Management of Supply Chain in Clinical laboratories

Eng. Sana'a A. Alsalameh, Eng. Mohamed F. Ababeneh

Royal Medical Services, Amman – Jordan

DOI: 10.29322/IJSRP.8.12.2018.p8471
http://dx.doi.org/10.29322/IJSRP.8.12.2018.p8471

Abstract – Recently, effective management of supply chain in clinical laboratories has been an emerging interest. This paper aims to investigate a Logistic Management Information System (LMIS) coupled with Radio frequency identification (RFID) to improve data collection, analysis and decision making during each phase of laboratories supply chain. The proposed model promotes to reduce cost, decrease delivery time and standardize the total process.

Index Terms - Laboratory Supply chain, Inventory, LMIS, DQOH, ROP, RFID.

I. Introduction

Clinical laboratories tests playing a significant role in diagnosis and treatment plan for patients, also it has a direct effect in the quality of delivered health services and the total national health care system. In developed countries, the cost of supply represents a critical portion of the total expenses of operating clinical laboratories and estimated between (15% to 40%) [1]. Therefore, management of supply chain in clinical laboratories consider as formidable challenge.In 1979, the concept of supply chain management was introduced by Thomas A, and Davis SE, to control the cost of clinical laboratories [2]. Other study achieved by Weinstein et al. 1985revealed that inventory procedures promote the management of supply chain and yield to financial benefits regarding to clinical laboratories [3]. Typically, the supply chain of clinical laboratories includes raw materials, manufacturers, distributors, and the end user. Materials can be categorized into three main groups. Disposable or non-reused items that used only once during laboratory test, including a wide variety of items such as specific disposable material (microscope slides, cover slips) or general laboratory consumables such as (tubes, gauze, gloves and alcohol). Durable materials that can be reused for multiple test. Bulk chemical material including reagents that used to detect and measure analyte. It vary widely in price, stability, environmental condition of storage such as cold and dry requirement for storage and biological hazard. Practically, the work load is the essential factor affecting the consumption of supplied materials in parallel to other factors related to delivery of vendors, shipment delay and performance of sock materials.

The careful monitoring of materials consumption leads to improve the management of supply chain and reduces the cost by ensuring that sufficient supplies are on hand and used before their expired date. As well as, purchase orders are completed at the specified time. To achieve the ideal supply chain for clinical laboratories, many parameters should be taken into account including the main following points:

- The rate at which the supply materials are used.
- The lead time to order and receive the supplied materials.
- The availability and cost of storage space.
- Unique specification of materials and expiration date or the need to use a specific lot.
- Lists of all suppliers used with vendor name, catalog number, price and storage location
- History of purchase for each supplied materials.
- Estimates of supply wastage.
- Unique characteristics of each supply, such as a short expiration date.

Well designed logistic supply chain is an essential issue to provide continuous supply of good quality of laboratories materials during the whole process of clinical laboratories. The good design of supply chain includes development of logistic management information system (LMIS) which contains tools, process for managing information, inventory control system and procedures for ideal storage and distribution for supplied materials. The main goal of LMIS is to build a mechanism that allow staff to collect and mange information to improve decision making, ensure an uninterrupted supply and identify any problem within the supply chain. Consequently, implementation of LMIS can be achieved through two main phases including; development and maintain standard operation procedures (SOP) to provide instructions about how to operate LMIS, completing the required forms and responsibilities of all staff in the subsystem. Therefore, appropriate training of staff is required to ensure optimal utilization of the designed system.

II. Methodology

The proposed model of supply chain management is based on circular design of work flow combined between clinical laboratories process and supply chain of required materials. In details, the suggested model is developed to count and determine the needed materials that require to be supplied based on the principle of consumption rate of used materials and the actual needs. Clinical laboratories requirement are sent to the supply chain information system. Then a priority of order takes a place on the system. Checking the storage for the desired materials, if it is available direct delivery will take place, if not available a purchasing order is generated and send to the vender department. Checking accuracy, quantity and other unique specification of desired material is the responsibility of LMIS. The below diagram illustrates the management of supply chain through clinical laboratories.

