$554,198.40	$180,114.48
Benefit of Available Instruments	$2,558,682.39	$2,558,682.39
Cost-Benefit Ratio	4.62	14.21

Table 4 – Cost-Benefit Analysis

6.3 FLOW CHART OF RETURN PROCESS

Figure 7 – Current Flow Chart

To be able to analyze the proposed solutions, the process flow of returned supplies should be understood. At Kennestone, the instruments are typically sorted and placed into closed container by members of the operating room staff. At the completion of an operation, they are then be moved on a covered cart to the sterile processing department. Before sterile processing can begin, kits that were used in a surgery must be moved from the operating rooms to the sterile processing department. Meanwhile, supplies that were unused are placed in bags and onto an area designated for the return area. Furthermore, these supplies can be damaged on their way to being returned and not accounted for in inventory, resulting in effecting costs.

As seen above in Figure 5 - “Current Flow Chart” (Left), the process flow of supplies once operation is completed is displayed. Kennestone Hospital’s primary concern is reducing the amount of supplies that are unused and sterile, sitting idly in the return area.

6.4 ANALYSIS FOR PROPOSED SOLUTION 2

Figure 6 - "Improved Flow Chart", displays what the process of returning instruments could like with eliminating the return area all together. This will eliminate $2,558, 682.29 of unused supplies returned annually. It will cost more than the available budgeted amount. It was observed that 2 minutes and 6 seconds were needed to properly put away one returned supply into inventory after a surgery. However, items are not always placed back. This step does not always happen when the items are returned, and the results of this are mounds of returned supplies. Items usually idle waiting to be put back into inventory. Considering each item can be properly inventoried in 2.1 minutes, an average daily count of 1,031 instruments would take 36.1 hours to be properly put away, costing $1,082.55-$1,805 (with current staff with pay ranging between $30-$50 per hour) per day to ensure instruments are properly inventoried and available for use to the OR. This equates to between $7,574-$12,635 per week, between $30,296-$50,540 per month, and between $363,552-$606,480 per year.

