INVENTORY MANAGEMENT IN THE CARDIOTHORACIC AND VASCULAR SURGERY (CTVS) SPECIALTY SUB STORES IN THE OPERATION THEATRE (OT) COMPLEX OF A MULTISPECIALTY TERTIARY CARE HOSPITAL

Internship Training
at
Medanta-The Medicity Hospital, Gurgaon

By
Puja Jain

Under the guidance of
Dr. Barun Kanjilal

MBA Hospital & Health Management
2013–15

Institute of Health Management Research
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2015

Internship Training

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Medanta- the Medicity hospital

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Enrolment Number: IIHMR/PGDHM/2013-15/18-1481

Under the guidance of

Prof. Barun Kanjilal

Post Graduate Diploma in Hospital and Health Management

2013-2015

Institute of Health Management Research

Jaipur

INSTITUTE OF HEALTH
MANAGEMENT RESEARCH
(WHO Collaborating Centre for District Health System Based on Primary Health Care)

IIHMR UNIVERSITY

TO WHOMSOEVER MAY CONCERN

This is to certify that **Dr Puja Jain** student of MBA Hospital and Health Management from IIHMR University, Jaipur has undergone dissertation/internship training at Medanta the Medicity hospital, Gurgaon from 9th February to 30th April.

The Candidate has successfully carried out the study designated to her during dissertation/internship training and her approach to the study has been sincere, scientific and analytical.

The dissertation/internship is in fulfillment of the course requirements.

I wish her all success in all his future endeavors.

Col. (Dr.) Ashok Kaushik
Dean, Academics and Student Affairs
IIHMR, Jaipur

Dr. Barun Kanjilal
Professor
IIHMR, Jaipur

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Date 04.05.15

INTERNSHIP COMPLETION LETTER

This is to certify that Dr. Puja Jain, student of MBA (Major in Hospital & Healthcare Management), Batch 2013 -15 Indian Institute of Health Management Research, Jaipur has successfully completed her internship with us.

- Project Title - Inventory management in CTVS specialty sub stores in Operation Theatre (OT) complex
- Project Duration - 09th Feb 2015 to 31st March 2015

During the period of her internship programme with us she was found to be punctual, hardworking and inquisitive.

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MONICA MUDGAL
SENIOR VICE PRESIDENT & HEAD - HUMAN RESOURCES

INSTITUTE OF HEALTH
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CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled "Inventory Management in the Cardiothoracic and Vascular Surgery (CTVS) Specialty Sub Stores in the Operation Theatre (OT) Complex of a Multispecialty Tertiary Care Hospital" submitted by Dr. Puja Jain , Enrollment No.1481 under the supervision of Prof. Barun Kanjilal for award of MBA Hospital and Health Management of the university carried out during the period from 9 February, 2015 to 30th April, 2015. Embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other Institute or other similar institution of higher learning.

pjajain.

Signature

1, Prabhu Dayal Marg, Near Sanganer Airport, Jaipur- 302029, Rajasthan, India.
Ph.: 0141- 3924700, 2791431- 32, Fax: 0141- 3924738, E-mail: iihmr@iihmr.org, Web.: www.iihmr.org

Abstract

A study on Inventory Management in the Cardiothoracic and Vascular Surgery (CTVS) Specialty Sub Stores in the Operation Theatre (OT) Complex of a Multispecialty Tertiary Care Hospital.

Author: Dr. Puja Jain

Background: Inventory management is a challenge that exists worldwide in all hospital settings. Its management reaps benefits like ensuring smooth work flow, reducing wastage, lowering cost and most importantly saving lives. The OT complex is a huge profit centre in a hospital and the hospital in which the study is carried out had 23 functional OTs and the volume of cases per day was very high and so was the consumption of items.

Objectives: To determine the buffer stock of single use items to be kept by the three cardiac sub stores. To find out whether there is overstocking of single use consumables in the three cardiac OT sub stores and enumerate the consumables that are overstocked. To find out whether there is overstocking of multiple use consumables and provide suggestion on ways to ensure compliance to the hospital policy in reference to the number of times a multiple use item is to be used.

Methodology: It is a descriptive and cross-sectional study.Primary data was collected by direct observation of processes. Secondary data was collected from the information technology (IT) department. The data for three months only (which includes December 2014, January2015 and February2015) was taken keeping in mind the given time constraints for the study.

Suggestions: Over stocked items to be removed from the sub stores to enable better inventory control over only the stock required there. Buffer stock of each item is to be maintained as per the defined criteria in the study, which therefore requires re -ascertaining the demand and consumption patterns on a regular basis and maintaining stock accordingly. The multiple use items that have not been used in the mentioned three months are to be handed over to the urology department for their use as they are doing those surgeries. An automated system of determining the number of uses and discard of a multiple use item is to be formed.

Preface

Dissertation is an integral part of the MBA in Health and Hospital management programme & for this purpose I had undergone dissertation in a multi super specialty tertiary care hospital.

During the dissertation period I was posted in the operation theatre (OT) complex area for its management and was involved in handling of the day to day operational problems there. This was an opportunity for me to not only identify but dive deep into the problems that were existing and come up with their possible solutions. There were a host of problems and to begin with I chose a problem that existed across the specialties in the OT complex, and that was of inventory management. The hospital currently has 23 functional OTs 21 of which are housed within the OT complex and 2 in the emergency area. It plans to expand its capacity to further add 17 more OTs. The number of cases operated each day ranges between 90 -120 per day. These numbers explain the huge amount of workload and a parallel amount of consumables and other items used in these cases. This necessarily warrants a very efficient management of consumables ensuring smooth work flow, reducing wastage and most importantly saving lives by ensuring timely and continuous flow of these items.

The dissertation report includes an introduction to the topic, the rationale of choosing it, a description of important terms and concepts used in the study, the problem statements, and objectives of the study, methodology used, findings, limitation, suggestions and resources used.

Thanking You

Puja Jain

Acknowledgement

There are many individuals in each person's professional life who contribute in enriching the experience by stimulating and influencing intellectual development. A sense of indebtedness to such people comes from within. Ordinarily this feeling is expressed in customary gesture of acknowledgement. Therefore, it seems right to acknowledge my gratitude with sense of venerates to the almighty God and all those people who helped me during the course of project work. Their valuable guidance and wise direction have enabled me to complete my project in a systemic and smooth manner.

The project report on **"Inventory management in the cardiothoracic and vascular surgery (CTVS) specialty sub stores in the operation theatre (OT) complex of a multispecialty tertiary care hospital"** has been compiled involving the hard work of many. Now is the time to express my heartiest gratitude towards them.

Firstly, I would like to thank my college, **The IIHMR University**, for providing me with an opportunity to learn from and work with the best personnel in the hospital industry, and for helping me gain an appreciation of where I currently stand as an administrator and how much work I would need in order to meet the quality specifications that the hospital industry seeks. Completion of this project would not have been possible without the valuable suggestions of my faculty guide **Dr. Barun Kanjilal (Professor- The IIHMR University),** who began guiding us on how to go about the dissertation even before the internship started. The presentation and material given by him has helped me sail through many hurdles, I am sincerely thankful to him. **Maj Vinod Kumar SV (The IIHMR University)** for guiding me during initial stages of project conceptualisation, providing me with relevant material that helped me develop a line of thought

for how to shape my project, **Dr. Santosh Kumar (Associate Professor- The IIHMR University) for providing us with the relevant material during the course, Dr. Ashok Kaushik (Dean, Academic and Student Affairs- The IIHMR University)** for his prompt responses and invaluable inputs whenever required, **Mr. Dalbir Singh (Placement Officer- The IIHMR University)** for facilitating my training at Medanta the Medicity.

I would like to thank **Mr. Pankaj Sahni (COO- Medanta-the Medicity hospital**) who allowed me to work on this topic and without whose permission this project would not have been possible, my project guide **Dr. V R Gupta (Medical Director- Medanta-the Medicity hospital**) who provided me with necessary support, guidance and encouragement whenever required, my mentor **Dr. Siddharth Yadav (OT manager- Medanta-the Medicity hospital)** who was there to share his valuable suggestions and thoughts on the topic and provide relevant criticism which helped me do a more rigorous analysis, **Mr. Rajiv Sikka (HOD- IT department)** for providing me access to the data required, **Mr. Arvind Pathak (Assistant manager- IT department)** for helping me get the data in the required format, **Mr. Shashikant (Head Technician- OT), Mr. Santosh (Incharge- OT store), Sister Birdi (Nursing Superintendant- OT), Sister Prem (Nursing supervisor- OT)**, **Ms Kamala Rana(Head perfusionist- OT) and Ms. Aarti (Technician- CTVS specialty)** who helped me understand the processes better.

Last but surely not the least, from the bottom of my heart I wish to thank my family and my friends for being who they are. Without their support and encouragement I could not have attained all that I have so far.

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Abbreviations

- AVG: Average
- BP: Blood Pressure
- CABG: Coronary Artery Bypass Graft
- CSL: Cycle Service Level
- CSSD: Central Sterile Supply Department
- CTVS: Cardio Thoracic and Vascular Surgery
- ELT: External Lead Time
- EOQ: Economic Order Quantity
- ILT: Internal Lead Time
- OT : Operation Theatre
- POCU: Pre Operative Care Unit
- Qty: Quantity
- ROL: Reorder level

1. Executive summary

This study has been carried out in a multi super specialty tertiary care hospital. The hospital has 23 functional OTs (operation theatres) of which 21 were housed in the OT complex and other 2 were in the emergency area. It also planned to expand its capacity to further add 17 more OTs in the future. Out of the 23 OTs, 7 OTs were specifically allocated to the cardiac speciality. The OTs functioned from 8am in the morning to 8pm in the evening (8 to 8 shift), 6 days a week.

To restrict the study only to the dissertation period, I could not go on with all the specialties and had to choose one. The number of cases operated in the cardiac specialty alone ranged between 6 -25 per day, averaging at around 13 cases per day which was the highest when compared to the number of surgeries performed in other specialties in the hospital. These numbers explain the huge amount of workload and a parallel amount of consumables and other items used in these cases. Also, it was the only specialty having three sub stores within the OT complex itself. This necessarily warranted a very efficient management of consumables ensuring smooth work flow, reducing wastage and most importantly saving lives by ensuring timely and continuous flow of these items.

The consumables under consideration for this study are the ones which are stored in the three cardiac OT sub stores.

For the purpose of this study they can be classified as follows:

i) On the basis of functionality:

   a) Perfusion sub store: includes consumables used during perfusion.

      (Under supervision of perfusionist)

   b) Surgical sub store: includes consumables used during surgery and narcotic

drugs. (Under of nursing staff)

c) Anaesthesia sub store: includes consumables used for anaesthesia induction (Under supervision of technicians)

ii) On the basis of number of uses:

a) Single use: consumables which can be used only once

b) Multiple use: consumables which can be used more than once as per the hospital policy.

iii) On the basis of category of charges' in the patient's bill:

a) Charged under consumables used

b) Charged under OT charges

Problem statement 1:

The buffer stock maintained by the three cardiac sub-stores was not based on any scientific method. It was rather arbitrary and was fixed five years ago when the consumption patterns would have been different from what they are today. So then how do we decide the amount of buffer stock of each consumable to be maintained?

To answer this question, do we consider the average consumption of each item and their maximum consumption per day and the difference between them to be the buffer stock or do we also include the lead time?

Since the system followed here is a multiple replenishment system (as mentioned earlier) wherein, there are two replenishment cycles, in this case between the hospital main store and the OT main store (1) and between the OT main store and the CTVS OT sub stores (2) so it is not

required to maintain much buffer stock. The lead time for the 2nd replenishment cycle in case of a stock out is less than five minutes, since it happens inside the OT complex only. It is very less and therefore, it is not considered in this case to calculate the buffer stock. In case of a stockout in the OT main store, the item will be brought from the hospital main stores by the general duty assistant (GDA), in which case also the lead time is less, it is <10 minutes. (Source of information: Direct observation of processes and interviewing store in-charge and nursing staff)

In this case lead time is negligible, almost zero in terms of days. Therefore,

Buffer Stock= Max. Consumption - Avg Consumption

Due to the vicinity of the cardiac sub stores to the OT main store and short lead time (<5 minutes) the cardiac sub stores are not required to maintain a lot of stock. Despite this, there seemed to be a lot of stock left in the cardiac sub stores at the end of each day. So the question arises Is there overstocking of single use consumables in these stores?

To answer this question, I needed to know the baseline for each consumable, above which they could be considered as overstocked. Since this was not available, I began studying the demand and consumption patterns of these items in the past three months. Understanding surgeries performed each day in the cardiac specialty for the mentioned three months (to understand the volume and average number of cases per day) and item movement of single use and multiple use consumables in those respective cases for the same three months (to find out consumption pattern of the same) helped me form a baseline for each consumable.

Therefore, for single use items it involved relating consumption per day in the time period for which data was analysed (three months) to the average number of cases per day and comparing it with the stock. Anything above the baseline plus the buffer stock (as calculated by the above mentioned method) was categorised as over stocked.

Overstock = [Existing stock – (Avg Consumption + Buffer Stock)]

(For each consumable) (For each consumable)

Wherein, existing stock of each consumable was taken from the audit reports of finance department, avg consumption for each and buffer stock for each as calculated by the above mentioned method.