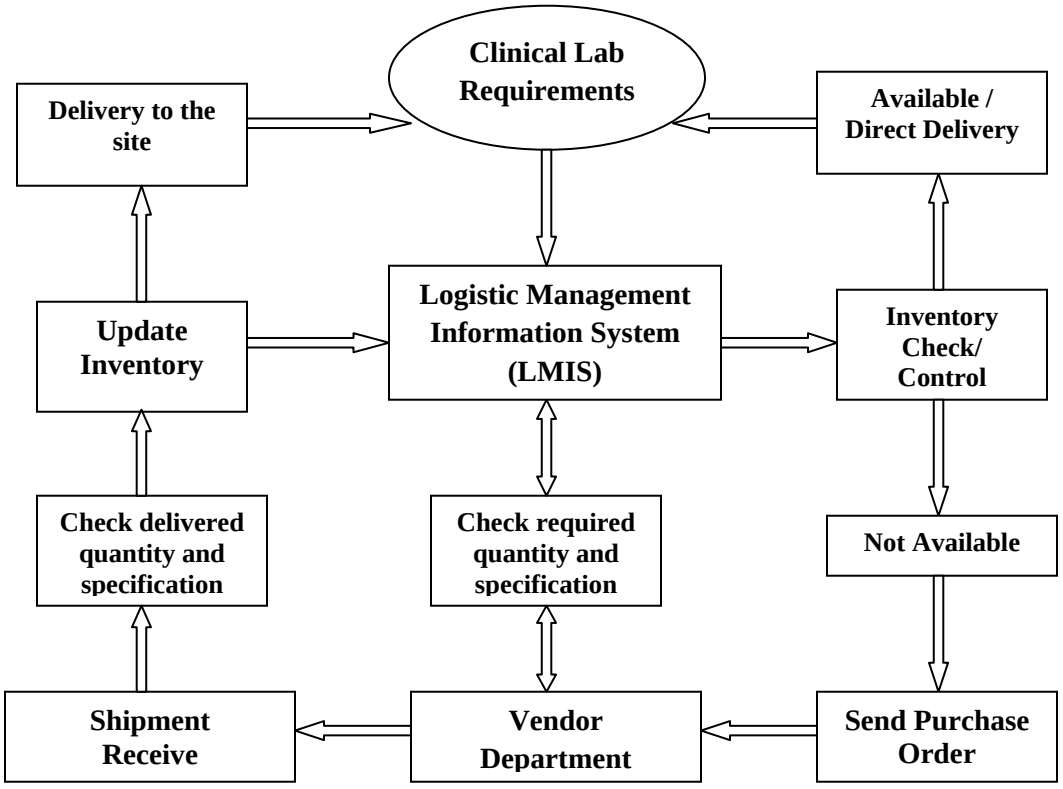

Figure 1: Supply Chain Management in Clinical Laboratories

III. Discussion

Management and utilization of collected data by logistic management information system (LMIS) enables the staff to calculate the desired quantity on hand (DQOH) and the reorder point (ROP) for each supplied material. Indeed, DQOH can be determined by reviewing the previous purchase history of each supplied material coupled with an understanding of the time needed for new supply material to arrive on the correct time (lead time). While, ROP can be determined by taking into the account the usage and consumption rate of each supplied material [4]. Practically,lead time is a critical issue regarding supply chain management. Therefore, it is recommended to utilize the principle of safety stock in supply chain to avoid any unexpected delay of supplied materials that allow sustainable work flow of clinical laboratories. Therefore, the proposed LMIS suggests that order should be placed when supply level reach ROP, and the quantity of ordered materials should cover at least the difference between quantity on hand (QOH) anddesired quantity on hand (DQOH). Consequently, LMIS can generate purchase order (PO) automatically based on the previous information about the supplied materials. However, the quantity of supplied materials within the (PO) can be edited and modified to increase or decrease the order quantity. In addition to that, tracking lot numbers and expiration dates can be achieved by LMIS when the shipped materials received. For each supply material, the quantity, lot numbers and expiration dates can be entered to the LMIS. Furthermore, query wizard reports are the main source of collected information about supply. Filling up these reports can cover all data about materials including cost of stock report, lot numbers, inventory, ROP, purchase history reports, vendor details and any other unique specification.Enabling accurate and rapid retrieving of information about any supplied material. On the other hand, supply contracts setting up the relation between manufacturer or their local agents and the buyers, specifying the prices, quality, delivery lead time and the returns. Also, distributing strategies playing an essential role in reducing the cost of storage and transportation of supplied materials. Enabling the decision makers of clinical laboratories to chose direct shipment to the point of usage or to the main storage.

