New Trends in Healthcare Supply chain

Joseph Mathew, Joshin John† and Dr. Sushil Kumar‡*
Operations Management, IIM Lucknow, Prabandh Nagar, Off Sitapur Road, Lucknow - 226013
E-mail: **joseph.mathew@iiml.org, †joshin.john@iiml.ac.in, ‡sk@iiml.ac.in*

Abstract
This paper focuses on the new trends to optimize costs in healthcare supply chain operations that include virtual centralization of supply chains, supply utilization management practices, use of RFID technologies, use of analytics, streamlining workflow etc. The application of these techniques can provide affordable healthcare solutions in developing countries.

Keywords: Healthcare supply chain, Virtual centralization, Vendor Managed inventory

Introduction
In the age of competition, no industry can survive without pondering much about reducing expenditures wherever possible. The same is true for health care industry, which is witnessing sharp rise in price in almost all its products and services. The alarmingly high pace of upward movement of cost is making the produce of the industry beyond the reach of the mass. Supply chain in this industry being a significant driver of cost is therefore grabbing all the attention from industry stakeholders.

This study focuses on discussing the basic nature and components of supply chain of health care industry with considerable attention on future scopes along with present trends. The supply chain in this industry is believed to be inherently complex and as a result it is quite a tough task to recognize any magic button that will help remove the inefficiencies to drive down costs. As part of the research for this paper we have done extensive studies of literatures and tried to gain insight on the complexity of health care supply chain management (SCM). The current trend shows that the industry struggles to meet on-time delivery. The major drawback remains in the fact that each part of the supply chain works independently, creating misaligned activities that prevents it from working as a system. We have also analysed the health care supply chain in Malaysia to have a better understanding of the current scenario in developing countries. The literature review throws light on issues like redesigning of inventory management systems in hospitals, aggregation of suppliers and their products through electronic catalogues, use of ERP system to address another bottleneck in the supply chain, namely: inefficient information flow in the system.

Finally the paper addresses certain new strategies emerging in the sector that are contributing towards efficient SCM practices. They are: RFID, Supply Utilization Management, Virtual Centralization of the Supply Chain and Vendor Managed Inventory. The RFID helps attaining inventory visibility and accurate counts at every stage of the supply chain and also helps reducing shrinkage and shipping errors. Supply Utilization Management helps reducing wastages, value mismatch and misuse through standardization and proper specification. Virtual centralization of the supply chain on the other hand helps improving level of cooperation in hospitals thereby helping them controlling costs and improving services. How virtual centralization works is explained with the help of an example of CSC : this is jointly owned and managed by multiple hospitals and healthcare units. CSC brings

together geographically dispersed healthcare units together and allows them to work together to attain maximum efficiencies in procurement, contracting and customer service.

Presently hospitals are looking for new sources of competitive advantage and cost cutting measures wherever possible. It is imperative to look into the supply chain management aspects and identify areas in which they can improve the quality of service for efficient patient care. Supply Chain Management in healthcare should ensure complete end-to-end visibility of information among suppliers, manufacturers, distributors and customers.

The healthcare supply chain involves the flow of many different product types and the participation of several stakeholders. The main purpose of the healthcare supply chain is to deliver products in a timely manner, in order to fulfill the needs of providers. Based on their functions, stakeholders in the healthcare supply chain can be divided into three major groups: producers, purchasers, and providers. (Figure 1)

