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Supply Chain Management »» in the Clinical Laboratory

ABSTRACT: Between 15 and 45 percent of a clinical laboratory's operating budget is spent on supplies. Given the size of this expenditure, laboratory managers must pay close attention to the supply chain and develop effective strategies to manage their inventory. Areas that need analysis include the carrying cost of supplies, the cost to generate a purchase order, methods to efficiently count supplies on hand, processes to ensure that lot number items are used before their expiration, and detailed analysis of the inventory. At the University of California-San Francisco Medical Center, we investigated options to manage our inventory and implemented a computerized system. The system required modifications to existing practices, which initially seemed unwieldy. However, after a relatively short learning curve, the improvement to operations has been significant, with a reduction in wasted reagents, fewer staff hours used to count supplies, and the ability to provide prompt analysis of the inventory for audits and discussions with administration. Focusing on the supply chain has allowed us to reduce inventory expenses by approximately 8 percent, reduce waste, given us a more focused understanding of our operations, and provided us with the ability to analyze our inventory easily.

In terms of supply and demand, the clinical laboratory has limited control. Test ordering is driven by patient volume and individual physician determination of the type and frequency of laboratory tests that need to be performed.¹⁻³ Variations in the number of patients and/or acuity may significantly alter the test volume performed by the laboratory. As such, laboratories must be prepared to handle a range of test volume at all times. Ideally, this requires that the laboratory manager ensure that sufficient levels of all supplies are always available. In reality, however, insufficient levels of some supplies are inevitable to prevent the overstocking of supplies due to expiration dates, limited storage space, the possibility that a supply item will be outmoded before use, and the commitment of funds necessary for excess supplies that may be needed for other operations. To ensure an optimum level of supplies that meet the testing demands, laboratory managers must focus on inventory management, which includes the reduction of supply expenses.¹⁻³

Supply expenses represent a significant portion of the operating budget of the clinical laboratory; published estimates range from 15 to 45 percent.⁴⁻⁶ At the University of California-San Francisco (UCSF), supplies account for 26 percent of the clinical laboratory's operating budget.

Given the amount of the budget dedicated to supplies, it is prudent for managers to focus on supply management. While having sufficient supplies on hand is necessary to conduct requested patient tests, careful inventory management has been shown in studies to yield supply expense savings of more than 10 percent.^{5,7,8}

In 1979, Thomas and Davis introduced the concept of supply management in the clinical laboratory.⁶ Other descriptions of inventory management projects in laboratories followed, as did peer organization and regulatory agency descriptions of inventory management.^{4,5,8-13} Some of the studies focused

on cardiac catheterization laboratories, others on research laboratories, and others on clinical laboratories, but all describe the positive results gained from an increased focus on supply management. For laboratories accredited through the College of American Pathologists (CAP), a checklist question addresses the need for an inventory management system.¹² The Clinical Laboratory Sciences Institute (CLSI) has produced an approved guideline that describes the basic implementation of an inventory management system.¹³

Many businesses outside of the clinical laboratory have organized and routine supply management systems in place that address the availability, quantity, cost, and distribution of supplies. This process is generally referred to as “supply chain management.” Supply chain management involves the complete circuit of production, distribution, and usage of supplies. This circuit generally includes raw materials, manufacturers, distributors, and the end user. Figure 1 illustrates a simplified supply chain that may be applied to the clinical laboratory. An understanding of the supply chain and a focus on managing the acquisition, storage, and monitoring of supplies are important areas for improvement in the operational efficiency and financial performance of the clinical laboratory.

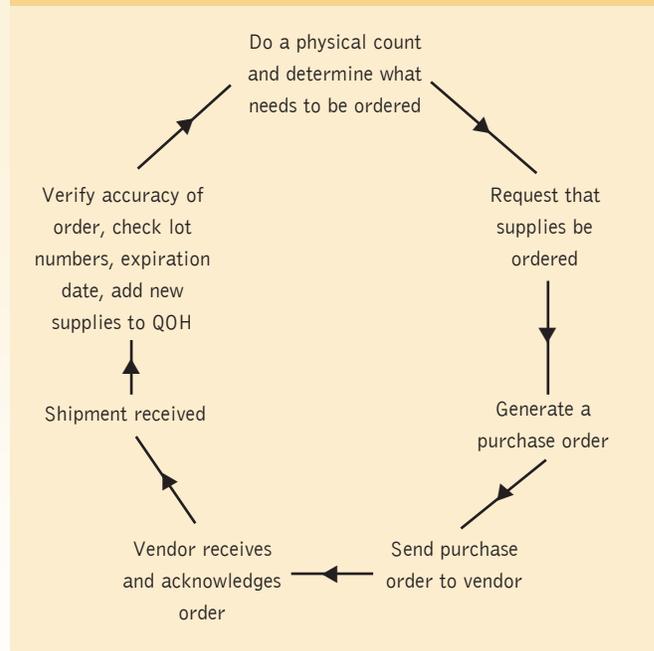
Supply Consumption and Distribution

The clinical laboratory’s typical inventory includes a variety of items, including disposables (gloves, tubes, gauze, and tourniquets), bulk chemicals (saline, hydrochloric acid, and bleach), and individual reagents and reagent kits. The patient testing workload, which can be unpredictable at times, is the primary factor affecting the consumption of supplies. An unpredictable workload, in combination with factors such as delivery delays, back-order problems with a vendor or distributor, and unacceptable performance of a shipment or new lot, dictates that sufficient in-stock levels of all supplies be maintained. However, overstocking of supplies may be wasteful and expensive. Standard material management stresses the importance of reducing on-hand supply costs (called the “carrying cost”).¹⁴

Careful oversight of the supply chain may help to reduce these costs and ensure that sufficient supplies are on hand and used before their expiration date, that purchase orders are generated in a timely fashion, that supplies distributed to off-site locations are properly tracked, and that inquiry and analysis of the processes may be performed as needed.