Recently, the growing popularity of electronic business and web based applications are significantly moved the traditional supply chain of clinical laboratories into automated or electronic version. The implemented technologies of information system is a key component in successful supply chain management and enable to deploy capabilities to enhance quality management and reduce the cost and the risk related to supplied materials in clinical laboratories. One of the most common information system used in automated supply chain management is Radio frequency identification (RFID) which is referred to identification and tracking of supplied materials using radio waves. RFID is an automatic identification solution that can identify and acquired data of supplied materials to improve effective information flow within the supply chain and improve quality control through the supply chain [5]. In addition to that, RFID system provide the staff with an access to the collected data to perform real time monitoring, tracing and control the work flow during each phase of supply chain [6]. In parallel to that, RFID can be combined with Internet of Things (IoT) applications to provide automatic tracing capability over web based network [7]. Work flow management of supply chain in clinical laboratories is mainly depending on the understanding of national laboratories network and the guidelines of national healthcare system.

The successful management of supply chain aims to increase efficiency and productivity in clinical laboratory. It has been focused in three main phases including; planning phase, implementation phase and monitoring phase.

- Planning Phase:

All clinical laboratories, weather governmental or privet facilities have limited resources that must be used in the most efficient manners. Planning phase significantly provides critical information to develop required management system that allocates all available resources. Assessments of available supply chain and laboratory services provided are a key point of planning phase which provides the decision making and procurement process with required technical information about selection of supplied materials, delivery time quantity, price and the location. After that, quantification process of laboratory requirements including reagents, durables materials and consumables are made, followed by forecasting that projects the quantity of requirements to meet the future needs based on collected data from the clinical laboratories field. Finally, budgeting to estimate the cost of forecasting supplied materials including any required training or maintenance is performed to compare available resources with required supply, modification of supply quantity can be made to meet the available funds, as well as, increasing fund is possible to meet the requirements.

- Implementation Phase:

Implementation of procurement process has to be consider according to the collected information of the previous phase, especially quantification and forecasting. Product specification is the essential issue at the phase, where standard and technical specification should be developed to all laboratory products including disposable, test kits, reagents, equipment, and durables materials. Also, specifications have to meet the correct quantity of requirements and technical attributes, and ensure the best quality with best cost. Pre-selection of supplier to determine the open versus limited sourcing for supplied materials can be performed during bidding stage according to the national health regulations. Finally, training and maintenance requirements should be specified previously and implemented at this phase. Prevented and corrective maintenance for laboratory equipments must be achieved according to regular schedules.

- Monitoring and Evaluating Phase:

Many indicators should be monitored and evaluated during the management of supply chain in clinical laboratories. Firstly, supplier performance during the supply chain should be evaluated and continuously monitored to ensure correct delivery time, quality, price, inventory control, and customer services. In addition to that, post market surveillance is an important role to determine product quality after utilization in clinical laboratories and assess end users feedback. Furthermore, lot testing can be performed to validate the quality of supplied materials especially before consignment is released to distribution. Also, samples of lot can be tested at different interval through the year to ensure continuous monitoring of quality. The below diagram shows the workflow at each phase of clinical laboratories supply chain.