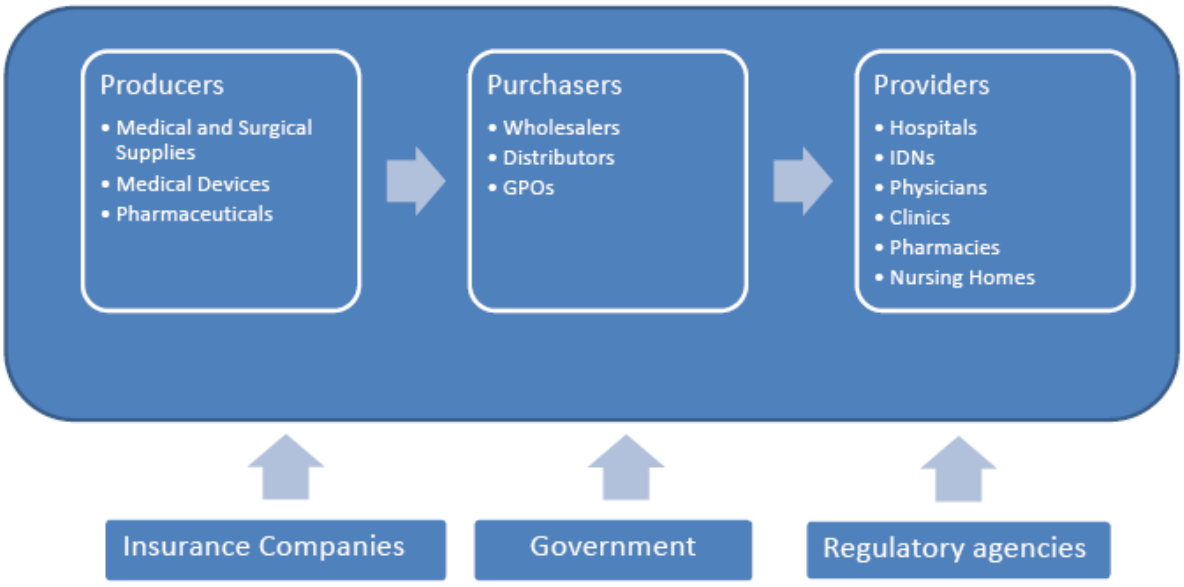

Figure 1: Healthcare supply chain configuration (Adapted from Burns 2002)

To add to the complexity of the system, there is also the involvement and participation of governmental institutions, regulatory agencies, and insurance companies (Ryan 2005).

Primary manufacture involves the creation of the active ingredient contained within the medication. Because of the need to avoid contamination between products, there are long downtimes in production to allow for cleaning, leading to batch production (Shah 2004). In effect, this represents mass production. Secondary production sees the active ingredient converted into useable products (such as tablets, capsules, etc.) This can potentially lead to a significant expansion in the number of product lines, especially once packaging is taken into consideration. Altricher and Caillet (2004) suggest 200 times growth in products across this stage in the supply chain. With increasing globalisation in the pharmaceutical industry, the location of manufacturing plants is often influenced by factors such as tax benefits (Papageorgiou 2001). Indeed, secondary manufacturing may be geographically separated from primary manufacturing and serve local or regional markets (Shah 2004).

Turning to the distribution of finished products, there are a number of different channels to the market. The dominant intermediary (in terms of volume at least) is the wholesaler. In the UK, approximately 80 per cent of volume flows through this channel (Shah 2004). Hospitals and retailers which have large demand requirements receive shipments

direct from the manufacturers distribution centre. Equally, hospitals may leverage economies of scale by consolidating their purchasing power through, for example, Group Purchasing Organisations (Roark 2005).

In terms of the characteristics of these supply chains, Shah (2004) provides detailed information with regards to typical performance levels. There are long lead times, with products taking between 1,000 and 8,000 hours to pass through the whole supply chain. Coupled with this, inventory levels appear quite high with stock turns taking between one and eight weeks. This is consistent with the findings of Haavik (2000) who reported that, in 1994, stock turns in hospital store rooms lasted four to five weeks. Another theme raised by several authors is demand amplification (Corrêa 2004, Shah 2004). Given the number of intermediaries within the supply chain, and the presence of batching within primary manufacturing, this should perhaps be expected.

The product flow (Figure 2) in the healthcare sector starts with the manufacturer and ends with the final customer at the healthcare provider. Depending on its type, a product can be directly delivered by the manufacturer to the healthcare provider, or channelled through a distributor before reaching the healthcare provider. The healthcare supply chain is frequently described as highly fragmented and relatively inefficient (Schneller and Smeltzer 2006). A major problem with the traditional healthcare supply chain is that each stage of the supply chain operates independently, leading to misaligned incentives and conflicting goals that prevent the supply chain from operating as a system. These conflicting goals, along with other barriers, have hindered the adoption and implementation of SCM practices.

