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A Study on The Application of Material Resource Planning, Vendor Managed Inventory And Just in Time Techniques For Procurement of Stents And Pacemakers in A Tertiary Care Institute.

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I. Introduction:

Heath care demand and supply cannot therefore, be left to be regulated solely by the invisible hand of the market. Nor can it be established on considerations of utility maximizing conduct alone[1]. Each area of a hospital has specific and unique material and supply need creating a requirement in these facilities for supply management system that can provide the necessary supplies when needed Materials management is an important issue for healthcare systems because it influences clinical and financial outcomes[2]. Hospital materials management (HMM) also involves the clinical sphere of healthcare service performance[2]. It is conceivable to suppose that the main cause of inefficiency is the existence of hidden stocks to avoid stock-outs[3], which would be more politics- and experience- rather than data-driven[4]

MRP is a scientific method of planning for arriving at time phased requirement of materials for meeting demand at the stipulated time. Sometimes this is also referred as dependent demand inventory system[7] Hospitals are searching continuously for innovative ways to contain costs without sacrificing quality and meet the patients' needs. One successful solution has been the adoption of JIT manufacturing systems which involve many functional areas of a company such as manufacturing, engineering, marketing, and purchasing. JIT concepts have successfully been implemented in manufacturing organizations. There is a reasonable consensus among researchers that JIT is a useful approach for reducing costs and improving quality and can be applied to service environments also [8]. JIT focuses on the process and not on the product. It can therefore be applied to any group of processes whether manufacturing or service. The philosophy behind JIT is continuous improvement of processes. The ultimate goal of JIT is to attack waste. This goal can be achieved by eliminating non value added services.

Vendor Managed Inventory[7]: In the traditional replenishment process, the customer has to create an order for the vendor at every step in the supply chain. The customer does not give prior notification of requirements, which means that the vendor is compelled to store safety stock that acts as a 'buffer' for all eventualities. The customers also have safety stock available of the same items as a protective mechanism in case they do not receive the required stock. This procedure leads to a larger amount of stock in the entire goods supply chain and, paradoxically, to a reduced level of customer service and a poorer response level.

Need for the Study

In order to achieve a comprehensive image of the HMM process and potential ways of exploiting IT to enable an efficient reengineering of this supply chain, reducing healthcare costs without affecting the quality of care Cardiology department contributes a major share to the revenue generated by the hospital. Most of the revenue generated by the department is due to the procedures performed in the cath lab.

Objectives:

1. Application of MRP methods to fix inventory levels for Vendor managed inventory.

II. Methodology

The study was carried out in the Cath lab stores of Nizam's institute of medical sciences, a tertiary care teaching hospital

A retrospective study of the data of cath lab stores during the period of April 1, 2015 to March 31, 2016 was done.

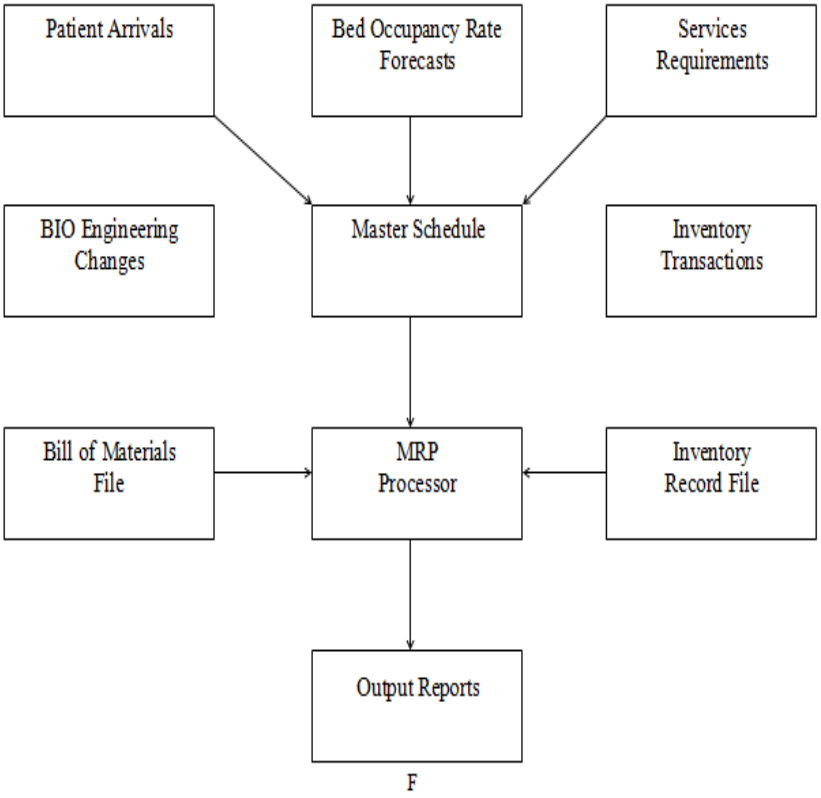
The following information was gathered from the stock records.