Problem statement 3:

The system to determine the number of uses of multiple-use items is person dependant and there are chances of it being either underused or overused. How do you say that it has been used say ‘x’ number of times and not ‘y’? The dots put by marker on these items (after every use may be erased during sterilisation or the respective staff may even forget to do so. What if the dots are simply put on these items, without these items being actually used? There is no system currently to verify all this. Therefore, how can we determine the actual number of times these consumables have been used and how much stock of the same should we keep?

The replenishment of different type of consumables varied and largely depended on their usage and consumption patterns.

Replenishment of single use consumables was done in the following way: A list of patients to be operated the next day was prepared each day by 11pm. Based on this list and any other emergency cases, surgeries were performed the next day. Consumables used on the respective cases were charged after every surgery by the OT main store. This consumption was recorded in three lists (sub-store wise list) for every patient operated.

At the end of the day, all three sub stores (perfusion, surgical and anaesthesia) had the list of consumables used respectively from their stores. This formed the total consumption of the respective stores for that day and was replenished by the OT main store the next day.

For consumables which were charged **under** the category of **OT charges** in the patient's bill, replenishment was done by the OT main store, twice a week based on the consumption.

For multiple use consumables:

Each item under this category had a specific number of defined uses as per the hospital policy, after which they were supposed to be discarded. A list of these consumables with their respective pre defined number of uses was present. As, these items were expensive their charges were divided amongst patients as per the hospital policy to bring down the cost to patient per surgery.

Each consumable was used as per its pre defined number of uses, determined by the hospital policy

↓

After each usage it was checked for any defect or whether it could be reused as per the hospital guidelines for respective items (this is a quality check) and sent for sterilisation to the central sterile supply department (CSSD)

↓

Before sterilisation the CSSD put a dot with a marker pen on the multiple use consumable *(number of dots correspond to the number of uses) and then sterilised it*

↓

This process continued, till the consumable *completed its number of pre defined uses and needed to be discarded*

↓

The consumables were discarded as per the hospital policy and a discard register was maintained, which also contained the details of the usage of the same

↓

The nursing supervisor takes this register to the hospital main store for other consumables

↓

Based on this discard register (which shows that the particular multiple use item under consideration was used till its pre-defined usage and also states reasons for non-compliance to this) *a new multiple use item was replenished.*

Note: Italics indicate problem areas/points.

The limitation in answering this question (the third question) was that the data to determine the actual number of times the multiple use consumables were being used was not made available. This problem was identified based on process understanding by direct observation and interviewing the nursing, technician, perfusionist and infection control staff. Therefore, my approach **to answering this question** would just be limited to finding out the consumption as per the transactions of these items during the defined period (three months) and relating it to the average number of cases per day and comparing it with the stock of the same that was maintained and then determine the stock of the same to be maintained.

Also to ensure that, these items are being used as per the hospital's policy an automated system of marking the number of uses and its discard can be made.

Suggestions: i) The items that are over stocked to be removed from the sub stores to enable better inventory control over only the stock required there. This would also save a lot of clinical time of the paramedical staff (nursing/technicians/perfusionists) which was otherwise wasted in maintaining more inventories. Needless to say, this would reap a whole lot of benefits associated with carrying fewer inventories.

ii) Buffer stock of each item to be maintained as per the defined criteria in the study, which therefore requires re -ascertaining the demand and consumption patterns on a regular basis and maintaining stock accordingly.

iii) An automated system of determining the number of uses and discard of a multiple use item to be formed. This system will not only prevent such items to be under or overused but will also act as a check to prevent any pilferage. This could be verified easily with the number of patients charged for the same and thus, it could also ensure compliance to hospital policy and help in making the system more transparent.

2. Introduction

A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. In general there are various supply chain stages in hospitals like the supplier, hospital's main store, sub stores, customers.

This study is restricted to inventory in just one supply chain stage and that is the sub-stores. There are two different ways to view the processes performed in a supply chain. (Kumar, 2013)

- **Cycle View**: The processes in a supply chain are divided into a series of cycles, each performed at the interface between two successive stages of a supply chain. This includes a procurement cycle (which happens between supplier and the hospital main stores) replenishment cycle (between hospital main stores and the sub stores) and the customer order cycle (between the sub stores and the customers).

- **Push/Pull View:** The processes in a supply chain are divided into two categories depending on whether they are executed in response to a customer order or in anticipation of customer orders. Pull processes are initiated by a customer order, whereas push processes are initiated and performed in anticipation of customer orders. **In hospital settings, push processes are the ones that happen**

We will see how the cycle view of processes can be applied to this setting and also how the setting of this hospital is different from settings in other hospital from this point of view, in the later sections.

What is Inventory?

Inventory is defined as the sum total of all the goods or materials at hand. In other words, the sum total of all the supplies which are held in stock for use or further distribution. (SV, 2012)

We require stocking of materials or supplies within the supply chain from the seller to the final user. This stock can conceptually be addressed as the inventory.

Why do we need Inventory?

Inventory is required because of the existing uncertainties down the supply chain. These uncertainties could lead to delay in supply of consumables or drugs required by the beneficiaries. From the health organization's perspective, these uncertainties could be grouped into internal and external factors as mentioned below:

Internal factors: management/ departmental decisions, user demands

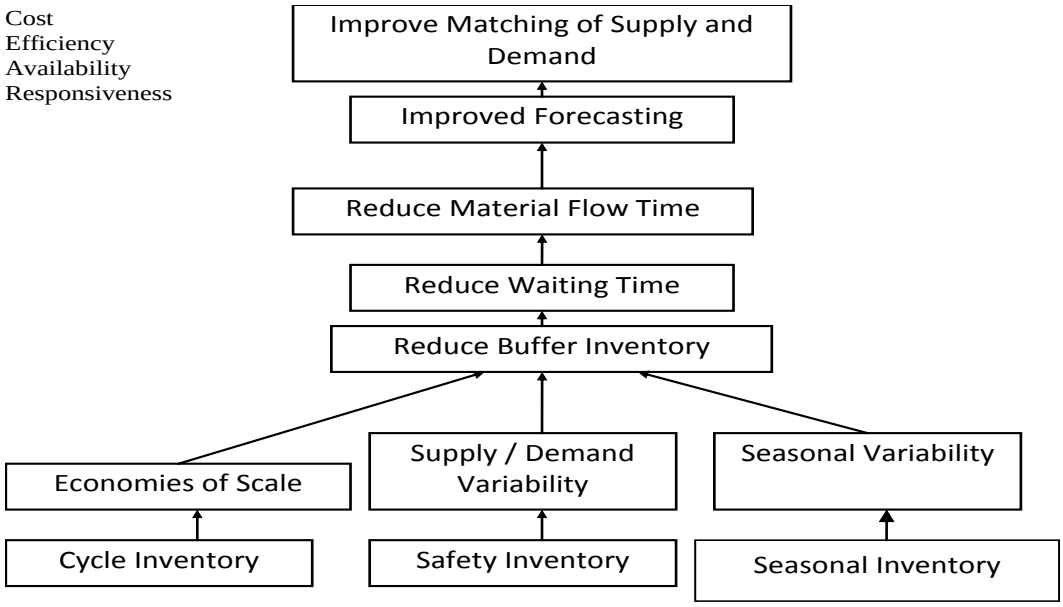
External factors: government regulations, availability, supplier constraints, lead times. (SV, 2012)

The basic objective of inventory management is uninterrupted and timely supply of items to patients/ hospital departments at lowest cost without compromising the quality and to improve the profitability of the hospital/s' supply chain. (Kumar, 2013)

Therefore, we would also achieve the objectives of this study while still ensuring that uninterrupted and timely supply of consumables is not compromised with.

Figure 1 below, explains the role of inventory in the supply chain especially when it comes to dealing with supply/ demand variability and improving matching of the same.

Figure 1: Role of Inventory in the supply chain. (Kumar, 2013)



The figure 1 above also helps us understand the use of safety/ buffer inventory in dealing with supply/ demand variability and how improved forecasting and reduced material flow time can help reduce the buffer inventory.

The stage of supply chain that we are concerned of in this study is the one that directly supplies to the end customer and the buffer inventory kept is just to cater to the changes in demand, as we have the OT main store in the same complex and the lead time is negligible.

The consumables under consideration for this study are the ones stored in the three CTVS OT sub stores.

For the purpose of this study they can be classified as follows:

i) On the basis of functionality:

   a) Perfusion sub store: includes consumables used during perfusion. (Under supervision of perfusionist)

   b) Surgical sub store: includes consumables used during surgery and narcotic drugs. (Under of nursing staff)

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iii) On the basis of category of charges' in the patient's bill:

   a) Charged under consumables used

   b) Charged under OT charges

Note: I have not included vendor managed items (VMIs) even though these items are physically present in these stores, as they are maintained by the vendors of the respective items and the hospital does not have to manage their stock. The vendors themselves ensure the availability of these items and the items are charged to the hospital only once they have been used in the patients.

3. Rationale

This study has been carried out in a multispecialty tertiary care hospital. During the dissertation period I was posted in the operation theatre (OT) complex area for its management and was involved in handling of the day to day operational problems there. This was an opportunity for me to not only identify but dive deep into the problems that were existing and come up with their possible solutions. There were a host of problems and to begin with I chose a problem that existed across the specialties in the OT complex, and that was of inventory management.

The hospital had 23 functional OTs (operation theatres) of which 21 OTs was housed in the OT complex and other 2 were in the emergency area. The number of surgeries performed in these OTs ranged between 80 to 120 per day. The hospital also planned to expand its capacity to further add 17 more OTs in the future. The OTs functioned from 8am in the morning to 8pm in the evening (8 to 8 shift), 6 days a week.

To restrict the study only to the dissertation period, I could not go on with all the specialties and had to choose one. Out of the 23 OTs, 7 OTs were specifically allocated to the CTVS speciality. The number of cases operated in this specialty alone ranged between 6 -25 per day, averaging at around 13 cases per day which was the highest when compared to the number of surgeries performed under other specialties in the hospital. These numbers explain the huge amount of workload and a parallel amount of consumables and other items used in these cases. Also, it was the only specialty having three sub stores within the OT complex itself. This necessarily warranted a very efficient management of consumables ensuring smooth work flow, reducing wastage and most importantly saving lives by ensuring timely and continuous flow of these items.

4. Important terms & concepts used in the study

Managing inventory can be a daunting task for an enterprise when tens of thousands of products are located in different locations. The challenge is even greater when these locations are in vicinity to each other and located within the same complex which in this case is the OT complex. In such networks, new products are first stored at a central facility which in this case is the OT main store. These central facilities are the internal suppliers to the customer-facing locations which in this case are the specialty-wise sub stores (in this study referring to CTVS specialty).

This is a rare distribution network when referring to hospitals as most of the hospitals have only one level of storage within the OT complex and from there itself the customer's orders are fulfilled. This can be owed to the large number of cases operated every day.

Managing inventory in such networks where there are multiple replenishment cycles vs. a network with a single replenishment cycle presents major pitfalls. One is the failure to achieve true network inventory optimization, because replenishment strategies are applied to one cycle without regard to its impact on the other cycles. These pitfalls can create substantial negative consequences, which includes carrying excess inventory in the form of redundant buffer stock. (Lee, 2003).

The objective of having multiple replenishment cycles is to deliver the desired end customer service levels at minimum with the inventory divided among the various replenishment stages.

Before moving forward I would like to discuss few terminologies which have been used in this report, for better clarity.

Buffer Stock: Buffer stock is the quantity of stock set apart as a safeguard against variation in demand and shortage or delay in supplies. It is also called safety or reserve stock. (SV, 2012) It is calculated by multiplying the difference between the maximum and average consumption rate per day by the lead time for the item. (Kumar, 2013)

Buffer Stock= (Maximum (Max.) Consumption- Average (Avg) Consumption) * Lead Time (in days)

There are various factors that influence the required level of safety inventory or buffer stock. (Walter Ramsey Crowe, 1977) (Kumar, 2013)

i) Demand uncertainty,

ii) Replenishment lead times,

iii) Lead time variability, and

iv) Desired product availability.

v) Continuous review policies vs. Periodic review policies.

The requirement of buffer stock in this case (reference to the CTVS specialty sub stores) is just to deal with the demand uncertainty.

Lead Time: It is the average duration of time in days between placing of an order & receipt of material. It is further divided into Internal lead Time (ILT) and External Lead Time (ELT). (SV, 2012)

- Internal lead time-Time required for the organizational formalities to be completed
- External lead time-Time required for placement of order & receipt of goods

The replenishment lead times and lead time variability are negligible and therefore insignificant in this case.

Product availability is a firm's ability to fill a customer's order out of available inventory. (Kumar, 2013)

There are several ways to measure product availability, some important methods are:

- Product fill rate
- Order fill rate
- Cycle service level (CSL)

Product fill rate: fraction of demand that is satisfied from product in inventory. Fill rate is equivalent to the probability that product is supplied from available inventory. If hospital sells Tab Crocin to 90% of its customers from inventory, with remaining 10% lost to a neighboring competitors because of a lack of available inventory. Fill rate is 90%. Fill rate increases if safety inventory is increased. This also increases the cycle service level.

Order fill rate: It is the fraction of order that is filled from available inventory. Order fill rate is also measured over specified orders rather than time. In a multiproduct scenario (as in the case of most medical prescriptions), an order is filled form inventory only if all product in the order /prescription can be supplied from the available inventory.