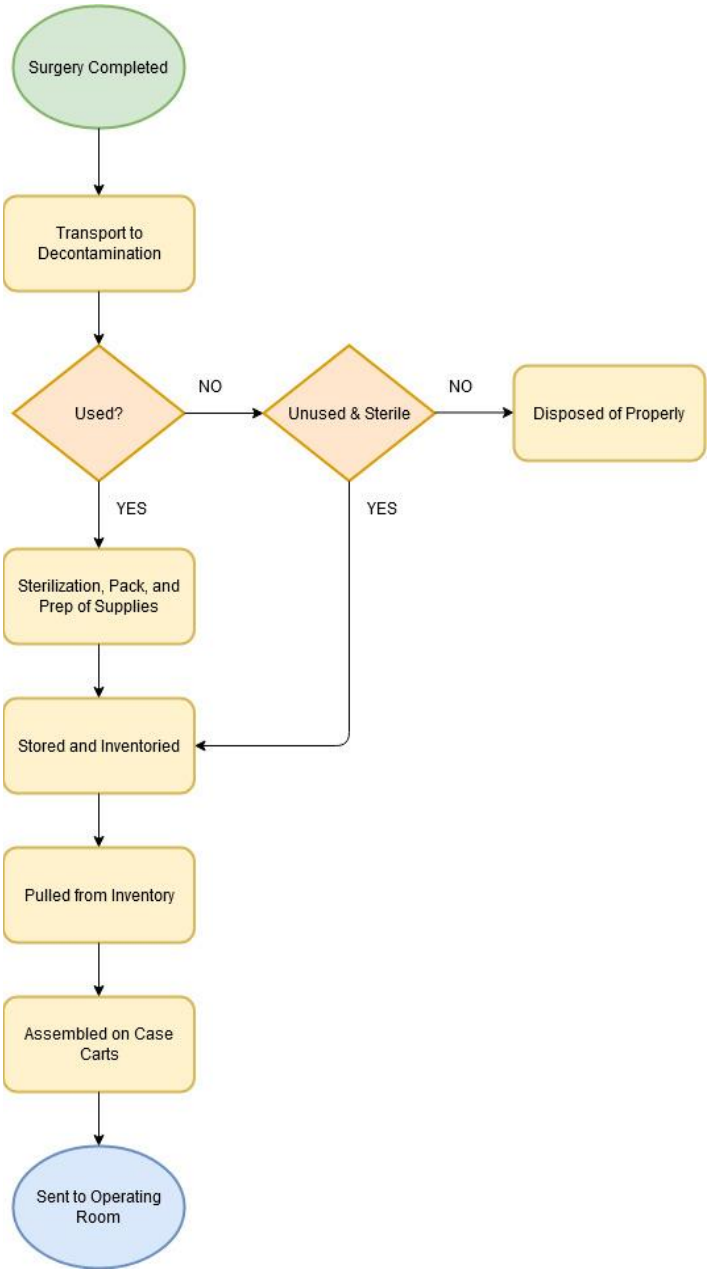

Figure 8 – Improved Flow Chart

6.5 ANALYSIS FOR PROPOSED SOLUTION 3

5S lean method used as a methodology can result in a clean workplace and help Kennestone hospital managing inventory level. Therefore, the following is the implementation of the methodology explained:

- Sort out useable inventory from non-useable inventory for example expired, broken, non-repairable, unsterile, supplies which will not be used. It also helps more space capacity in facility by removing unused supplies.
- Set orders of all returned supplies high dollar items with high priority and inventoried closer to ORs. These are more needed closer to the ORs in case of emergency surgical procedures arise. If the supplies are fewer valuable items, they are of lesser priory and do not need to be set proximity.
- In the third area is shine and upkeeping the supplies. This is making sure returned items are not expires or unsterile.
- The fourth step standardize by keeping high prioritize and high dollar supplies with special tags. By tagging supplies the high priority supplies can be place close to urgent work area. And tagging high dollar supplies can be place in separate areas to avoid any confusion for waste. This is beneficial in the communication process and improve efficiency.
- The final step includes sustaining. Consistency is very important factor for organization and sustainability makes sure to keep system to be organize and back wall in order line. Organization can be re analyzed time to time according to utilization of supplies or which return items are being returned more often.

However, according to Ahmadi and their analyst team, who extensively studied hospital inventory levels, states, "One important aspect of inventory control models, especially in the highly uncertain environment of healthcare, is how the models address the uncertainty involved in the system. In the supply chain context, there are two main sources of uncertainty, which can result in undesirable system performance, eg, shortage of required supplies and shortage of capacity." [2] With Kennestone Hosptial’s ER department being one of the three level II traumas in metro Atlanta the levels of supplies may be difficult to predict. Further

requirements of collecting the volume of patients coming in and out of the ER would be required. However, with the high level of uncertainty which is involved in ER departments it is impractical to accurately estimate how much supplies would be needed in each location. Therefore, the practical implementation of the recommended solution 3 would not be feasible.

CHAPTER 7 – CONCLUSIONS & RECOMMENDATIONS

7.1 RECOMMENDATIONS

The team recommends going with proposed solution 1, where a dedicated employee is brought into the department to handle all returned supplies regularly. Using the current department's staff to put away all returned supplies would cost $526,780 annually in labor costs alone, whereas hiring a temporary team member to put away all returned supplies would cost $171,200 annually. This solution provides immediate access to all billable supplies, does not interfere with the department staff's current processing post-operation, and make available over $2.5 million of unused supplies sitting in the return area. The solutions involving retraining the entire staff and incorporating a SKU system could reach much higher budgetary needs to implement. Whichever decision is made, the cost-benefit ratio will be worth if for the department. With a cost-benefit ratio of 14.1 for Proposed Solution 1, hiring dedicated staff is this group's recommendation.

7.2 CONCLUSIONS

When approaching the optimization needs of the WellStar Kennestone Hospital, our team explored points of inefficiencies for opportunity. Our team raised proposed actionable recommendations with the focus on addressing the stated inefficiencies with cost effective strategies. These recommendations were founded upon the consideration of key data metrics, the reviewing of case studies, observation of processes and application of statistical analyses. The three-fold recommendations targeted at decreasing the return rate of unused surgical supplies addressed dynamism within the current process in the facets of workforce, workflow design layout, and the supplies tracking system. Upon taking all variables such as cost, ease of implementation, and return on process investiture into consideration, the team makes the final recommendation that Kennestone Hospital consider the services of a temporary agency in hiring workforce specifically dedicated to the task of oversight and handling of the surgical supplies.