- Opening & closing balance of stock
- Issues & Receipts
- Price of individual items

Data collected was entered and analyzed in Microsoft Excel.

III. Observations & Analysis:

MRP is a forecasting technique which gives an idea about the estimated demand. The material requirement planning concept can be conveniently applied for procurement and stocking of stents of different companies and variants as they are regularly consumed.



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The following data was collected

Cardiology admissions

Year	Admissions
2013-14	6954
2014-15	6877
2015-16	6617

On an average there are 550 admissions per month in the cardiology dept. Techniques, such as Material Requirements Planning (MRP), which have been well established in manufacturing industries, have to be modified for use in healthcare MRP calculates the requirement of materials and schedules of supply demand pattern. It helps in determining when to buy and what frequency to buy. The prerequisite for MRP are master production schedules, bill of materials, inventory status records. MRP inputs covers master production schedules, production structure file or bill of materials file, and inventory records file. Structure of a material requirement planning (MRP) system comprises of revenue forecasts, patient arrivals, master schedule, engineering changes, inventory transactions, and inventory record files. If hospitals are to survive in the competitive environment, MRP is a good system for healthcare Materials Management. MRP as a guide in Hospital Material Requirement Planning (HRMP) system can be developed. The need to develop these standard material requirements will act as spring board for improved communication between materials managers and clinical managers and will also accelerate all parties understanding of interrelated nature of everyone's contributors to direct patient care. Material Requirement Planning (MRP) refers to systems that keep track of requirements and plan operations of the hospital in discrete time intervals. Usually the term includes explosion of net requirement on subordinate items. Computer support is the basic requirement to operate system, even in smaller hospitals. With continuing expansion of the microcomputer and personal computer markets, many of them now operate in online, real-time environment. Standardized material requirements are established for each

diagnosis and procedure at each hospital. As projected admissions of patients and surgery cases are scheduled, the computer network generates lists of required materials. The lists so generated are compared to stock on hand and on order quantities and the required purchase orders for replenishment of stocks are generated automatically by the system[7].

Cath lab procedures

Procedure	2013-14	2014-15	2015-16	Avg /day
Ad Hoc Coronary Angioplasty	188	179	240	0.7
Cardiac Catheterization	275	298	344	0.9
Coronary angiogram	3552	3520	3534	9.7
Direct stenting	201	152	120	0.3
PTCA	469	877	778	2.2
Peripheral angioplasty	96	117	129	0.3
Renal angioplasty	21	29	29	0.07

Stents are maintained on consignment basis. The inventory carrying costs are borne by the vendor which eventually is passed on to customer or hospital, In the event of adopting vendor managed inventory no such costs will occur.

Just in Time

A lot of research papers[9-15] have been reported on this issue which has suggested the concept of JIT purchasing and stockless programs in materials management of healthcare operations[16,17] it has been said that although the characteristics of service systems vary from a manufacturing system but JIT techniques can be applied to service environments also JIT is short form of 'Just in Time'**.** This was originally introduced in Toyoto production system for the purpose of eliminating waste.