Cycle service level (CSL): It is the fraction of replenishment cycles (D/Q) that end with all the customers demand being met. A CSL is equal to the probability of not having a stock out in a replenishment cycle. CSL is measured over a specified number of replenishment cycles. Example-If a hospital orders replenishment lots of 600 crocin boxes, the interval between arrival

of two successive replenishment lots is a replenishment cycle. If Pharmacist at the hospital manages inventory such that the store does not run out of inventory in 6 out of 10 replenishment cycles, the store achieves 60% CSL.

Desired product availability is also not an issue as a lot of stock is maintained just to enable that and also the OT main store takes care of that during their continuous review process and ensures at least 90% CSL.

Reorder Level: It denotes the stock level at which fresh order needs to be placed. It is calculated by multiplying the average daily consumption by lead time and adding the buffer stock to it. If there is no variation in lead time and average consumption during lead time then this formula holds true for the re-order level (ROL) (Kumar, 2013)

ROL= Average consumption/day x Lead time + Buffer stock

In this case lead time is negligible (less than 5 minutes) and when calculated in terms of number of days it is almost zero.

Therefore, the reorder level is approximately equal to the buffer stock, which is what remains at the end of each day and hence replenishments happen daily.

Stockout: A customer order arrives when product is not available. (Kumar, 2013)

Inventory in this case can be controlled by setting various stock levels for each item. It also depends on the timing of inventory replenishments which in this case is daily. Economic order quantity (EOQ) is another effective method of inventory management but cannot be used in this case.

Economic order quantity (**EOQ**) is the order quantity that minimizes the total cost of inventory, such as inventory holding costs, ordering costs and shortage costs. (SV, 2012) Therefore, EOQ is the optimum size of order which minimizes the cost of ordering as well as the cost of carrying the inventory. It is beneficial only when the following conditions are there:

a. When the demand and lead time are relatively constant.
b. Your carrying costs and setup or ordering costs are known and relatively stable.
c. When you use make to stock strategy.

In this case the demand is not relatively constant, although the lead time is. Also the carrying costs and ordering costs are unknown. The strategy followed here is the make to order strategy and replenishments are done daily.

Even then if we just compare the costs of carrying (which includes blocked capital and interest payments, cost of space and storage facilities, cost of labour, cost of salaries to staff , cost of obsolescence, pilferage , damages) and the costs of not carrying (which includes direct stock out cost, expensive emergency purchase ,indirect stock out cost ,criticism, patient dissatisfaction, illness, death) in this case, the costs of not carrying seems to outweigh the costs of carrying just for a simple reason that the area that we are discussing here is the OT complex and any stockout here can lead to grave outcomes, even death. Although the costs of carrying are also not less since the nursing staff have to spend a lot of time in just maintaining inventory, which otherwise could have been spent on patient care and not to forget the other ills of carrying stock as mentioned earlier. Therefore, a balance between the two is required and some amount of buffer stock has to be maintained in the specialty wise sub stores (in this case the three CTVS sub stores) even though replenishments happen daily.

Inventory control is a management tool which tries to ensure that optimal quantity of items is present at the facilities in accordance with the need at the most economical cost possible. It also ensures that there are no stock outs or overstocking. (SV, 2012) **Tools used for inventory control here include maintaining a buffer stock and daily replenishments by following a cyclic ordering system.** The **cyclic ordering system** is one in which the stock position is reviewed at definite intervals (which is daily). Availability and consumption are assessed for placing orders. The review is physical check, a visual review of the inventory documents and a computer based system. The quantity ordered each time varies according to the stock position. The projected requirements are based on previous year's trends of consumption but in the method followed in this hospital they are just replenishments of previous day's consumption. This system may work well for materials which show irregular or seasonal variation. The main limitation of this system is that it does not permit ordering based on EOQ method.

5. Problem Statements

Problem 1:

The buffer stock maintained by the three cardiac sub-stores is not based on any scientific method. It is rather arbitrary and was fixed five years ago when the consumption patterns would have been different from what they are today.

Problem 2:

Due to the vicinity of the cardiac sub stores to the OT main store and short lead time (<5 minutes) the cardiac sub stores are not required to maintain a lot of buffer stock. Despite this, there seemed to be a lot of stock left in the cardiac sub stores at the end of each day. So the question arises, is there overstocking of single use consumables in these stores.

Problem 3:

The system to determine the number of uses of multiple-use items is person dependant and there are chances of it being either underused or overused. How do you say that it has been used say ‘x’ number of times and not ‘y’? The dots put by marker on these items (after every use may be erased during sterilisation or the respective staff may even forget to do so. There is no system currently to verify all this. Therefore, it is difficult to determine the actual number of times these consumables have been used so how do we determine if there is overstocking of the same?

6. Objectives

i) To determine the buffer stock of single use items to be kept by the three cardiac sub stores.

ii) To find out whether there is overstocking of consumables (single use) in the three cardiac OT sub stores and enumerate the consumables (single use) that are overstocked.

iii) To find out whether there is overstocking of multiple use consumables and provide suggestion on ways to ensure compliance to the hospital policy in reference to the number of times a multiple use item is to be used.

7. Methodology

The duration of the study was two months. It is a descriptive and cross-sectional study.

Data collection: Primary data was collected by direct observation of processes. Secondary data was collected from the information technology (IT) department. The data for three months only (which includes December 2014, January2015 and February2015) was taken keeping in mind the given time constraints for the study.

Data includes:

i) Details on surgeries performed each day in the cardiac specialty for the three months (to understand the volume and average number of cases per day).

ii) An audit report of stock (which would show the baseline of stock for each consumable to be maintained by each of the three cardiac OT sub stores).

iii) Item movement of single use and multiple use consumables for the three months (to find out consumption of the same). This includes patient wise consumption of each consumable for the mentioned time period.

Method: Writing notes while observing and getting data from hospital information system (HIS) and systems, applications, products (SAP) through the IT department.

The data was given by the IT department after the requirement of it was requested to be given by my guide in the hospital and chief operating officer (COO) of the hospital to the IT department. After obtaining these permissions, a format of the data required was asked to be submitted to them. The data requirement seemed to be a little difficult to pull out from the system as the consumables were being given at the customer facing location by the OT sub stores but the consumption of the same was shown in the system from the OT main stores (as the billing was done there). Another difficulty was in segregating the data only for the CTVS specialty as the consumption of all the specialties was there from the OT main store only. Since the study is restricted to the three sub stores in the CTVS specialty so the consumables which were not stored in these sub stores and were available in the OT main store have not been included in the study.

The data obtained through the IT department was summarised by cross sectional analysis. The data was taken up in the excel sheets and the consumption of consumables in each and every patient in the mentioned three months was summarised to show the consumption of each item in the same period. The data for the cases that were operated each day in the mentioned period was also taken and summarised to get the average number of cases per day and the maximum number of cases that had been operated in a day. The average number of cases per day was related to the average and maximum consumptions of each item and this data obtained was further analysed.

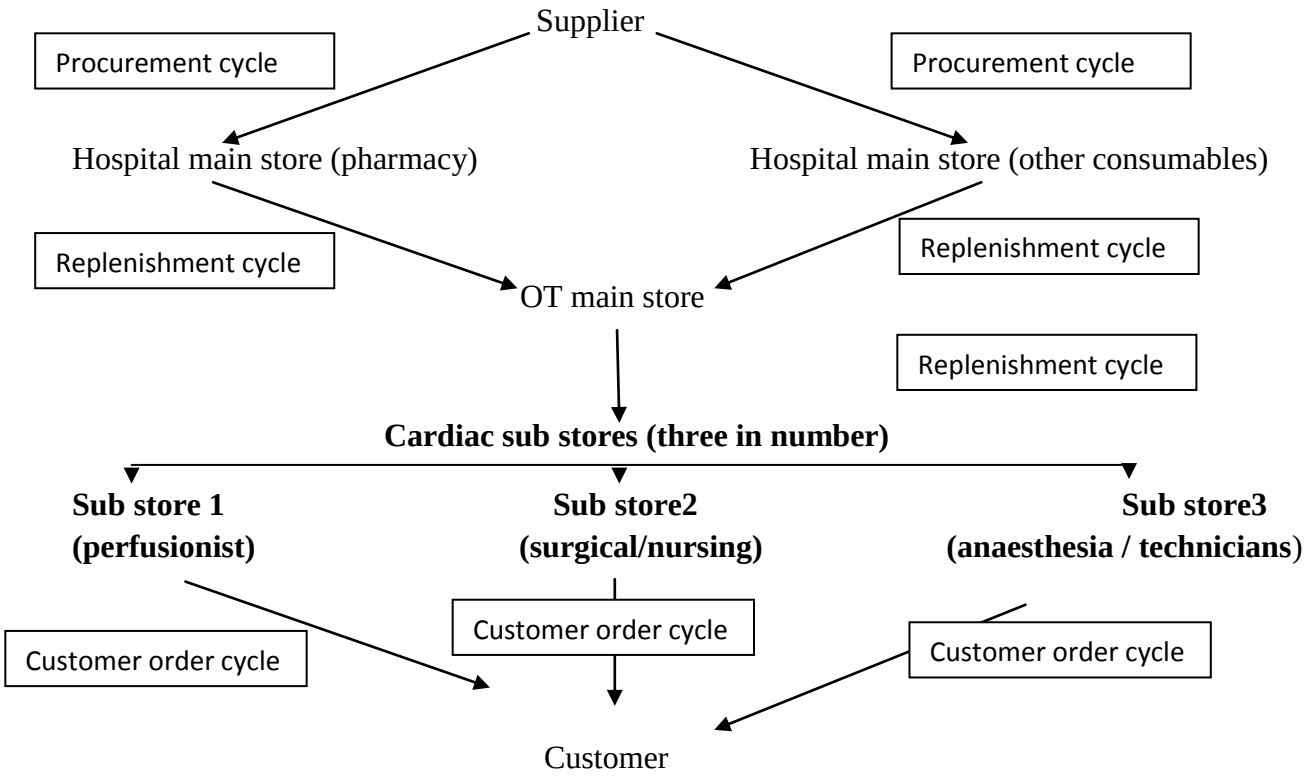
8. Findings

Problem 1:

The buffer stock maintained by the three cardiac sub-stores is not based on any scientific method. It is rather arbitrary and was fixed five years ago when the consumption patterns would have been different from what they are today.

The consumables under consideration for this study are the ones as have been mentioned above. The supply chain stages that were there in this hospital can also be explained by the cycle view of supply chain as described below in figure 2.

Figure 2: Various supply chain stages in this hospital



As we can see from above in figure 2, there are two replenishment cycles and the second replenishment cycle between OT main store and cardiac sub-store happens inside the OT complex only. In this case therefore, the lead time is very less. It is < 5minutes. In case of a stockout in the OT main store, the item will be brought from the hospital main stores by the general duty assistant (GDA), in which case the lead time is <10 minutes. (Source of information: Direct observation of processes and interviewing store in-charge and nursing staff). Thus, a limited amount of buffer stock is to be kept here. This stage of supply chain requires being **agile** and the objective of which is to respond to short-term changes in demand or supply quickly. It also has to be adaptive by evaluating needs of ultimate consumers regularly and maintaining stock accordingly.

The cycle between the customer and the sub stores has been mentioned as a customer order cycle instead of a replenishment cycle even though the customer does not directly order for the consumables required in their particular surgeries instead it is ordered on their behalf by the clinicians. This order cycle is not one in which the customer/ patient orders for herself or himself and that is due to asymmetry of information between the customer and the surgeons and the therefore, the surgeons on behalf of the patient places the order since the relationship between them is an agency relationship. Therefore, even though the order is not physically placed by the patient but it is still on behalf of the patient and so considered as a customer order cycle. Besides, the main objective of the supply chain is to satisfy the needs and demands of the customer and thus, the supply chain cycle is incomplete without a customer order cycle.

The stage of supply chain that we are concerned of in this study is the one that directly supplies to the end customer and the buffer inventory kept is just to cater to the changes in demand, as we

have the OT main store in the same complex and the lead time is negligible. Thus, a limited amount of buffer stock is to be kept here but the question is how much of it is required to be maintained?

To answer this question, do we consider the average consumption of each item and their maximum consumption per day and the difference between them to be the buffer stock or do we also include the lead time, as the formula says?

The formula for buffer stock is as follows:

Buffer Stock= (Maximum (Max.) Consumption- Average (Avg) Consumption) * Lead Time (In days)

Since the system followed here is a multiple replenishment system (as mentioned earlier) wherein, there are two replenishment cycles which in this case is between the hospital main store and the OT main store (1) and between the OT main store and the CTVS OT sub stores (2), it is not required to maintain much buffer stock. The lead time for the 2nd replenishment cycle in case of a stock out is less than five minutes, which is very less and in terms of days it is almost zero days and therefore, it is not considered in this case to calculate the buffer stock.

In this case lead time is negligible, almost zero in terms of days. Therefore,

Buffer Stock = Max. Consumption – Avg. Consumption

Wherein,

Avg. Consumption is Avg. consumption of each item per day (avg. in mentioned three months)

= [{Avg. consumption (Dec, 14) + Avg. consumption (Jan, 15) + Avg. consumption (Feb, 15)} / 3]

Avg. consumption for x month= Avg. consumption per day in x month / number of working days

Avg. consumption per day (each consumable) = Total consumption per day / total cases operated in that day

Max. Consumption = Consumption in case of max. number of cases per day.

For this we have to find out the maximum number of cases that have been operated per day in the mentioned period. Average consumption that we got above is the consumption in average number of cases operated per day; therefore the maximum consumption should be the consumption in maximum number of cases that have been operated per day. This can be found by applying the unitary method.