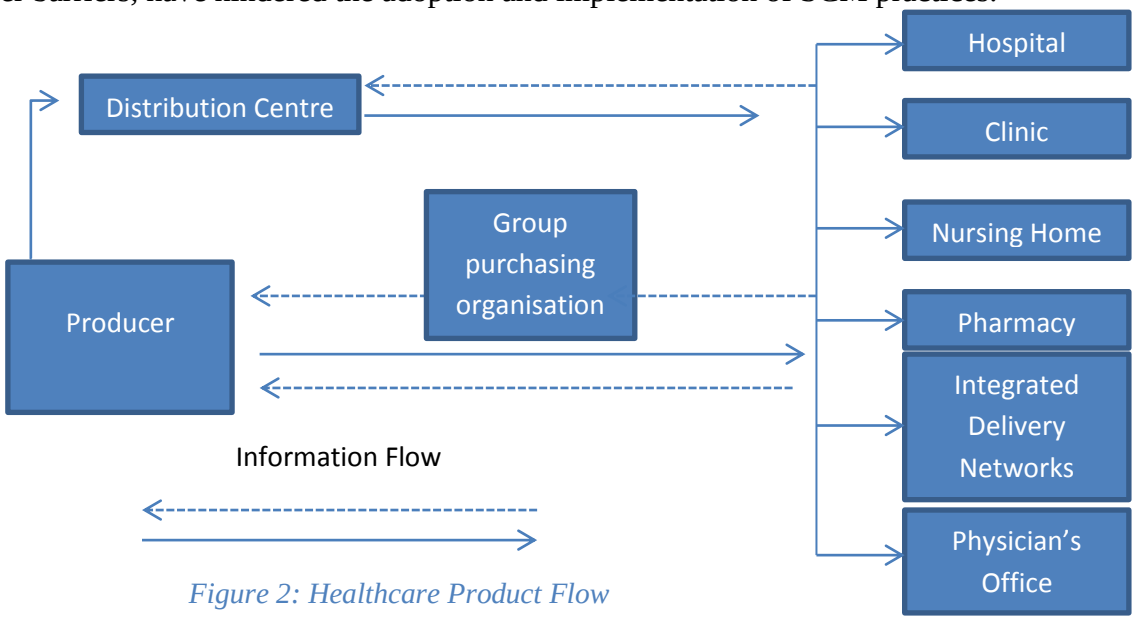

Figure 2: Healthcare Product Flow

Literature on Supply Chain Management Practices in the Healthcare Sector

The following literature reviews portray the current status of the healthcare sector relative to barriers and practices for implementation of SCM principles.

Heinbuch (1995) described an approach to meeting the challenge of healthcare cost reduction through the hospital material management function. The work highlights the value of taking a proactive stance to meet the challenge of transferring technology across industry sectors.

Alverson (2003) discussed the importance of disciplined inventory management for hospitals, and suggested serious consequences of traditional hospital purchasing including lack of inventory control, missed contract compliance, excess inventory levels, frequent

stock-outs and costly emergency deliveries, workflow interruptions, expensive rework, and increased health system labor requirements.

The literature on information technology (IT) provides some solutions to material management in the healthcare sector. Burns (2002) discussed aggregation of suppliers and their products through electronic catalogues, visibility of orders and materials, and efficiency in procurement.

Schneller and Smeltzer (2006) suggested that e-procurement systems can help to significantly reduce purchasing costs through the consolidation of supplier networks and creation of supplier partnerships. They also suggested that transaction and administration costs can be reduced through the use of ERP systems, which provide an automated and paperless format for information to flow throughout an organization.