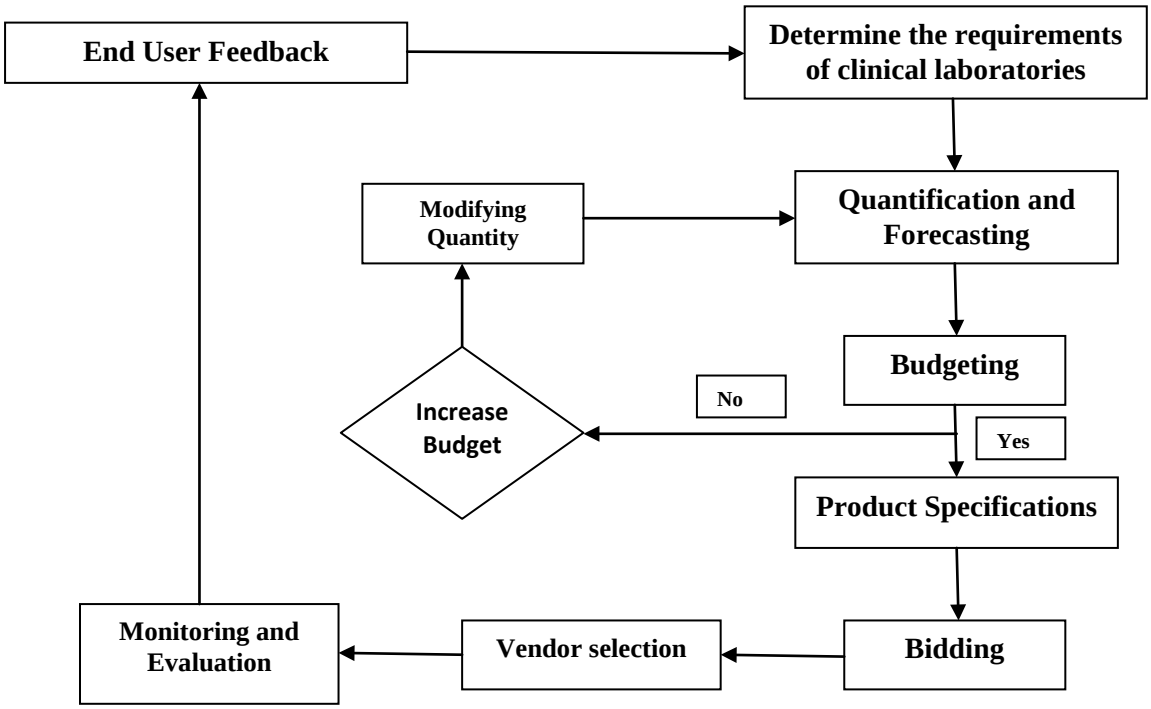

Figure 2: Supply Chain Phases

IV. Conclusion

The management of supply chain in clinical laboratories is a critical issue regarding different parameters that have involved during the process. Management of DQOH, ROP, QOH, PO, lead time, inventory stock can be achieved by computerized system deals with collected information at each phase of supply chain and prompts accurate decision making to ensure sustainable supply for clinical laboratories. Our suggested model of Logistic Management Information System (LMIS) aims to reduce cost and time needed to deliver clinical laboratories requirements. As well as, ensure accurate delivery time, best quality of supplied materials and perfect distribution of materials between laboratories and stock inventory. In addition to that, the development and improvement of electronic supply chain based on using of automated identification system such as RFID coupled with web applications or IoT facilitate optimal utilization and retrieving of collected data, and enhance continues monitoring and evaluation of logistic supply chain. Finally, management of supply chain is a continuous strategic process that cannot be achieved in isolated steps, but it should be performed as a sustainable operation for clinical laboratories.

References

1. Chapman JT. Computerized Material Management, Inventory Control, and Purchase Orders in the Clinical Laboratory. Amer Clin Lab. 1999; 18:14-15.
2. Thomas A, Davis SE. Controlling Laboratory Costs is as Easy as ABC. Amer J Med Technol. 1979; 45:50-52.

3. Weinstein W, Wenk RE. Hospital Laboratory Inventory Management. Clin Lab Med. 1985; 5:753-760.
4. Arnold JRT. Introduction to Materials Management. 3rd ed., New Jersey: Prentice Hall, 1998.
5. Hsu, C. and Wallace, W., 2007. An industrial network flow information integration model for supply chain management and intelligent transportation. Enterprise Information Systems, 1 (3), 327–351.
6. Mousavi, A., et al., 2005. Tracking and traceability solution using a novel material handling system. Innovative Food Science and Emerging Technologies, 6 (1), 91–105.
7. Yan, B. and Huang, G., 2009. Supply chain information transmission based on RFID and Internet of Things. In: Proceedings of 2009 ISECS International Colloquium on Computing, Communication, Control, and Management, 8–9 August, Sanya, China, Los Alamitos, CA: IEEE, 166–169.