The data of cases operated, for a period of three months (December,14; January,15; February,15) was analysed to see the average cases per day and maximum number of cases that could be operated in a day and this is presented below in table 1.

Table 1: Month wise distribution of cases operated in the CTVS speciality

December,14		**January,15**		**February,15**	
Total no. of cases	317	Total no. of cases	272	Total no. of cases	285
Total no. of working days	24	Total no. of working days	23	Total no. of working days	20
Average	13	Average	12	Average	14
Max. no of cases/day	18	Max. no of cases/day	18	Max. no of cases/day	20
Min. no of cases/day	6	Min. no of cases/day	2	Min. no of cases/day	4

As, can be seen from the above table that average number of cases operated per day (excluding the days when case was only one, which is an exception, hence excluded) was 13 for the month of December,14; 12 for the month of January,15 and 14 for the month of February,15.

The average number of cases operated per day for this period= [{**avg. cases (Dec, 14) + avg. cases (Jan, 15) + avg. cases (Feb, 15)} / 3]**

= (13 + 12 + 14)/ 3

= 13 cases per day.

Therefore from above calculations we can say that the average number of cases performed in a day is 13 and the maximum number of cases that had been operated in a day during this period is 20 (as mentioned in table 1). **Thus, the consumption of 13 cases has been taken as the average consumption per day and the consumption for 20 cases to be the maximum consumption in a day.**

The Buffer stock for each item was then calculated by the formula,

Buffer Stock = Max. Consumption - Avg. Consumption

The buffer stock that is required to be maintained for each item has been calculated.

The table 2 below shows only a sample of the same. It includes item wise average consumption in a day for each month, the overall average consumption (which is the average of three months' consumption per day), the buffer stock required to be maintained **(which in the table is referred as buffer stock 1)** and the buffer stock that is being maintained **(which in the table is referred as buffer stock 2)**. The buffer stock that is currently being maintained has also been presented in

table 2 just to enable a comparison between the present stock level of the buffer stock and that which is required to be maintained and give a view of the difference between the both.

The items included in the table 2 are single use items only, as the way to calculate the buffer stock for multiple use items is different since they can be used multiple times as per the policy. The non-clinical processes involved in their re-use and their stock status has been explained later. **The complete list of item wise quantity of buffer stock to be maintained is in the annexure 1**

Table 2: Item wise quantity of buffer stock to be maintained (sample)

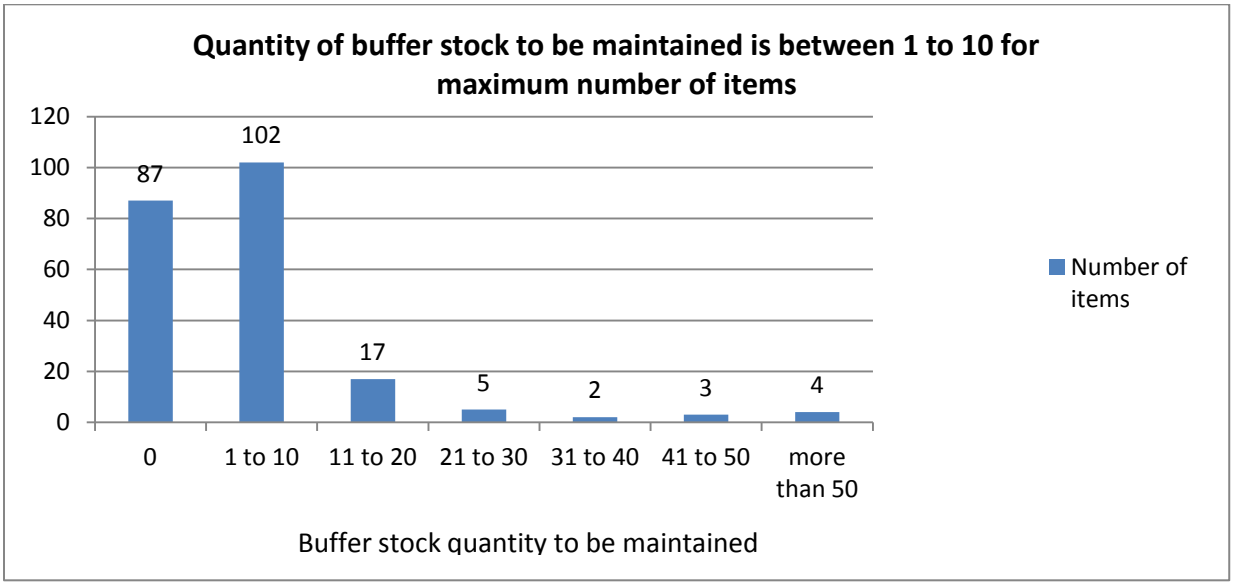
ITEM CODE	ITEM NAME	AVERAGE CONSUMPTION QTY				IF CASES 20 (Max.)	BUFFER STOCK (1)	BUFFER STOCK (2)
		DEC	JAN	FEB	OVER ALL Avg.			
12M021020049	IABP CATHETER 7.5FR 40CC-DATASCOPE	1.12	1.04	0.58	1	1	0	6
12M021020114	OXYGENATOR CAPIOX ADULT SX-18-TERUMO	3.27	2.42	3.23	3	5	2	5
12M021020086	TUBING PACK ADULT 2050-MEDTRONIC	1.31	1.46	1.65	1	2	1	18
12M021020142	OXYGENATOR AFFINITY ADULT 95214-MEDT	0.50	0.15	0.42	0	1	0	6
12M021020116	OXYGENATOR CAPIOX PAED SX-10-TERUMO	0.69	0.35	0.65	1	1	0	4

As, can be seen from table 2, there is a lot of difference between the buffer stock that is required to be maintained (referred to as buffer stock 1) and the buffer stock that is currently

being maintained (referred to as buffer stock 2). For example, let us take the first item in table 2- IABP catheter 7.5fr 40cc-datascope for which no buffer stock is required to be maintained yet 6 quantities of the item is being kept as buffer, which is not required since in this calculation we have already included the stock for maximum number of cases possible to be kept in the sub stores and still if it is required there is the OT main store within the same complex and the item can be brought from there.

The quantity of buffer stock to be maintained has been grouped in different categories like zero (which means no buffer stock required) or between 1 to 10, 11 to 20, 21 to 30, 31 to 40, 41 to 50 and more than 50 against which the number of items requiring maintenance of buffer stock in the specified ranges has been plotted to further understand the pattern of the stocking levels that are required. Figure 3 explains this.

Figure 3: Number of items for which buffer stock is to be maintained- range wise



Source: Analysis of data received from IT department

As can be seen from the figure 3 above, the quantity of buffer stock to be maintained is in the range of 1 to 10 for (102 out of total 220 items) 46% of the items. No buffer stock is to be maintained for (87 out of the total 220 items) 39.5% of the total items. Only for 20% of the items buffer stock of more than 10 is required.

Problem 2:

Due to the vicinity of the cardiac sub stores to the OT main store and short lead time (<5 minutes) the cardiac sub stores are not required to maintain a lot of buffer stock. Despite this, there seemed to be a lot of stock left in the cardiac sub stores at the end of each day. So the question arises, is there overstocking of single use consumables in these stores?

To answer this question, I needed to know the baseline for each consumable, above which they could be considered as overstocked. Since this was not available, I began studying the demand and consumption patterns of these items in the past three months. Understanding surgeries performed each day in the cardiac specialty for the three months (to understand the volume and average number of cases per day) and item movement of single use in those respective cases for the same three months (to find out consumption of the same) helped me form a baseline for each consumable.

Therefore, for single use items it involved relating consumption per day in the time period for which data was analysed (three months) to the average number of cases per day and comparing it with the stock. Anything above the baseline plus the buffer stock was categorised as over stocked.

Overstock = [Existing stock – (Avg. Consumption + Buffer Stock)]

(For each consumable) (For each consumable)

Wherein, existing stock of each consumable was taken from the audit reports of finance department, avg. consumption for each and buffer stock for each as calculated by the above mentioned method.

Overstocking of items leads to blocking of the money that could have been used for other purposes. This is the opportunity cost of overstocking. It can be explained in money value by taking the cost value of each of these overstocked items and multiplying it with the quantity overstocked for each item.

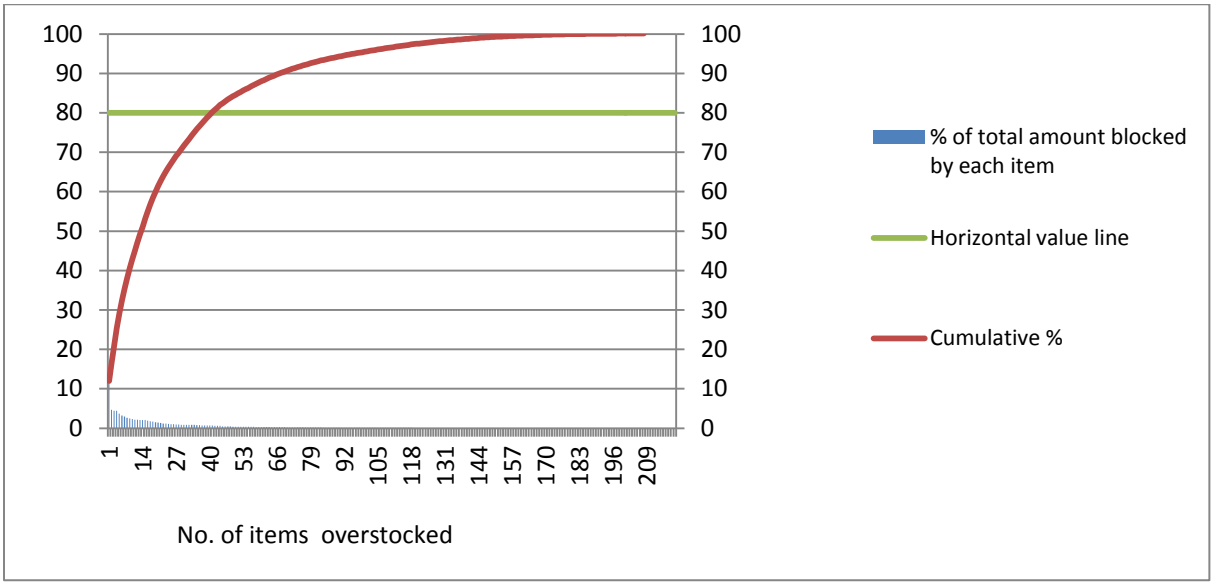
On further analysis of this data it was observed that the maximum amount blocked was only by few of these items. This relates to the Pareto's Principle given by Vilfredo Pareto which is also known as the "80/20 Rule" – which is the idea that 20% of causes generate 80% of results. This tool can be used to find the 20% of work that will generate 80% of the results that doing all of the work would deliver. The figures 80 and 20 are illustrative – the Pareto Principle illustrates the lack of symmetry that often appears between work put in and results achieved. For example, 13% of work could generate 87% of returns. Or 70% of problems could be resolved by dealing with 30% of the causes (www.mindtools.com, 2011)

This technique helps to identify the top portion of causes that need to be addressed to resolve the majority of problems (www.mindtools.com, 2011).This principle can be applied in this case to highlight those few overstocked consumables which have been contributing to maximum amount being blocked and removal of the same can help us deal with 80% of the amount blocked.

A Pareto chart has been used for this purpose. This chart is named after Vilfredo Pareto and is a type of chart that contains both bars and a line graph, where individual values are represented in descending order by bars, and the cumulative total is represented by the line. The left vertical axis is the frequency of occurrence, but it can alternatively represent cost or another important unit of measure. The right vertical axis is the cumulative percentage of the total number of occurrences, total cost, or total of the particular unit of measure. Since the reasons are in decreasing order, the cumulative function is a concave function (www.mindtools.com, 2011).

Taking example of this case, as can be seen from **figure 4**, in order to deal with 80% of amount being blocked, it is sufficient to remove the overstocked quantity of approximately 19% items.

Figure 4: Pareto's chart showing 80% of amount being blocked by approx. 19% items



Source: Analysis of data received from IT department

A total of 656 single use items were studied, out of which 220 were overstocked. These items contributed to an amount of Rs. 14, 58,022/- (Fourteen lakhs fifty eight thousand and twenty two

rupees only) being blocked. As can be seen from above, out of these 220 items, 41 items which is approximately 19% (18.63%) of total items overstocked contribute to 80% of the amount being blocked which is Rs. 11,66,809/- (eleven lakhs sixty six thousand and eight hundred and nine rupees).

The **table 3** below shows a sample of the overstocked items calculated by the formula as has been discussed earlier. It includes average consumption of each item monthly (for the three months) and overall (which is the average consumption of three months combined). It also shows the consumption if cases were maximum (which is 20) and then overstocked quantity and amount blocked which is the opportunity cost. **The list of items which contribute to 80% of the opportunity cost is in the annexure 2**.