Current state of SCM in Healthcare industry

Within the healthcare industry, the supply chain associated with pharmaceutical products is critical in ensuring a high standard of care for patients and providing adequate supplies of medication for pharmacies. In terms of cost, it is estimated that supply accounts for 25-30 percent of operational costs for hospitals (Roark 2005). Therefore, it is essential that this is managed effectively to ensure both service and cost objectives are met. Various issues existing at the distribution element, particularly from the wholesaler to the hospital are as follows:

Product life cycle: Once the active ingredient is patented, it may take eight years to develop the product into something that can be marketed (Papageorgiou 2001). Once the patent expires, alternative products may enter the market, or companies may reduce the product price (Lauer 2004). New technology is shortening life cycles creating new pressures on the distribution channels.

Profit margins: Despite pharmaceutical products having a high value per unit, operating margins are small in the wholesaler sector particularly. One cause of this is the control over pricing held by hospitals, retailers and manufacturers (Lauer 2004).

*Forecasting***:** It is difficult to predict the exact demand for medicines. One of the issues is the availability of accurate data on consumption. However, the lack of standard nomenclature for healthcare products, plus the preferences of clinicians creates further uncertainties (Lauer 2004).

*Lack of supply chain education***:** Awareness of the concept of supply chain management, particularly within hospitals, is low (Lauer 2004). Therefore, managers are not properly equipped to control the supply of medication.

Given this context, a number of initiatives have been undertaken over recent years with a view to reducing supply chain costs and improving customer service. Initial improvements have been based around implementing just-in-time (JIT) approaches (Kowalski 1986). Subsequently, this has been developed further with the introduction of stockless inventory systems (Wilson 1992). The JIT and stockless approach can reduce inventory holding costs in the organization, while maintaining service levels (Lynch 1991). More recently, it has been suggested that the stockless system should only be used for high volume products, with a more traditional approach for low volume medical supplies (Rivard-Royer 2002). However, there is a requirement for improved information and communication technology (ICT) systems to support this, along with automated processing of orders and suppliers (mainly wholesalers) close to the hospital to enable rapid replenishment. Both JIT and stockless approaches represent “pull” type inventory management systems.

Supply chain process

Healthcare supply chain in a developing country is analysed from data available in literature. The process referred to below details supply chain management practices in healthcare industry in Malaysia. We have used Malaysia as a reference to study the health care supply chain practices followed in a developing country. The major issues faced are analysed and we have proposed various supply chain integration methods to improve the existing practices.

In Malaysia, each clinic is responsible for monitoring and managing their own inventory and they place an order to the wholesaler when required. The decision on which products to order at each period and the quantity required relies upon the experience and skill of staff at the clinics. Clinics make an order directly using the online Purchase Order (PO) system. Generally, orders are placed during the first and third week of every month. All the orders will be processed and delivered within five days. Each order is referred to by the PO number, which is automatically generated in the system. The first stage of order processing at the wholesaler is to check the order details and the availability of the products for delivery. If the product is not in stock, the supply manager is informed. If an order for the products is outstanding, contact is made with the supplier to identify its status. Otherwise a new order on the supplier is produced. In this case the delivery will be delayed until the product is available in stock. Sometimes certain products will be replaced by others where the alternative product can perform the same purpose. For example, orange lozenges can replace herbal lozenges because the only difference is the flavour.

The next process is the packaging where products will be packed based on the PO. All products required for one clinic are packed together to make delivery easier. This process should be done three days before the delivery date. All products delivered to the specific branch are listed on the Delivery order (DO) form, each of which has a unique number. The stock keeper needs to update the inventory status in the record book based on the information in the DO to ensure the inventory status at the wholesaler is up-to-date. Deliveries are made based on a schedule which takes into account the availability of the company's transport fleet (one van and one lorry) and drivers. Usually, deliveries will be made twice a month, with vehicles adopting a milk-run approach and delivering to a number of branches in the area.

When the order arrives at the clinic, they check whether the products delivered to them are the same as those on the DO forms. If satisfied, the products are moved as soon as possible to the store or fridge, depending upon whether the medication needs to be kept chilled. The DO and the delivery form need to be signed as a proof of delivery, with a copy being returned back to the wholesaler through the driver. If the product delivered is different to the DO, the clinic should inform the wholesaler as soon as possible by phone and indicate the errors on the DO. If the product has been left behind or delivered to the wrong branch, a revised delivery will be scheduled to correct this error.