- This system is aimed at regulating flow process, the right parts needed in assembly reach the assembly line at the time they are needed and only in the quantity needed.
- This system is for minimizing inventory and in turn that leading to reduction in unnecessary wastage of space for storing and cost locked up in inventory, waste of machine hours, man hours and material handling time due to over production etc
- The operating method of the above system is 'Kanban'. Kanban is nothing but a tag or a piece of paper which contains all relevant information, part number, description, process area used, time of delivery, quantity available, quantity delivered, production quantity etc.
- This is used within the plant in operation area i.e. from stores or previous production area to the supply area and outside the plant with the vendors.
- According to Taichi Ohiino this is an idea developed from super market and its operating system.

Pacemakers, ASD, VSD devices are purchased using the JIT (just in time) concept .Pace makers demand is low and erratic. As and when demand arises it is procured from the local distributors who maintain the stock for all the hospitals in twin cities .The consumption of pace makers of different specifications are procured .The details of consumption are shown in annexure no 6 .Since the pace makers are not regularly used and are available with the suppliers as and when required from ex stock.. Hence it is advisable to adopt Just in time procurement concept .As an abundant caution the hospital can give a letter of intent showing the forecasted demand so that supplier can maintain stocks. Past experience shows there are no abnormal delays affecting the patient care. Hence it is suggested that just in time concept can be adopted without holding inventories of costly items like pacemakers.

Consumption of Stents

Item	**2013-14**	**2014-15**	**2015-16**		**Avg**		**Avg Per Day**
XIENCE -V STENT	115	395	363		291.0		0.8
ENDEAVOR RESOLUTE STENTS	281	100	341		240.7		0.7
INTEGRITY STENTS	0	24	166		63.3		0.2
BIOMIME STENT	160	354	143		219.0		0.6
TAXUS STENTS	10	11	141		54.0		0.1

ENDEAVOR SPRINT STENTS	54	73	132		86.3		0.2
SUPRALIMUS STENTS	182	50	115		115.7		0.3
LUMINEXX STENT	35	45	92		57.3		0.2
EXPRESS VASCULAR STENT	0	6	85		30.3		0.1
PROMUS ELEMENT STENTS	32	35	81		49.3		0.1
DRIVER STENT	85	115	63		87.7		0.2
COROFLEX BLUE STENTS(BMS)	85	74	60		73.0		0.2
BX-SONIC STENT	0	1	27		9.3		0.0
PATRIOT STENT	109	131	24		88.0		0.2
YUKON STENTS	201	83	16		100.0		0.3
COROFLEX BLUE STENTS	43	82	11		45.3		0.1
DRIVER STENT (BMS CE)	0	25	11		12.0		0.0
PRECISE STENT	19	9	10		12.7		0.0
LIBERTE STENT	30	2	7		13.0		0.0
RESISTANT STENT	0	0	5		1.7		0.0
COBALT+C & MINI STENT	0	21	3		8.0		0.0
EXPRESS VASCULAR SD STENT	0	12	3		5.0		0.0
DRIVER INTEGRITY STENTS	0	1	2		1.0		0.0
PROSTAR PLUS STENT	0	37	2		13.0		0.0
SONIC STENT	7	2	2		3.7		0.0
BVS ABSORB STENT	0	0	1		0.3		0.0
COBAL+C STENT	73	74	1		49.3		0.1
MICRO DRIVER STENT	0	0	1		0.3		0.0
PRESSURE WIRE	51	39	1		30.3		0.1
ASSURANT COBALT STENT	11	1	0		4.0		0.0
BRIDGE ASSURANT STENT	1	1	0		0.7		0.0
CHROMAXX STENT	32	21	0		17.7		0.0
CLEAR FLEX STENT	1	13	0		4.7		0.0
COROFLEX PLEASE	77	41	0		39.3		0.1
CYHPHER STENTS	71	121	0		64.0		0.2
DELIGHT STENTS	98	63	0		53.7		0.1
DRIVER STENT (Rapid Exchange FDA)	18	0	0		6.0		0.0
ENDURANT STENT	2	0	0		0.7		0.0
EXPORT CATHETER	35	15	0		16.7		0.0
FLUENCY PLUS STENT	2	0	0		0.7		0.0
GENESIS STENT	41	5	0		15.3		0.0
JANUS STENT	21	0	0		7.0		0.0
LIFE STENT	0	2	0		0.7		0.0
OPTIMA STENT	0	5	0		1.7		0.0
PALMAZ BARE STENT	1	0	0		0.3		0.0
PALMAZ BLUE STENT	35	38	0		24.3		0.1
PLAMAZ AORTIC STENT	1	0	0		0.3		0.0
RESOLUTE INTEGRITY STENTS	0	21	0		7.0		0.0