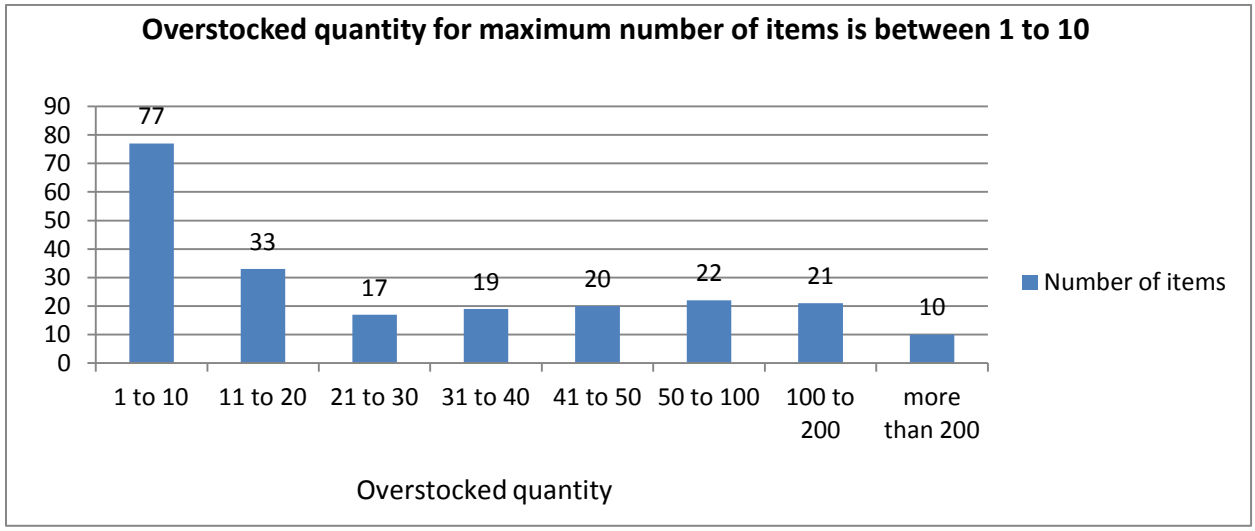
The table below shows only a sample of items that are overstocked.

Table 3: Overstocked quantity of single use consumable (sample)

ITEM CODE	ITEM NAME	AVERAGE CONSUMPTION QTY					STOCK	OVERSTOCKED QTY	UNIT COST	OPPURTUNITY COST	% OF TOTAL OPPURTUNITY COST	CUMULATIVE FRQUENCY %
		DEC	JAN	FEB	OVERALL	IF CASES 20 (MAX.)						
12M021020049	IABP CATHETER 7.5FR 40CC-DATASCOPE	1.12	1.04	0.58	1	1	7	6	30975.00	173374	12	12
12M021020114	OXYGENATOR CAPIOX ADULT SX-18-TERUMO	3.27	2.42	3.23	3	5	10	5	12547.50	68083	5	17
12M021020086	TUBING PACK ADULT 2050-MEDTRONIC	1.31	1.46	1.65	1	2	20	18	3612.00	64057	4	21

The overstocked quantity of each item can further be grouped together in different ranges to see the extent of overstocking for different number of items. Presented below in **figure 5** is a chart which summarizes the same. The chart explains the number of items having overstock quantity in the ranges mentioned. For example, 10 items have overstocked quantity of more than 200 units.

Figure 5: Number of items having overstock quantity in different ranges



Source: Analysis of data received from IT department

As, can be seen from above maximum quantity overstocked is in the range of 1 to 10. 77 out of 220 items i.e, 35% of items have overstock between 1 to 10 and 15% of the items (33 out of 220) have overstock items in range of 11 to 20, making it 50% of the items. We can also see that 25% of the items have overstock quantity of more than 50 which is a huge quantity of overstock.

Problem statement 3:

The system to determine the number of uses of multiple-use items is person dependant and there are chances of it being either underused or overused. How do you say that it has been used say 'x' number of times and not 'y'? The dots put by marker on these items (after every use may be erased during sterilisation or the respective staff may even forget to do so. What if the dots are simply put on these items, without these items being actually used? There is no system currently to verify all this. Therefore, it is difficult to determine the actual number of times these consumables have been used so how do we determine if there is overstocking of the same?

Replenishment of consumables was done in the following way:

A list of patients to be operated the next day is prepared by 11pm. Based on this list and any other emergency cases, surgeries are performed the next day. Consumables used on the respective cases are charged after every surgery by the OT main store. This consumption is recorded in three lists (sub-store wise list) for every patient operated.

At the end of the day, all three sub stores (perfusion, surgical and anaesthesia) have the list of consumables used respectively from their stores. This forms the total consumption of the respective stores for the day.

Activities in the daily replenishment cycle of the cardiac OT sub stores by the OT main store for different consumables are as follows:

For single use consumables:

Total consumption for each consumable is prepared by the respective sub stores

↓

This list is taken by the respective sub stores to the OT main store

↓

OT main store verifies the consumption with the consumables charged by them to each patient.

↓

The consumables used are replenished by the OT main store to the respective sub stores

For consumables which were charged **under** the category of **OT charges** in the patient's bill, replenishment was done by the OT main store, twice a week based on the consumption.

For multiple use consumables:

Each item under this category had a specific number of defined uses as per the hospital policy, after which they were supposed to be discarded. A list of these consumables with their respective pre defined number of uses was present. As, these items were expensive their charges were divided amongst patients as per the hospital policy to bring down the cost to patient per surgery.

Each consumable was used as per its pre defined number of uses, determined by the hospital policy

↓

After each usage it was checked for any defect or whether it could be reused as per the hospital guidelines for respective items (this is a quality check) and sent for sterilisation to the central sterile supply department (CSSD)

↓

Before sterilisation the CSSD put a dot with a marker pen on the multiple use consumable *(number of dots correspond to the number of uses) and then sterilised it*

↓

This process continued, till the consumable *completed its number of pre defined uses and needed to be discarded*

↓

The consumables were discarded as per the hospital policy and a discard register was maintained, which also contained the details of the usage of the same

↓

The nursing supervisor takes this register to the hospital main store for other consumables

↓

Based on this discard register (which shows that the particular multiple use item under consideration was used till its pre-defined usage and also states reasons for non-compliance to this) *a new multiple use item was replenished.*

Note: Italics indicate problem areas/points.

The limitation in answering this question was that the data to determine the actual number of times the multiple use consumables were being used was not made available. This problem was identified based on process understanding by direct observation and interviewing the nursing, technician, perfusionist and infection control staff.

Therefore, my approach to answering this question would just be limited to finding out the consumption as per the transactions of these items during the defined period (three months) and relating it to the average number of cases per day and comparing this with the stock of the same that was maintained. If the data for determining the actual number of re-uses of each consumable would have been available my approach would be to consider these re-uses recorded as activity codes which are unique for each usage of the re-usable item. The consumption could be determined based on each use and taking an average of the number of re-uses of each item per day. The rest of the steps would be similar as followed in this case.

A sample of the list of multiple use with their stock status has been given in **table 4**. The table includes average consumption of each item and their closing balance monthly, a combined average of the consumption for three months. It also includes average consumption if the

maximum number of cases i.e, 20 in this case would have been operated, the closing balance of Feb, 15 and the difference between the two which is the overstocked quantity.

Table 4: List of multiple use items with their stock status (sample)

		DEC		JAN		FEB		3 MONTHS			
ITEM CODE	**ITEM NAME**	**AVERAGE CONSUMPTION**	**CLOSING BALANCE**	**AVERAGE CONSUMPTION**	**CLOSING BALANCE**	**AVERAGE CONSUMPTION**	**CLOSING BALANCE**	**AVERAGE CONSUMPTION**	**AVERGE CONSUMPTION (IF 20 CASES)**	**CLOSING BALANCE (FEB)**	**OVERSTOCKED QTY**
12M0110100038	SHUNT INTRACOR CLEARVIEW 2.5MM-MEDTRONIC	19	5	5	0	**0**	0	8	12	0	
12M0110100034	SHUNT INTRACOR CLEARVIEW 1.25MM-MEDT	0	10	10	10	**10**	0	7	10	0	
12M0110100036	SHUNT INTRACOR CLEARVIEW 1.75MM-MEDT	4	0	0	10	**16**	4	7	10	4	
12M0110100037	SHUNT INTRACOR CLEARVIEW 2.0MM-MEDTRONIC	0	10	5	0	**15**	5	7	10	5	
12M0110100023	OCTOPUS TISSUE STAB.SYSTEM 4.3-MEDTRONIC	6	2	5	3	**5**	2	5	8	2	
12M0110100033	FELT TEFLON 6X6 007837-BARD	0	5	5	7	**7**	7	4	6	7	1

The stock status of few re-usable items has been included just to get a view of how drastically their consumptions have been varying between months. This gives a feel of their unregulated use, although this could not be verified due to the limitation of access to such data. Also in this case of overstocking of multiple use items the baseline for items to be considered as overstocked,

is the closing balance of the last month in the mentioned period (which is Feb, 15 in this case). This has been done due to limitation of access to such data as mentioned earlier. **The complete list of multiple use items with their stock status is in annexure 3**

There were few multiple use items which had not been used even once in the mentioned time period. The **table 5** below contains a list of these items with their respective quantity stocked, price of each unit and the total opportunity cost of stocking these items. The items that are in bold towards the end of this table are the ones used in robotic surgery. These items have been highlighted as these are very expensive items and used only in robotic surgery which on further discussion with the OT incharge was found to not have been done in the CTVS specialty in last six months.

Table 5: List of reusable items not used even once in mentioned three months

ITEM CODE	ITEM NAME	QUANTITY	PRICE	OPPURTUNITY COST (in Rs.)
12M011010001	SURGILOOP YELLOW MAXI 1001-80-SCANLAN	8	150	1200
12M011010026	CAROTID SHUNT JAVID-007714-BARD	2	1200	2400
12M241240075	**RESONO FORCEPS-420181-06-PER USE**	**14**	**15730**	**220220**
12M241240079	**VALVE HOOK-420192-PER USE**	**30**	**9240**	**277200**
12M241240082	**CURVED SCISSORS-420178-PER USE**	**13**	**14300**	**185900**
12M241240084	**LONG TIP FORCEPS-420048-PER USE**	**15**	**18182**	**272730**
12M241240085	**MEGA NEEDLE DRIVER-420194-PER USE**	**11**	**16577**	**182347**
12M241240089	**SNAP FIT INSTRUMENT-420157-PER USE**	**26**	**5775**	**150150**
12M241240093	**420182 ENDOWRIST STABILIZER**	**3**	**66087**	**198261**

	INSTRUMENT			
12M241240095	**420171 MICRO BIPOLAR FORCEPS**	**1**	**23172**	**23172**
TOTAL AMOUNT BLOCKED				**1513580**

As, we can see from the **table 5** above, the total amount blocked by these items is Rs. **1513580**/- (Fifteen lakh thirteen thousand five hundred and eighty rupees only) and this is contributed mainly by the items in bold (items used in robotic surgery), therefore a huge amount of money is blocked in this.

The amount blocked by overstocking single use consumables (as mentioned above) is 14, 58,022 and for re-usable consumables is 1513580 **summing up to a total of Rs. 29,71,602/- (Twenty nine lakh seventy one thousand and six hundred and two rupees only). This is a huge opportunity cost for the organization as this amount can be used in better ways.**

Note: This amount excludes the cost for 12 items with varying quantities of overstock as the cost data for the same was not made available.

9. Limitations

i) The baseline for consumables (single use) to be considered as overstocked will be determined based on the average consumption per day of the same in the three months and the average number of cases per day during that period, due to unavailability of other information.

ii) The data to determine the actual number of times the multiple use consumables have been used is not been made available. This problem has been identified based on process understanding by direct observation and interviewing the nursing, technician, perfusionist and infection control staff. Therefore, my approach to this would be to find out the consumption as per the transactions of these items and determine the stock of the same to be maintained.

10. Suggestions

i) The items that are over stocked to be removed from the sub stores to enable better inventory control over only the stock required there. This would also save a lot of clinical time of the paramedical staff (nursing/technicians/perfusionists) which was otherwise wasted in maintaining more inventories. Needless to say, this would reap a whole lot of benefits associated with carrying fewer inventories.

ii) Buffer stock of each item to be maintained as per the defined criteria in the study, which therefore requires re -ascertaining the demand and consumption patterns on a regular basis and maintaining stock accordingly.

iii) The multiple use or reusable items that are used in robotic surgery and have not been used in the mentioned three months to be handed over to the urology department for their use as they are doing those surgeries.

iv) An automated system of determining the number of uses and discard of a multiple use item to be formed. This system will not only prevent such items to be under or overused but will also act as a check to prevent any pilferage and make the system more transparent as it could also allow verification of the same.

11.Resources Used

Guido van Heck, B. (2009, November 27). Inventory Management- Introducing A Framework To Assess Operational Performance. Delft University of Technology.

Kumar, D. S. (2013). Course booklet of Supply Chain Management- PGDHM (Hospital Stream). *Inventory Managemnt* . Jaipur, Rajasthan, India.

Lee, C. B. (2003). Multi- Echelon Inventory Optimization. Evant White Paper Series.

National Food Service Management Institute, T. U. (2012). Inventory Management and Tracking.

SV, M. V. (2012). Course booklet 2 of Supply Chain Management, PGDHM (Health Stream). *Inventory Control* . Jaipur, Rajasthan, India.