The common issues faced are in case of urgent orders and stock unavailability at the wholesaler. Urgent orders can be placed if a product reaches a critical inventory level. This occurs because orders are generated manually and based only on the experience of individuals at the clinics. With normal orders, there is a delivery lead time of five days, increasing the risk of a stock out. Unlike consumer products, where the customer can either defer their purchase or acquire an alternative, this can be critical in providing patient care as there may be no alternative treatment for the patient. Therefore, urgent orders need to be delivered immediately. Just a few products are delivered in each urgent shipment and, due to the scattered locations of clinics; vehicle fill is lower with increased transportation costs. Inventory replenishment at the wholesaler is based on the orders placed by clinics. Because of the nature of decision making at the clinics, it is difficult to forecast their requirements. Coupled with two major peaks in orders each month, the wholesaler may face difficulty if the many clinics order the same products at the same time. This will cause out of stock problems

at the wholesaler. Some clinics will get the products ordered while others need to wait until the new stock arrives.

Proposed Solution - Supply Chain Integration

In hospitals, the supply chain strategy should be to maximize patient care. The hospital supply chain enables this strategy by:

- Ensuring product availability
- Minimizing storage space
- Maximizing patient care space
- Reduce material handling time and costs for all medical staff (nurses, pharmacists, doctors)
- Minimizing non-liquid assets (inventory)

New Strategies

This paper looks in detail the following new strategies practiced in the hospital industry to optimize the supply chain.

Virtual centralization of the supply chain

Cooperation using virtually centralized supply chain management can set hospitals on the path to controlling costs and improving service. Virtual centralization is integrating operations from the perspective of the market rather than the health system. The most developed example is a consolidated service centre (CSC) that is jointly owned and managed by multiple hospitals and healthcare systems. A CSC brings together geographically based groups of hospitals to form single entities that work together to centralize contracting, procurement, distribution, and logistical operations. The CSC serves as the focal point not only of distribution, hut also of centralized contracting, procurement, and customer service.

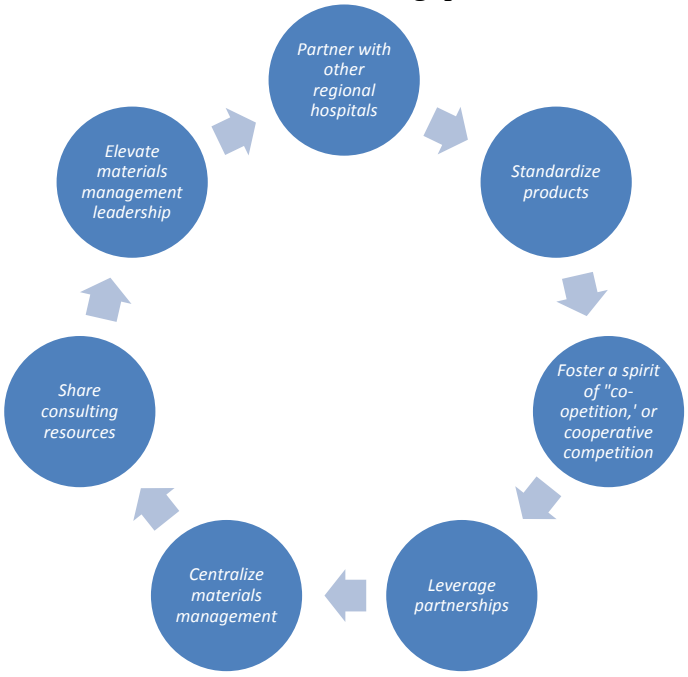

Figure 3: How to form a Consolidated Service Centre?

This innovative approach helps to solve critical problems relating to staff, time, and budget shortages. And while saving money is the top priority, a CSC also provides networking opportunities for participants. Being able to share best practices, conflict resolution, and advice will help to improve the bottom line.