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APPENDIX

APPENDIX A- ACKNOWLEDGEMENT

We would like to thank you WellStar Kennestone sterile Department John Clark, Central Sterile Supply Director and Ayako Prince who gave us opportunity to work on our Senior Design project. They provide us all the support and assistance during our visit to the SPD facility. We also would like to thank you Dr Adeel Khalid and Dr Ergai Awataf for their assistance and their patience during this critical time.

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APPENDEX C– CONTRIBUTIONS

Thomas Waluk	Led correspondence with industry contact Co-led data collection Co-led creation of poster Led analysis of the report Assisted in revising and editing of the report Contributed to literature review Aided in content of the presentation Assisted in solutions for report Delegated responsibilities for team Aided collection of report references and figures
Alondra Quintero	Aided in content of the presentation Aided collection of report references and figures Created Gantt Chart Co-led creation of poster Assisted creation of budget and approach in report Contributed to content of the literature review Assisted in revising and editing of the report Led project video Co-led data collection Assisted in solutions for report
Shamaila Khalil	Aided in content of the presentation Aided collection of report references and figures Assisted creation of budget Created several figures for the report and presentation Created initial report layout Led initial creation of literature review Aided in revising of report Aided in creation of video Assigned platform for group communication Assisted in solutions for report
Michael Aniagboso	Aided in creation of video Created executive summary in report Created conclusion in report Aided in revising of report Assisted in writing solution for report Aided in content of the presentation Assisted in analysis Assisted in references

APPENDIX D – REFLECTIONS

"There were so many reference points of growth I was exposed to through this project. The relevance of data analysis and review according to Industrial Engineering methods was a strong learning point that got reinforced during this project. Another facet of growth was seeing firsthand the necessity of Industrial Engineering in different industries. Going through the experience with the team taught me the importance of effective communication and how critical it is to define a distinctive path to achieving one goal. I thoroughly enjoyed working with my team and appreciate the insights Dr. Adeel shared with us on our periodic reviews. My thanks to the WellStar Kennestone Hospital and the Kennesaw State University Industrial Engineering department for affording me this opportunity." -Michael Aniagsboso

"This project really helped us to understand how our field is going to be real life. This project is really close to my field and collecting fact-based data at SPD facility helped me to understand how much data can make difference in solving problems and future predictions. I also learned working with team is very critical but very important for my career in future. I would like to thank Dr Adeel Department of Industrial Engineer at Kennesaw State University for your support and assistance." -Shamaila Khalil

"This project set an example of how Industrial Engineering Students may contribute to improvements in the healthcare systems. This experience was also a great illustration of how industrial projects occur in the workforce. To initiate, our project team encountered several delays in the initial stages of our project. Onboarding should have occurred prior to the semester since we were only able to gain access to the facility several weeks into the semester. We also had miscommunications and the entire team has difficulties clarifying goals and the objective of the project. We began to coach and develop one another with effective communication towards the end of the project, which helped with our common goal of completing and delivering a researched and data-driven recommendation. "-Alondra Quintero

"This was a great opportunity to affect change in an arena where change only happens through many lines of 'red tape', if ever. There were many calls and emails and meetings that happened before we were allowed access to the hospital; this makes sense for legal reasons, and made me wish we started the onboarding process months before the start of the semester. This also taught me the lesson of persistence paying off and how to communicate effectively. Everyone is busy enough in their daily lives, and in the end I am grateful to WellStar's staff for helping and guiding us through this process. Super grateful for your time and energy.

It appears we were going to optimize the sterile processing department at Kennestone. After our first call, it was told to the two groups of students that we would be split into two groups, with separate objectives. Up to this point, working as the project manager, I did well communicating with the staff of WellStar and both groups of students to gain access to the facility, but my communication within our own group was not as clear as I imagined it to be. Thanks to COVID and me traveling for work, I was unable to physically visit the facility, which only compounded my confusion with the group's communication. We were on different pages with the group's objective until several weeks before the deadline of the report, and even then only 75% knew what was going on until days before final submission of the body of work. Thanks to patience, listening to each other, releasing control, and a lot of hard work, we put together what we could with the time remaining.

I wish I had released control sooner, and that 100% of the group was clear with the objective from the start. I wish we could have started initial discussions with WellStar prior to the start of the semester. I am grateful and proud of the group effort put in - thank you. Everyone is a teacher – especially those that teach you what NOT to do." - Thomas Waluk