Walter Ramsey Crowe, B. U. (1977). Forecasting and Inventory Control for Hospital Management.

www.hponline.com. (n.d.). Retrieved 4 12, 2015, from http://www.hponline.com/inside/2013-03/1303-SF-InvMgtBP.html

www.lean.org. (n.d.). Retrieved 4 8, 2015, from http://www.lean.org/Common/LexiconTerm.cfm?TermId=183

www.mindtools.com. (2011, 10 11). Retrieved 5 15, 2015, from http://www.mindtools.com/pages/article/newTED_01.htm

www.wikipedia.org. (n.d.). Retrieved 4 18, 2015, from http://en.wikipedia.org/wiki/Inventory

www.wikipedia.org. (n.d.). Retrieved 4 20, 2015, from http://en.wikipedia.org/wiki/Safety_stock

12. Annexure

Annexure 1: Item wise quantity of buffer stock to be maintained

ITEM CODE	ITEM NAME	AVERAGE CONSUMPTION QTY					BUFFER STOCK (1)	BUFFER STOCK (2)
		DEC	JAN	FEB	OVERALL	IF CASES 20 (MAX.)		
12M021020049	IABP CATHETER 7.5FR 40CC-DATASCOPE	1.12	1.04	0.58	1	1	0	6
12M021020114	OXYGENATOR CAPIOX ADULT SX-18-TERUMO	3.27	2.42	3.23	3	5	2	5
12M021020086	TUBING PACK ADULT 2050-MEDTRONIC	1.31	1.46	1.65	1	2	1	18
12M021020142	OXYGENATOR AFFINITY ADULT 95214-MEDT	0.50	0.15	0.42	0	1	0	6
12M021020116	OXYGENATOR CAPIOX PAED SX-10-TERUMO	0.69	0.35	0.65	1	1	0	4
12M021020085	BLOOD CARDIOPLEGIA DEL SYS MYOTHERM-MEDT	1.81	1.81	2.27	2	3	1	12
12M151150303	SURGIPRO II 6/0 (VP-706X)-TYCO	9.92	17.58	19.81	16	24	8	264
12M151150301	SURGIPRO II 4/0 (VP-557X)-TYCO	17.23	16.12	17.65	17	26	9	226
12M031030289	SHEATH INTRODUCER INTROFLEX1301BF85H-EDW	10.31	9.62	11.15	10	16	6	34
12M011010053	HORIZON CLIP SMALL 1204 100Cx6/BOX -PILL	93.54	84.73	85.27	88	135	47	365
12M021020052	CUSTOM TUBING PACK PAED 7509-DIDECO	0.58	0.15	0.35	0	1	0	5
12M021020087	TUBING PACK ADULT OXYGENATOR 2054-MEDT	2.54	1.31	2.23	2	3	1	7
12M301300008	SURGICEL HEMOSTAT 4 X8 (1952)-ETHICON	1.77	2.23	2.58	2	3	1	21
12M151150258	VICRYL 3-0 NW2936/VP2936-ETHICON	2.31	9.46	29.46	14	21	7	123

12M151150304	SURGIPRO II 7/0 VP-630X-TYCO	25.81	23.73	26.08	25	39	14	141
12M021020115	OXYGENATOR CAPIOX BABY RX-05-TERUMO	0.19	0.08	0.12	0	0	0	2
12M151150065	CENTISORB 2-0 PNJ 945-CENTENNIAL	51.15	46.77	47.81	49	75	26	165
12M331330000	DRAPE IOBAN 6650-3M	9.19	9.19	9.27	9	14	5	66
12M011010052	HORIZON CLIP MEDIUM 600PCS2204PILLING	24.04	17.42	16.77	19	30	10	170
12M031030206	DOUBLE LUMEN BRONCHIAL TUBE37F LT-RUSCH	0.04	0.04	0.00	0	0	0	9
12M151150319	ETHIBOND XL 2-0 PNW617-ETHICON	2.27	2.04	3.35	3	4	1	56
12M151150087	ETHIBOND 2-0 W6937-ETHICON	2.69	3.15	2.85	3	4	2	68
12M151150300	SURGIPRO II 3/0 (VP-522X)-TYCO	4.15	4.69	7.77	6	9	3	99
12M151150034	CENTILENE 8/0 P-812-CENTENNIAL	1.46	1.23	1.58	1	2	1	28
12M301300006	SURGICEL HEMOSTAT 2 X3 (1953)-ETHICON	2.46	1.54	2.27	2	3	1	21
12M031030313	LEADERFLEX ART CATH 22G 1212.04-VYGON	0.65	0.35	0.54	1	1	0	10
16P320320032	Tisseel 2ml Kit(Fibrin Sealant) Inj	0.46	0.38	0.77	1	1	0	1
12M151150002	CARDIAC PACING WIRE CEP-15-CENTENNIAL	18.12	14.92	16.50	17	25	9	71
12M021020088	CUSTOM TUBING PACK PAED. 2066/2072-MEDTR	0.31	0.27	0.42	0	1	0	4
16P210210007	Lactated Ringer 500ml (Viaflex) Inj	4.81	0.00	0.35	2	3	1	332
12M151150220	PROLENE 6-0 W8597-ETHICON	0.46	0.38	0.81	1	1	0	47
12M011010057	VASCULAR PATCH 0.6MM 5X7.5CM-W L GORE	0.04	0.00	0.00	0	0	0	1
16P020020093	Fentanyl 50mcg/ml 10ml Inj(Fentanyl) inj	18.54	17.04	19.85	18	28	10	167
12M1211200	PRESSURE MONITORING KIT	11.27	10.19	10.50	11	16	6	14

09	DOUBLE BKT204-BL							
12M031030148	ARTERIAL CANNULA 20 G-BD	11.31	11.00	12.69	12	18	6	62
12M151150086	ETHIBOND 2-0 W6917-ETHICON	2.12	3.88	3.96	3	5	2	43
12M021020198	FLEXIBLE ARCH ART CANNUL 24FR-71424-MEDT	1.08	1.35	1.42	1	2	1	8
12M151150024	CENTILENE 5-0 KC8205 PL3-CENTENNIAL	3.23	0.77	2.15	2	3	1	45
16P320320031	Tisseel 1ml Kit(Fibrin Sealant)Inj	0.12	0.08	0.15	0	0	0	2
12M031030290	SWAN GANZ TD CATH(VIP831HF75P)-EDWARDS	9.77	9.27	10.88	10	15	5	5
12M151150093	ETHIBOND EXCEL 4-0 X871H-ETHICON	3.31	1.00	2.62	2	4	1	44
12M011010000	CHEST DRAINAGE SYSTEM-BL	21.73	20.08	23.46	22	33	12	27
12M031030014	TRIPLE LUMEN CVC 7F-BL	10.38	9.73	10.85	10	16	6	14
12M031030327	SWAN GANZ CCO CATHETER-139HF75P-EDWARDS	0.27	0.23	0.19	0	0	0	2
12M151150031	CENTILENE 6-0 P-8725-CENTENNIAL	6.42	3.77	6.54	6	9	3	39
12M151150320	ETHIBOND XL 2-0 PNW617A-ETHICON	3.15	2.19	3.27	3	4	2	20
12M151150302	SURGIPRO II 5/0 VP-556X-TYCO	0.73	1.31	0.69	1	1	0	35
12M331330038	DERMINCISE INCISE DRAPE 38.45.60 VYGON	3.54	1.85	2.58	3	4	1	16
12M151150250	VICRYL 1 VP2347-ETHICON	7.69	9.23	9.08	9	13	5	23
12M331330037	DERMICISE 38.45.45-VYGON	2.92	2.27	2.88	3	4	1	16
12M151150029	CENTILENE 6-0 P-8597-CENTENNIAL	3.00	2.00	1.42	2	3	1	33
12M031030013	TRIPLE LUMEN CVC 5.5F-BL	0.35	0.15	0.27	0	0	0	6
12M151150008	CENTIBOND 2-0 CX-673AB - CENTENNIAL	8.31	4.50	4.81	6	9	3	39

12M151150124	MERSILK 1 NW5062-ETHICON	36.62	31.69	38.50	36	55	19	65
12M151150030	CENTILENE 6-0 P-8707-CENTENNIAL	3.00	2.54	1.92	2	4	1	32
12M151150071	CENTSTEEL 2-0 662G--CENTENNIAL	0.31	0.12	0.81	0	1	0	9
16P120120053	Cordarone 3 Ml(Amiodarone) Inj	4.08	1.92	2.92	3	5	2	110
12M331330001	STERIDRAPE 1050-3M	15.73	16.50	16.88	16	25	9	25
12M031030205	DOUBLE LUMEN BRONCHIAL TUBE35F LT-RUSCH	0.04	0.04	0.00	0	0	0	2
12M151150026	CENTILENE 5-0 P-8556-CENTENNIAL	5.38	3.46	5.81	5	8	3	28
16P010010034	Neovec 10mg (Vecuronium) Inj	25.46	23.31	25.12	25	38	13	62
12M031030207	DOUBLE LUMEN ENDOBRONCH TUBE 39 LT-RUSCH	0.08	0.12	0.08	0	0	0	2
12M131130073	CAUTERY PENCIL DISPOSABLE 516-NIKKO	3.23	4.92	4.65	4	7	2	28
12M031030383	VENTILATOR CIR-2151 WITH HME-1341-INTERS	7.92	9.96	10.19	9	14	5	19
12M151150027	CENTILENE 5-0 P-8710-CENTENNIAL	5.23	3.08	4.00	4	6	2	30
12M031030017	FLUID WARMING SET 245-RANGER	0.23	0.31	0.04	0	0	0	5
12M021020012	CONNECTOR Y 1/4X1/4X1/4-BL	21.50	21.42	23.96	22	34	12	116
12M151150001	CARDIAC PACING WIRE CEP-13-CENTENNIAL	3.00	1.23	4.19	3	4	2	20
16P210210050	Sodium Bicarbonate 25ml Inj	34.12	27.08	19.62	27	41	15	258
12M031030012	TRIPLE LUMEN CVC 4.5F-BL	0.19	0.15	0.12	0	0	0	4
16P150150008	Neutrahep 5 Ml(Protamine Sulphate) Inj	47.12	50.58	51.54	50	77	27	123
12M151150033	CENTILENE 7-0 P8704 AB-CENTENNIAL	6.35	3.96	5.81	5	8	3	16
12M1511500	CENTISORB NO.0 PNJ 946-	5.08	7.04	5.15	6	9	3	15

68	CENTENNIAL							
16P070070097	Altacef1.5gm(Cefuroxime) Inj	11.35	9.92	11.46	11	17	6	32
16P010010013	Etomidate-Lipuro 10 Ml (Etomidate)Inj	1.38	1.54	1.62	2	2	1	8
12M151150074	BONE WAX 810-ETHICON	4.23	3.15	3.96	4	6	2	42
16P120120001	Dobutrex 250 Mg(Dobutamine) Inj	3.42	2.88	0.81	2	4	1	18
12M151150017	CENTILENE 2-0 P 8977-CENTENNIAL	0.81	0.46	0.73	1	1	0	23
12M151150021	CENTILENE 4-0 P-8526AB-CENTENNIAL	10.54	7.38	9.08	9	14	5	10
12M021020117	HEMOFILTER KIT ALLMED 1.6-ALLMED	3.23	2.15	3.27	3	4	2	2
12M151150191	PROLENE 1-0 NW840-ETHICON	0.12	0.00	0.19	0	0	0	24
12M121120287	GELSPON SPONGOSTON STAN.80X50X10MM-EUCAR	2.88	2.27	2.27	2	4	1	44
12M151150322	CENTISTEEL NO. 1 CM 661 G NH-CENTENIAL	0.35	0.31	0.15	0	0	0	9
12M031030194	VENTILATOR CIRCUIT ADULT3.2 MT2001-INTER	1.00	0.12	0.31	0	1	0	6
12M121120282	UROMETER PLUS ADULT 250ML-ROMSONS	9.54	9.88	11.00	10	16	5	34
12M121120183	SYRINGE DISP WITHOUT NEEDLE 50ML-DISPOVA	5.19	9.58	11.54	9	13	5	132
16P070070163	Magnex 1gm (Cefoperazone+Sulbactam) Inj	2.88	2.12	1.73	2	3	1	9
12M151150020	CENTILENE 4-0 KC-8204-CENTENNIAL	0.62	0.50	1.12	1	1	0	11
12M031030309	LEADER CATH 20G,8CM 115.09-VYGON	1.23	0.46	0.62	1	1	0	2
16P120120208	Adrenor 4mg/2ml(Noradrenaline)Inj	5.31	6.15	8.35	7	10	4	138
12M121120275	COTTON CREPE BANDAGE 10CMX4M-394-KOB	8.38	11.38	14.35	11	17	6	33
12M031030305	CENTRACATH 30CM 130.10-VYGON	0.08	0.04	0.00	0	0	0	5