Hospitals would be empowered to have much more control over product selection and distribution. Consolidation of supply services would result in significantly improved visibility of a hospital's supply chain expenses, improved product pricing through standardization and volume aggregation, reduced inventory, lower distribution costs, and reduced inbound freight costs. Other benefits include elimination of distribution mark-up costs and lower product prices, inventories, and inbound freight costs.

This type of arrangement would be especially beneficial to rural, small, and mid-size hospitals because they would not have to manage or install complex IT systems and could share with others the expense of these systems as well as the staff who use them. They might also be able to outsource their procurement functions to these collaborative logistics centres. This arrangement would not only have a major impact on the bottom line, but also would allow them to focus more effort into working with clinical quality value analysis teams that help to support clinical product selection.

RFID Applications in Healthcare

Radio Frequency Identification (RFID) is a technology that connects objects to the Internet, so that they can be traced, and companies can share data about them. In contrast to bar codes application, RFID tags are robust and do not require line-of-sight identification, thus eliminating the need for human intervention. The tags are programmable and contain information regarding destination, weight, and a time stamp. The tags allow automation throughout the supply chain which includes warehouse space optimization and efficient goods tracking in order to bring down the cost and enhance customer service. RFID tags offer real-time, accurate information and compel applications and processes across the organizations to provide value to service.

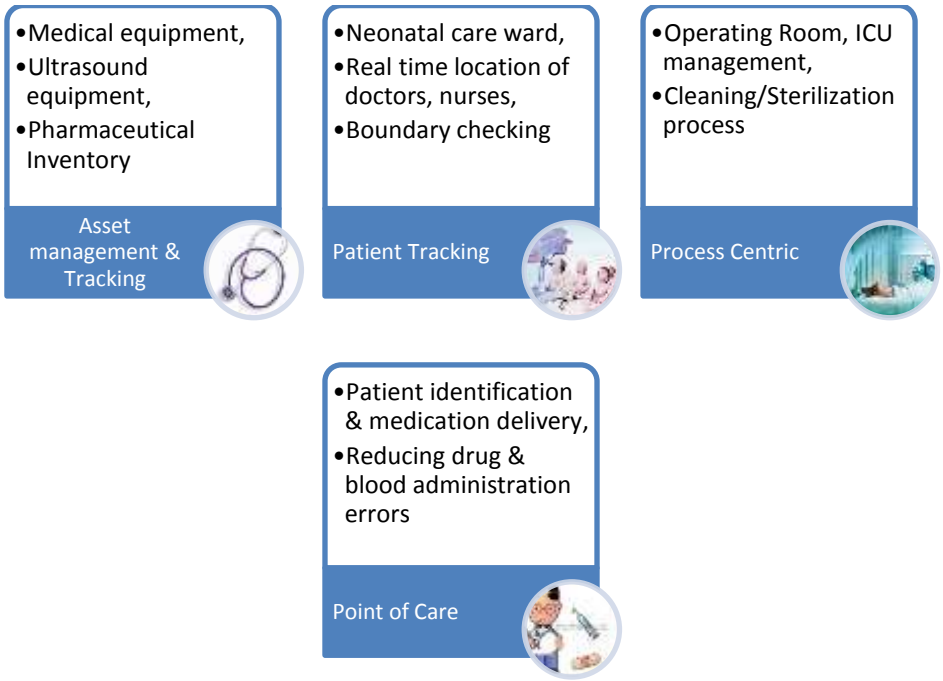

Figure 4: RFID Applications

Real-time tracking of goods throughout the supply chain provides one of the major opportunities for improving customer service. Real-time information on delivery time supports Just-in-Time (JIT) manufacturing and retailing, enabling organizations to make strategic decisions. With the help of RFID, the following can be achieved:

- Improved tracking of high-value items/assets
- Reduced shrinkage and shipping errors in the supply chain

- Inventory visibility, accuracy, and efficiency at each stage
- Improved production planning and smart recalls for effective scheduling, and
- Technology standards to drive down costs with higher consumption of tags (economies of scale).