SATIN FLEX STENT	42	0	0		14.0		0.0
STAINLESS STL. TECHNIC+ STENT	45	0	0		15.0		0.0
SUPRA-CORE STENT (DES-CE)	0	15	0		5.0		0.0
VALIANT THORACIC STENTS	5	0	0		1.7		0.0
ZILVER FLEX STENT	0	3	0		1.0		0.0

Consumption of Pacemakers

Item	2013-14	2014-15	2015-16		Avg	Avg Per Day
Aicd Dual Chamber Pacemaker	5	2	2		3.0	0.01
Angio Guard	14	8	8		10.0	0.03
Asahi Corsair	0	3	7		3.3	0.01
Asd Device	12	11	12		11.7	0.03
Asd Device Closure With Kit	3	0	1		1.3	0.00
Asd Device With Delivery Kit	0	0	5		1.7	0.00
Asd Occluder Device	2	0	7		3.0	0.01
Bipolar Pacing Lead	0	1	1		0.7	0.00
Crt Pacemaker	13	8	10		10.3	0.03
Dddr Pacemaker	32	36	35		34.3	0.09
Dior Balloon	6	3	0		3.0	0.01
Dual Chamber Aicd	0	1	2		1.0	0.00
Duct Occluder (Pda Device)	0	0	1		0.3	0.00
Ivc Filter	7	4	16		9.0	0.02
Moma Ultra Device	1	0	0		0.3	0.00
Pacemaker Lead	4	5	2		3.7	0.01
Pacemaker Vvir	1	0	0		0.3	0.00
Pacing Lead	1	2	1		1.3	0.00
Pda Device	11	12	6		9.7	0.03
Pda Occluder	2	4	1		2.3	0.01
Screwing Lead (St.Jude)	0	0	1		0.3	0.00
Single Chamber Aicd	0	0	1		0.3	0.00
Single Lead Pacemaker (Vvir)	0	0	1		0.3	0.00
Ventricle Lead	0	0	1		0.3	0.00
Valiant Thoracic Stents	5	0	0		1.7	0.00
Vddr Pacemaker	1	1	0		0.7	0.00
Vsd Device	2	1	0		1.0	0.00
Vvir Pacemaker	36	31	23		30.0	0.08
Asd Device Closer	16	13	0		9.7	0.03

Items where JIT can be implemented

Item	Annual demand	Buffer stock	Price
Cutting Balloons	0	0	42263
Carotid sheaths	0	0	1500
Pericardiocentesis kit	0	0	10660
Atrial Septostomy catheter	0	0	60770
Biopsy forceps	1	1	22768
Bifurcation balloon	1	1	18500
Snair kits	2	1	15600
Septal Puncture needle	3	1	5950
Carotid balloons	4	1	7000
PDA coil closure device with delivery kit	4	1	10150
Mullins sheaths	5	1	2449
Microcatheters	5	1	13860
PBAV balloons	5	1	13394
PDA coils	7	1	6580
Berman catheters	9	1	7000
Angiomed syringes	13	1	1450
INOUE balloon	15	1	92150

IV. Conclusion

Application of Material Resource Planning, Vendor Managed Inventory and Just in Time techniques for procurement of stents and pacemakers in a tertiary care institute is the need of the hour and healthcare institutes should adapt to the latest investment management techniques.

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