12M331330012	CURAPORE 10 X 30 CM - LOHMANN	10.35	9.35	11.35	10	16	6	44
12M031030150	IV CANNULA ADULT VENFLON 16G-BD	8.12	6.85	10.00	8	13	4	77
16P010010033	Neocuron 4mg/2ml 2ml (Pancuronium) Inj	20.50	26.15	29.88	26	39	14	111
12M011010012	ASEPTO PUMP-ROMSONS	1.92	2.38	2.69	2	4	1	21
12M121120012	PRESSURE MONITORING LINE 150 RED M/F-BL	49.35	43.58	39.73	44	68	24	82
12M151150245	UMBILICAL COTTON TAPE W276-ETHICON	1.62	2.81	2.69	2	4	1	56
12M151150056	CENTISILK 4-0 CNW5049-CENTENNIAL	2.85	1.81	2.31	2	4	1	44
12M121120034	BLOOD TRANSFUSION SET-ROMSONS	22.65	18.58	24.46	22	34	12	137
12M151150321	TICRON 2-0 3219-56 10SUTURE/BOOK-TYCO	0.69	0.46	0.65	1	1	0	5
16P010010026	Artacil 25mg(Artacurium Besyl)Inj	0.50	1.04	0.04	1	1	0	39
16P210210006	Lactated Ringer 1000ml (Viaflex) Inj	0.23	0.00	0.00	0	0	0	31
12M121120133	FOLEYS CATHETER 2 WAY 8FG-RUSCH	0.46	0.27	0.19	0	0	0	10
12M121120127	FOLEYS CATHETER 2 WAY 10FG-RUSCH	0.35	0.31	0.27	0	0	0	10
12M121120114	CREPE BANDAGE VELSOFT FLESH 15CMX4M-DATT	2.19	0.00	0.00	1	1	0	19
12M121120128	FOLEYS CATHETER 2 WAY 14F-RUSCH	8.46	8.65	9.69	9	14	5	36
16P020020094	Fentanyl 50mcg/ml 2ml (Fentanyl) Inj	5.23	5.31	4.46	5	8	3	96
12M021020004	CONNECTOR STRAIGHT 1/4 X 1/4-BL	3.77	2.38	3.15	3	5	2	45
12M031030154	IV CANNULA PAED NEOFLON 24G-BD	0.04	0.12	0.08	0	0	0	25
16P210210086	Sodium Chloride 0.9%500ml(P)(Claris) Inj	28.96	40.23	27.81	32	50	17	100
16P2102100	Potassium Chloride 10ml Inj.	17.81	16.38	21.23	18	28	10	204

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12M151150015	CENTIBOND 2-0 LC-6987-CENTENNIAL	0.46	1.73	0.00	1	1	0	12
12M151150038	CENTILONE 2-0 CNW3398-CENTENNIAL	3.12	5.65	2.88	4	6	2	30
16P010010040	Thiosol Inj 500mg (Thiopentone) Inj	5.35	6.85	6.50	6	10	3	40
12M151150003	CARTIPLEDGET.3X3X1.5MM CCP-30-CENTENNIAL	0.35	0.35	0.31	0	1	0	5
16P010010055	Lox 2% Jelly 30gm (Lignocaine)Tube	4.54	4.73	3.31	4	6	2	52
12M151150014	CENTIBOND 2-0 LC6977-CENTENNIAL	0.35	0.08	0.15	0	0	0	11
16P120120219	Plegiocard 20 Ml (Cardioplegia) Inj	6.73	4.73	6.46	6	9	3	10
12M121120091	SUCTION CATH TC 14 F-ROMSONS	17.73	18.81	17.73	18	28	10	173
16P300300085	Efipress 1 Ml(Ephedrine Hcl) Inj	2.46	2.96	6.58	4	6	2	100
12M121120199	CAUTERY PLATE(A) 2506-NIKO	12.35	10.88	12.85	12	19	6	6
12M011010001	SURGILOOP YELLOW MAXI 1001-80-SCANLAN	0.12	0.19	0.00	0	0	0	8
16P120120217	Milicor 10mg/10ml (Milrinone) Inj	0.12	0.15	0.23	0	0	0	6
12M121120109	GLOVES-STERILE SURGICAL 7.0 - SURGICARE	72.88	83.77	71.50	76	117	41	83
12M151150005	CENTI STEEL NO.6 CM654G - CENTENNIAL	0.08	0.00	0.15	0	0	0	2
12M341340025	APRON DISPOSABLE S&S	58.08	60.77	39.81	53	81	28	119
12M031030152	IV CANNULA ADULT VENFLON 20G-BD	1.12	2.77	2.38	2	3	1	42
12M341340031	DRAPE KIT FOR CTVS-S&S	0.15	0.19	0.12	0	0	0	1
12M121120181	SYRINGE DISP WITHOUT NEEDLE 20ML-DISPOVA	26.92	16.08	25.42	23	35	12	143
12M151150037	CENTILONE 2-0 CNW3390-CENTENNIAL	21.92	25.92	29.77	26	40	14	92

16P2102100 80	Mannitol 20% 350 Ml(Glass) (SKK)Inj	6.50	4.58	5.81	6	9	3	11
16P0100100 52	Lox 2% 30ml (Lignocaine) Inj	1.77	2.00	2.31	2	3	1	47
12M1311300 42	SKIN MARKER PEN DERMARK-ROMSONS	3.54	2.46	3.92	3	5	2	15
12M1511502 40	SUTUPAK 1-0 SW214 -ETHICON	14.54	15.65	14.81	15	23	8	49
12M1211201 10	GLOVES-STERILE SURGICAL 7.5 - SURGICARE	33.81	30.92	43.50	36	56	19	69
16P0700702 72	Ticocin 400mg(Teicoplanin)(Cipla)Inj	0.23	0.15	0.50	0	0	0	2
12M3313300 27	TEGADERM 1623-3M	37.42	32.15	35.31	35	54	19	46
12M0310300 56	E.T. TUBE CUFFED 7.5-PORTEX	0.96	0.62	1.15	1	1	0	14
12M0310300 52	E.T. TUBE CUFFED 8-PORTEX	0.85	0.92	0.38	1	1	0	13
12M1311300 80	CHEST DRAINAGE CATHETER ST.32FG-LIFELINE	29.42	28.88	28.65	29	45	16	15
16P1201201 68	Adrenaline Tartrate (Adrenaline) Inj 1Ml	14.27	13.31	13.92	14	21	7	129
12M3413400 42	TROLLY COVER SMALL D-304-S&S	29.62	20.77	20.00	23	36	13	64
12M1511502 35	SUTUPAK 4-0 SW211-ETHICON	3.50	2.88	2.69	3	5	2	43
12M1511501 37	MERSILK 4-0 NW5000-ETHICON	0.69	1.12	1.46	1	2	1	10
12M1311300 32	CHEST DRAINAGE CATH ST 20F-ROMSONS	0.62	0.38	0.31	0	1	0	9
12M1311300 31	CHEST DRAINAGE CATH ST 16F-ROMSONS	1.19	0.62	1.27	1	2	1	8
12M1211201 84	SYRINGE DISP WITHOUT NEEDLE 5ML-DISPOVAN	73.04	70.77	91.65	78	121	42	379
12M1211201 11	GLOVES-STERILE SURGICAL 8.0 - SURGICARE	21.50	12.73	18.50	18	27	9	48
12M1211200 62	PEDIADRIP SET(MEASURE VOLUME SET)-ROMSON	12.73	10.27	11.62	12	18	6	20
12M0310301	IV CANNULA ADULT VENFLON	1.81	1.69	1.19	2	2	1	23

53	22G-BD							
16P010010056	Loxicard 2% 50 ml(Lignocaine)Inj	3.92	4.35	4.50	4	7	2	13
12M031030054	E.T. TUBE CUFFED 5.5-PORTEX	0.12	0.04	0.08	0	0	0	12
12M121120180	SYRINGE DISP WITHOUT NEEDLE 10ML-DISPOVA	83.58	113.00	129.38	109	167	59	183
12M031030061	E.T. TUBE PLAIN 4.0-PORTEX	0.31	0.15	0.15	0	0	0	6
12M121120108	GLOVES-STERILE SURGICAL 6.5 - SURGICARE	93.69	55.04	71.35	73	113	40	37
12M121120134	FOLEYS CATHETER 2 WAY12F-RUSCH	0.23	0.12	0.12	0	0	0	10
16P010010036	Pyrolate 0.2mg/ml 1ml(Glyco Pyrolate)Inj	0.69	0.46	0.54	1	1	0	49
12M121120182	SYRINGE DISP WITHOUT NEEDLE 2ML-DISPOVAN	174.04	91.65	40.81	102	157	55	343
16P070070171	Alfakim 500mg(Amikacin) inj	12.62	9.62	9.69	11	16	6	34
16P070070351	Genticyn 2 Ml (Gentamycin) Inj	11.31	5.65	0.00	6	9	3	91
12M021020014	CONNECTOR Y 3/8X3/8X3/8 - BL	1.42	0.15	0.00	1	1	0	11
12M131130071	SURGICAL BRUSH IMPREGNATED 901-VYGON	0.12	0.19	0.00	0	0	0	5
12M121120129	FOLEYS CATHETER 2 WAY 16F-RUSCH	1.38	0.77	1.38	1	2	1	8
12M131130033	CHEST DRAINAGE CATH ST 24F-ROMSONS	0.19	0.12	0.08	0	0	0	5
12M031030149	IV CANNULA ADULT VENFLON 14G-BD	1.27	1.38	2.35	2	3	1	14
12M121120016	PRESSURE MONITORING LINE 200CM. M/M-BL	0.92	0.92	2.15	1	2	1	16
12M131130030	CHEST DRAINAGE CATH ST 12F-ROMSONS	0.38	0.19	0.54	0	1	0	4
16P120120079	Metolar 5 Ml1mg/ml(Metoprolol) Inj	2.54	2.15	2.38	2	4	1	46
12M021020013	CONNECTOR Y 3/8X3/8X1/2-BL	0.04	0.08	0.69	0	0	0	10

12M121120148	ECG ELECTRODE MS-005-NIKO GEL	113.00	99.85	114.65	109	168	59	132
12M031030055	E.T. TUBE CUFFED 6-PORTEX	0.12	0.04	0.04	0	0	0	5
12M021020007	CONNECTOR STRAIGHT 3/8 X 3/8-BL	0.04	0.00	0.38	0	0	0	9
12M151150058	CENTISILK NO.1CNW 215-CENTENNIAL	0.38	0.00	0.04	0	0	0	24
12M011010016	SNUGGER SET ADULT-ROMSONS	0.04	0.00	0.00	0	0	0	3
12M031030049	E.T. TUBE CUFFED 5-PORTEX	0.15	0.04	0.08	0	0	0	5
16P210210045	Dextrose 25 % 25 Ml(Dextrose I.V)Inj	0.15	0.04	0.58	0	0	0	15
12M121120130	FOLEYS CATHETER 2 WAY 18F-RUSCH	0.23	0.23	0.54	0	1	0	4
12M341340037	JUGLAR SET DISP-S&S	17.31	11.35	8.31	12	19	7	31
16P210210044	Calcium Gluconate 10ml Inj	1.00	2.50	3.31	2	3	1	17
12M121120273	PEDIATRIC ECG ELECTRODE-P-00-S/50-AMBU	0.42	0.00	0.23	0	0	0	15
12M121120162	NEEDLE DISPOSABLE 16X1.5-DISPOVAN	71.46	47.77	59.00	59	91	32	119
12M121120164	NEEDLE DISPOSABLE 20X1.5-DISPOVAN	40.08	21.88	30.38	31	47	17	208
12M021020006	CONNECTOR STRAIGHT 3/8 X 1/4-BL	1.27	0.00	0.00	0	1	0	4
12M121120171	NEEDLE DISPOSABLE 26X0.5-DISPOVAN	23.00	8.08	0.96	11	16	6	254
12M021020005	CONNECTOR STRAIGHT 1/2 X 1/2-BL	0.15	0.23	0.00	0	0	0	4
12M121120069	RYLES TUBE NO.10 -ROMSONS	0.04	0.04	0.08	0	0	0	15
16P120120169	Atropine 1ml(Atropine Sulphate) Inj	0.12	0.15	0.35	0	0	0	50
12M031030050	E.T. TUBE CUFFED 6.5-PORTEX	0.08	0.08	0.04	0	0	0	2
16P0100100	Lox 4 %Topical Solution 30ml Inj	0.04	0.04	0.23	0	0	0	5

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12M121120072	RYLES TUBE NO.16 -ROMSONS	1.96	1.31	2.19	2	3	1	11
12M031030028	GUEDEL AIRWAYS 4-ROMSONS	0.15	0.08	0.58	0	0	0	5
12M341340026	CAMERA COVER DISP-S&S	0.46	0.27	0.12	0	0	0	5
16P300300032	Budecort Respule 1 Mg(Budesonide) Inh	0.08	0.08	0.08	0	0	0	5
12M121120163	NEEDLE DISPOSABLE 18X1.5-DISPOVAN	184.69	208.15	244.96	213	327	114	83
16P120120054	Lasix 2ml (Frusemide) Inj	13.23	10.15	11.73	12	18	6	32
12M121120170	NEEDLE DISPOSABLE 24X1-DISPOVAN	42.04	40.96	26.73	37	56	20	140
12M121120272	3 WAY STOP COCK WITH EXTN. 150CM-ROMSONS	15.15	13.58	21.69	17	26	9	4
12M031030027	GUEDEL AIRWAYS 3-ROMSONS	0.81	0.73	2.15	1	2	1	3
16P170170002	Dexadran 8Mg/2ml ((Dexamethasone)Inj	0.04	0.08	0.08	0	0	0	10
12M031030026	GUEDEL AIRWAYS 2-ROMSONS	0.92	0.81	2.50	1	2	1	3
16P010010039	Sucol 50mg/ml 10ml(succinylcholine) Inj	0.38	0.35	0.54	0	1	0	1
12M021020010	CONNECTOR STRAIGHT LL 1/4 X1/4-BL	0.15	0.85	0.00	0	1	0	0
12M121120047	INFANT FEEDING TUBE 8F-ROMSONS	0.04	0.08	0.12	0	0	0	5
12M121120046	INFANT FEEDING TUBE 7F-ROMSONS	0.42	0.00	0.08	0	0	0	5
12M121120045	INFANT FEEDING TUBE 6F-ROMSONS	0.35	0.50	0.31	0	1	0	4
12M121120048	INFANT FEEDING TUBE 9F-ROMSONS	1.46	0.50	1.12	1	2	1	3
12M121120165	NEEDLE DISPOSABLE 21X1.5-DISPOVAN	50.73	20.85	46.50	39	61	21	9
16P150150001	Floseal Kit 5ml(Hemostatic Matrix) Inj	0.00	0.38	0.12	0	0	0	2