However barriers to using RFID technology in healthcare industry include

- Technical issues - RFID may interfere with the hospital environment e.g., medical devices. Second, RFID systems are not always reliable. RFID read accuracy depends on a variety of factors such as tagged object, tag placement, angle of rotation, and read distance.
- Cost - RFID costs include initial hardware and software costs, training, as well as the continuously high costs of RFID infrastructure maintenance and upgrade.
- Privacy concerns - The benefits of using RFID in medical settings are achievable only if patients are confident that the data being transmitted will not be misused [The patient information associated with RFID tag is highly mobile and sensitive.
- Other barriers - Other barriers to RFID adoption include the lack of organizational support, trust issues & security concerns.

Supply Utilization Management

Newly uncovered savings come not from reduced prices, but from eliminating waste, inefficiency, misuse, and value mismatches of the products, services, and technologies healthcare organizations employ. The following types of utilization misalignment are common in healthcare organizations.

Standardization. Customizing products to customers' exact requirements can reduce an organization's supply chain expenses. Otherwise, the healthcare organization's money is wasted on unnecessary functions and features. Hence customization is preferred over standardization.

Over-specification. Hospitals often purchase products with components or features that are not medically, legally, or functionally required.

Under-specification. Too few components, wrong components, or missing critical features in products, services, and technologies are another common cause of utilization misalignment.

Value mismatches. Many healthcare organizations bloat their supply budgets with costly products, services, and technologies that are not functionally required. These organizations often fail to look for available lower cost functional alternatives that can meet or exceed the customer's requirements.

New technology. All new technology needs to be closely monitored for at least three months to ensure that it is meeting or exceeding the manufacturer's performance specifications.

Old technology. All technology-whether elevators, IV pumps, anaesthesia machines, or imaging systems-has a useful life of a certain number of years, and is not cost effective for the hospital to continue to maintain it beyond its useful life.

Vendor Managed Inventory

Under Vendor Managed Inventory (VMI), the supplier assumes responsibility for the management of inventory at the customer, and takes decisions regarding replenishment (Waller et al. 1999). To some extent, this builds on the information requirements of stockless inventory systems. The main difference is moving responsibility for stock control to the supplier, as the ordering process remains automated. For VMI to work successfully there is a need for accurate information on current stock levels and consumption. However, providing

such information within hospitals can be difficult (Haavik 2000 and McKone-Sweet 2005). In Kim (2005), VMI has brought a number of benefits including less administration at the hospital, fewer errors, improved information reliability and a 30 per cent reduction in inventory. By contrast, Altricher and Caillet (2004) found that, because of a lack of trust in the supply chain, the hospital kept over-ruling the VMI system, holding more stock and eliminating any benefits that accrued.

Conclusions

Today, healthcare providers are under enormous pressure due to increasing competition, government regulations, rising costs, demand for higher quality of service. Undoubtedly, healthcare becomes tremendously complex as a business activity to manage diversified locations, changing organizational structures, mergers, employees, and multiple information systems across the globe. Healthcare organisations must strive for value addition across entire supply chain by monitoring supply chain performance. The latest innovations in RFID technology, Supply Utilization management & Virtually centralized Supply chain management holds the key to the future. Looking to the future, supply utilization management is an emerging recommended practice that will enable healthcare organizations to dig deeper and more broadly into their supply chain expenses to harvest new and even better supply savings. Exploiting the power of RFID technology is not simply about replacing bar codes with tags. The specific benefits that RFID tags offer over bar codes present an entirely new way of working in the competitive business environment.

To summarize: the health care industry is highly interdependent and only one part can't attain efficiency leaving behind others. That is the reason why strategy such as Virtual Centralization is proving to be popular and successful. That is not the end of the road, the industry has to look forward to each and every minute development in the supply chain of related industries to reap the benefit of being alert and quick to adapt to.

References

Acharyulu, G. 2007. *RFID in the Healthcare Supply Chain : Improving Performance Through Greater Visibility*. Journal of Management, **VI**(11): 32-46.

Altricher, F., T. Caillet. 2004. SCM in a pharmaceutical company. Stadtler, H., C. Kilger, eds. *Supply Chain Management and Advanced Planning: Concepts, Models, Software and Case Studies*. Springer-Verlag, NY, 355-70.

Alverson, C. 2003. *Beyond Purchasing Managing Hospital Inventory*. Managed Healthcare Executive.

Burns, R. Lawton. 2002. *The Healthcare Value Chain: Producers, Purchasers, and Providers*. Jossey-Bass.

Corrêa, H.L. 2004. Supply chain management in Latin America: the Brazilian pharmaceutical industry case. *CELog Working Paper*. Available at: http://celog.fgvsp.br/../../../fig/artigos/supply_chain.pdf (accessed date Jan 15, 2013).

Grasman, S. E., S. Missouri 2010. *Barriers and Best Practices for Material Management in the Healthcare Sector*. Purchasing. **22**(4): 11-20.

Haavik, S. 2000. *Building a demand-driven, vendor-managed supply chain.* Healthcare Financial Management. 56-61.

Heinbuch, E. Susan. 1995. *A Case Study of Successful Technology Transfer to Health Care: Total Quality Materials Management and Just-In-Time.* Journal of Management in Medicine. **9**(2):48-56.

Kim, D. 2005. *An integrated supply chain management system: a case study in healthcare sector*. Lecture Notes in Computer Science. **3590**:218-27.

Lauer, C. 2004. *Excellence in supply chain management.* Modern Healthcare. **34**(50): 29-32.

Waller, M., M.E. Johnson, T. Davis. 1999. *Vendor-managed inventory in the retail supply chain*. Journal of Business Logistics.**20**(1):183-203.

Lo, W. 2009. *A practical framework of industry-university for supply chain management of health care industry with using distance health-care ICT platform*. International Journal of Electronic Business. **7**(4). 241-247.

McKone-Sweet, K.E., P. Hamilton, S.B. Willis. 2005. *The ailing healthcare supply chain: a prescription for change.* Journal of Supply Chain Management. 4-17.

Mustaffa, N. H., A. Potter. 2009. *Healthcare supply chain management in Malaysia: a case study.* Supply Chain Management: An International Journal. **14**(3): 234–243.

Papageorgiou, L.G., G.E. Rotstein, N. Shah. 2001. *Strategic supply chain optimization for the pharmaceutical industries*. Industrial and Engineering Chemistry Research. **40**:275-86.
Parker, J., D. DeLay. 2008. *The future of the healthcare supply chain. Healthcare financial management*. Journal of the Healthcare Financial Management Association. **62**(4):66-9.
Rahman, B., N. Wilson. 2010. *An HSRC-ASU White Paper Repositioning Supply Chain in Health Care Systems*. Supply Chain Management.
Raviprakash, A. V., B. Prabu, N. Alagumurthi, V. Soundararajan. 2009. *RFID : Rx to Healthcare Industry*.
Roark, D.C. 2005. *Managing the healthcare supply chain*. Nursing Management. 36-40.
Ryan, K. Jennifer. 2005. *Systems Engineering: Opportunities for Health Care*, *Building a Better Delivery System: A New Engineering/ Health Care Partnership*. National Academy Press.
Schneller, S. Eugene S., Larry R. Smeltzer. 2006. *Strategic Management of the Healthcare Supply Chain*. Jossey-Bass.
Shah, N. 2004. *Pharmaceutical supply chains: key issues and strategies for optimisation*. Computers and Chemical Engineering.**28**:929-41.
Shekhar, B Raja, G. Acharyulu. 2012. *Role of Value Chain Strategy in Healthcare Supply Chain Management : An Empirical Study in India*. International Journal of Management. **29**(1): 91-98.
Yokl, R. T. 2011. *The future of supply chain expense management. Healthcare financial management.* Journal of the Healthcare Financial Management Association. **65**(3):38-40.