12M021020048	IABP CATHETER 7.5FR 34CC-DATASCOPE	0.00	0.08	0.15	0	0	0	5
12M151150233	STEEL 5 MNW 9495-ETHICON	0.00	7.69	15.35	8	12	4	38
12M011010042	EMBOLECTOMY CATEHETER 3 FR-EDWARDS	0.00	0.04	0.00	0	0	0	1
12M071070035	LIGACLIP LT 400-ETHICON	0.00	0.04	0.00	0	0	0	20
12M121120173	SYRINGE 1ML INSULIN U-40-UP-30G-DISPOVAN	0.00	0.35	1.85	1	1	0	99
16P020020095	Morphine 15 Mg Inj	0.00	0.04	0.00	0	0	0	34
12M151150043	CENTISILK 1 CNW5332-CENTENNIAL	0.00	0.00	3.15	1	2	1	148
16P210210031	Ringer Plain 500 Ml (Glass) Inj	0.00	0.00	1.92	1	1	0	49
12M151150019	CENTILENE 3-0 P-8522-CENTENNIAL	0.00	0.00	0.08	0	0	0	24
12M121120092	SUCTION DRAINGE TUBE8MM X 3.5-ROMSONS	0.00	0.00	0.19	0	0	0	50
12M041040188	GUIDEWIRE J TIP 35X150-ANGIOSAFE	0.00	0.00	0.04	0	0	0	1

Annexure 2: Item wise overstocked quantity of single use consumables

(Includes only approximately 19% of items which contribute to around 80% consumption value)

ITEM CODE	ITEM NAME	AVERAGE CONSUMPTION QTY					STOCK	OVERSTOCKED QTY	UNIT COST	AMOUNT BLOCKED	% OF TOTAL AMOUNT BLOCKED	CUMULATIVE FRQUENCY %
		DEC	JAN	FEB	OVER ALL	IF CASES 20 (MAX.)						
12M021020049	IABP CATHETER 7.5FR 40CC-DATASCOPE	1.12	1.04	0.58	1	1	7	6	30975.00	173374	12	12

12M02 1020114	OXYGENATOR CAPIOX ADULT SX-18-TERUMO	3.27	2.42	3.23	3	5	10	5	12547.50	68083	5	17
12M02 1020086	TUBING PACK ADULT 2050-MEDTRONIC	1.31	1.46	1.65	1	2	20	18	3612.00	64057	4	21
12M02 1020142	OXYGENATOR AFFINITY ADULT 95214-MEDT	0.50	0.15	0.42	0	1	7	6	9922.50	64013	4	25
12M02 1020116	OXYGENATOR CAPIOX PAED SX-10-TERUMO	0.69	0.35	0.65	1	1	5	4	12915.00	53367	4	29
12M02 1020085	BLOOD CARDIOPLEGIA DEL SYS MYOTHERM-MEDT	1.81	1.81	2.27	2	3	15	12	3914.40	46897	3	32
12M15 1150303	SURGIPRO II 6/0 (VP-706X)-TYCO	9.92	17.58	19.81	16	24	288	264	163.91	43229	3	35
12M15 1150301	SURGIPRO II 4/0 (VP-557X)-TYCO	17.23	16.12	17.65	17	26	252	226	172.12	38873	3	38
12M03 1030289	SHEATH INTRODUCER INTROFLEX1301BF85H-EDW	10.31	9.62	11.15	10	16	50	34	1061.55	36159	2	40
12M01 1010053	HORIZON CLIP SMALL 1204 100Cx6/BOX –PILL	93.54	84.73	85.27	88	135	500	365	91.29	33307	2	43
12M02 1020052	CUSTOM TUBING PACK PAED 7509-DIDECO	0.58	0.15	0.35	0	1	6	5	5785.50	31518	2	45
12M02 1020087	TUBING PACK ADULT OXYGENATOR 2054-MEDT	2.54	1.31	2.23	2	3	10	7	4515.00	31076	2	47
12M30 1300008	SURGICEL HEMOSTAT 4 X8 (1952)-ETHICON	1.77	2.23	2.58	2	3	24	21	1457.40	30060	2	49
12M15 1150258	VICRYL 3-0 NW2936/VP2936-ETHICON	2.31	9.46	29.46	14	21	144	123	244.11	29991	2	51
12M15 1150304	SURGIPRO II 7/0 VP-630X-TYCO	25.81	23.73	26.08	25	39	180	141	209.81	29630	2	53
12M02 10201	OXYGENATOR CAPIOX BABY RX-05-TERUMO	0.19	0.08	0.12	0	0	2	2	15697.	28237	2	55

15									50			
12M15 1150065	CENTISORB 2-0 PNJ 945-CENTENNIAL	51.15	46.77	47.81	49	75	240	165	151.48	25034	2	57
12M33 1330000	DRAPE IOBAN 6650-3M	9.19	9.19	9.27	9	14	80	66	361.95	23823	2	58
12M01 1010052	HORIZON CLIP MEDIUM 600PCS2204PILLING	24.04	17.42	16.77	19	30	200	170	126.06	21448	1	60
12M03 1030206	DOUBLE LUMEN BRONCHIAL TUBE37F LT-RUSCH	0.04	0.04	0.00	0	0	9	9	2362.50	21167	1	61
12M15 1150319	ETHIBOND XL 2-0 PNW617-ETHICON	2.27	2.04	3.35	3	4	60	56	341.88	19170	1	63
12M15 1150087	ETHIBOND 2-0 W6937-ETHICON	2.69	3.15	2.85	3	4	72	68	258.79	17479	1	64
12M15 1150300	SURGIPRO II 3/0 (VP-522X)-TYCO	4.15	4.69	7.77	6	9	108	99	168.00	16713	1	65
12M15 1150034	CENTILENE 8/0 P-812-CENTENNIAL	1.46	1.23	1.58	1	2	30	28	561.61	15618	1	66
12M30 1300006	SURGICEL HEMOSTAT 2 X3 (1953)-ETHICON	2.46	1.54	2.27	2	3	24	21	697.20	14490	1	67
12M03 1030313	LEADERFLEX ART CATH 22G 1212.04-VYGON	0.65	0.35	0.54	1	1	11	10	1417.93	14475	1	68
16P32 0320032	Tisseel 2ml Kit(Fibrin Sealant) Inj	0.46	0.38	0.77	1	1	2	1	11576.25	13586	1	69
12M15 1150002	CARDIAC PACING WIRE CEP-15-CENTENNIAL	18.12	14.92	16.50	17	25	96	71	191.18	13497	1	70
12M02 1020088	CUSTOM TUBING PACK PAED. 2066/2072-MEDTR	0.31	0.27	0.42	0	1	5	4	2882.25	12937	1	71
16P21 0210007	Lactated Ringer 500ml (Viaflex) Inj	4.81	0.00	0.35	2	3	335	332	37.38	12423	1	72

12M15 11502 20	PROLENE 6-0 W8597-ETHICON	0.46	0.38	0.81	1	1	48	47	260 .75	122 95	1	73
12M01 10100 57	VASCULAR PATCH 0.6MM 5X7.5CM-W L GORE	0.04	0.00	0.00	0	0	1	1	124 95. 00	122 49	1	73
16P02 00200 93	Fentanyl 50mcg/ml 10ml Inj(Fentanyl) inj	18.54	17.04	19.85	18	28	19 5	167	72. 62	120 97	1	74
12M12 11200 09	PRESSURE MONITORING KIT DOUBLE BKT204-BL	11.27	10.19	10.50	11	16	30	14	880 .43	119 83	1	75
12M03 10301 48	ARTERIAL CANNULA 20 G-BD	11.31	11.00	12.69	12	18	80	62	184 .80	114 67	1	76
12M15 11500 86	ETHIBOND 2-0 W6917-ETHICON	2.12	3.88	3.96	3	5	48	43	258 .79	111 01	1	77
12M02 10201 98	FLEXIBLE ARCH ART CANNUL 24FR-71424-MEDT	1.08	1.35	1.42	1	2	10	8	132 3.0 0	106 20	1	77
12M15 11500 24	CENTILENE 5-0 KC8205 PL3-CENTENNIAL	3.23	0.77	2.15	2	3	48	45	235 .49	105 61	1	78
16P32 03200 31	Tisseel 1ml Kit(Fibrin Sealant)Inj	0.12	0.08	0.15	0	0	2	2	577 5.0 0	105 27	1	79
12M03 10302 90	SWAN GANZ TD CATH(VIP831HF75P)-EDWARDS	9.77	9.27	10.88	10	15	20	5	219 9.6 8	102 43	1	79
12M15 11500 93	ETHIBOND EXCEL 4-0 X871H-ETHICON	3.31	1.00	2.62	2	4	48	44	223 .52	993 5	1	80

Annexure 3: List of multiple use items with their stock status

		DEC	JAN	FEB	3 MONTHS	

ITEM CODE	ITEM NAME	AVERAGE CONSUMPTION	CLOSING BALANCE	AVERAGE CONSUMPTION	CLOSING BALANCE	AVERAGE CONSUMPTION	CLOSING BALANCE	AVERAGE CONSUMPTION	AVERGE CONSUMPTION (IF 20 CASES)	CLOSING BALANCE (FEB)	OVERSTOCKED QTY
12M01101003 8	SHUNT INTRACOR CLEARVIEW 2.5MM-MEDTRONIC	19	5	5	0	0	0	8	12	0	
12M01101003 4	SHUNT INTRACOR CLEARVIEW 1.25MM-MEDT	0	10	10	10	10	0	7	10	0	
12M01101003 6	SHUNT INTRACOR CLEARVIEW 1.75MM-MEDT	4	0	0	10	16	4	7	10	4	
12M01101003 7	SHUNT INTRACOR CLEARVIEW 2.0MM-MEDTRONIC	0	10	5	0	15	5	7	10	5	
12M01101002 3	OCTOPUS TISSUE STAB.SYSTEM 4.3-MEDTRONIC	6	2	5	3	5	2	5	8	2	
12M01101003 5	SHUNT INTRACOR CLEARVIEW 1.5MM-MEDTRONIC	8	5	5	1	1	0	5	7	0	
12M01101003 3	FELT TEFLON 6X6 007837-BARD	0	5	5	7	7	7	4	6	7	1
12M01101005 0	AORTIC PUNCH 4.0MM DISP-PILLING	1	4	4	5	5	5	3	5	5	
12M01101007 6	TITAN ULTRA TISSUE STABLIZER-TERUMO	6	1	1	0	0	2	2	4	2	
12M01101004 9	AORTIC PUNCH 3.6MM DISP-PILLING	0	0	0	5	5	1	2	3	1	
12M01101003 9	SHUNT INTRACOR CLEARVIEW 3.0MM-MEDTRONIC	4	0	0	0	0	0	1	2	0	
12M01101003 2	FELT SAUVAGE FILAMENTOUS 6X6 007829-BARD	0	6	3	10	0	10	1	2	10	8
12M01101002 4	STARFISH 2 HEART POSITIONER-MEDTRONIC	1	1	1	0	0	0	1	1	0	

12M01101003 1	FELT DOUBLE VELOUR 6 X 6 007827-BARD	0	2	2	5	0	5	1	1	5	4
12M02102012 5	BLOWER MISTER KIT 22120-MEDT	2	0	0	0	0	0	1	1	0	
12M01101002 9	FELT PTF LOW POROSITY 6X6 007839-BARD	0	1	1	2	0	2	0	1	2	1
12M01101000 1	SURGILOOP YELLOW MAXI 1001-80-SCANLAN	0	8	0	8	0	8	0	0	8	8
12M01101002 6	CAROTID SHUNT JAVID-007714-BARD	0	2	0	2	0	2	0	0	2	2
12M24124007 5	**RESONO FORCEPS-420181-06-PER USE**	**0**	**14**	**0**	**14**	**0**	**14**	**0**	**0**	**14**	**14**
12M24124007 9	**VALVE HOOK-420192-PER USE**	**0**	**30**	**0**	**30**	**0**	**30**	**0**	**0**	**30**	**30**
12M24124008 2	**CURVED SCISSORS-420178-PER USE**	**0**	**13**	**0**	**13**	**0**	**13**	**0**	**0**	**13**	**13**
12M24124008 4	**LONG TIP FORCEPS-420048-PER USE**	**0**	**15**	**0**	**15**	**0**	**15**	**0**	**0**	**15**	**15**
12M24124008 5	**MEGA NEEDLE DRIVER-420194-PER USE**	**0**	**11**	**0**	**11**	**0**	**11**	**0**	**0**	**11**	**11**
12M24124008 9	**SNAP FIT INSTRUMENT-420157-PER USE**	**0**	**26**	**0**	**26**	**0**	**26**	**0**	**0**	**26**	**26**
12M24124009 3	**420182 EndoWrist Stabilizer Instrument**	**0**	**3**	**0**	**3**	**0**	**3**	**0**	**0**	**3**	**3**
12M24124009 5	**420171 Micro Bipolar Forceps**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**1**