To efficiently manage supplies, it is critical to determine the optimum quantity of supplies to be kept on hand, as

FIGURE 1
SUPPLY CHAIN MANAGEMENT CIRCUIT



well as the most effective reorder times. In order to determine these values, a number of parameters must be quantified, including:

- The rate at which the supply is used
- The lead time to order and receive the supply
- The availability and cost of storage space
- Unique characteristics such as expiration date or the need to use a specific lot

Initial determination of these values is most often conducted through trial and error. With experience, most laboratory managers can devise an efficient ordering system. However, pinpointing the ideal supply chain is a complicated process.

Evaluating the Past

At UCSF, we implemented computerized inventory management in a portion of our laboratories in 1998. In early 2005, we set about evaluating our supply chain across all sections of the laboratory in order to better understand our ordering patterns, evaluate the quantity of supplies on hand, calculate our supply wastage, and determine the

labor requirements for managing our supply chain. To complete this analysis, we assembled the following:

- Lists of all supplies used with vendor name, catalog number, unit of measure, price, storage location, etc.
- Purchase history of each supply
- Estimates of supply wastage
- Unique characteristics of each supply, such as a short expiration date or the need for one lot over a long-time period

Using these data, we calculated a Desired Quantity on Hand (DQOH) and a Reorder Point (ROP) for each supply. The DQOH was determined by reviewing the purchase history of each supply coupled with an understanding of the time required for new supplies to arrive (lead time). The ROP was determined by taking into account the usage of each supply and the lead time necessary. The ROP included a "safety stock" to cover unexpected delays that would allow us to continue to be able to perform required testing in case of emergency. The use of a DQOH and ROP — often recommended by material management professionals — is termed the Min-Max System.¹⁴ The Min-Max System suggests that an order should be placed when supply levels reach their ROP and that the quantity ordered should be the difference between the quantity on hand (QOH) and the DQOH.

At UCSF, we assisted in the initial design and evaluation of a computerized material management system called InvMan (COVE Laboratory Software, Sonoma, CA). The system was set up to manage and report on the clinical laboratory's inventory, purchase orders, and equipment.

Putting Theory Into Use

Our Chemistry, Immunology and Molecular Diagnostics sections stock and use more than 1,840 different supplies from more than 172 vendors. The value of the representative QOH for these three sections is approximately \$550,000. To determine if we could improve our supply management practices in Chemistry, Immunology, and Molecular Diagnostics, we sought to address five specific tasks:

- Wherever possible, expedite and automate the physical count of the inventory
- Rapidly and accurately generate Purchase Orders
- Track lot numbers and expiration dates upon receipt of a shipment

- Analyze our inventory and purchase history with objective, data-driven reports

- Identify and coordinate the provision of supplies to off-site locations

Wherever Possible, Expedite and Automate the Physical Count of the Inventory

We use both a semi-automatic and a manual method for counting our in-stock inventory. The semi-automated system uses bar code labels produced by the software program and a portable bar code scanner. At weekly intervals, a laboratory technician scans the supply labels and uploads the data to the software program. This data may be used to compute a new QOH or can be deducted from (or added to) our supply quantities. Our supplies, which are infrequently used and generally stocked at low levels, are counted manually without the use of the bar code scanner. We group them onto a Worklist that has the supplies organized by storage location, which assists the staff in ensuring that all supplies are counted at an indicated frequency.

Generating Purchase Orders

Because all supplies have a DQOH and a ROP, and the physical count of the inventory determines the QOH, the Purchase Order (PO) process is semi-automatic. The software generates the PO for any supply that is at or below the ROP. The computer time to produce this PO is less than 5 seconds, even when the number of supplies to be ordered is quite large. This PO is sometimes edited as we increase or decrease an order quantity or we anticipate a need for a supply that is not reflected by the DQOH and ROP data.

Tracking Lot Numbers and Expiration Dates

In the past, we had instances when, unbeknownst to the supervisor, a lot was about to expire. In addition, when notices from a vendor were received informing us of a performance problem with a specific lot number, the review of worksheets to determine if we had received the lot in question was time consuming and error prone. Using our computerized material management application, we now enter the lot number and expiration date when the shipment is received. For each supply received, we enter the quantity, lot number, and expiration date. The system displays a table when we log on that shows which supplies are set to expire within a user-selected number of days. Because the lot number, date of receipt, and expiration date are all maintained in the system for each supply, retrieving information about a specific lot number through our computer application is rapid and accurate.

Reports

Part of the drawback with a manual or in-house spreadsheet/database system is the inability to rapidly analyze the

inventory, PO, and other portions of the supply chain. The software package provides more than 25 reports, along with a query wizard. The basic reports cover all of the data, with reports such as the Cost of Stock Report, Items at ROP, Lot Number Report, and Vendor Details Report. We use the Item Purchase History Report to calculate the routine use of each supply, which is then used to set the DQOH and ROP. The Query Wizard has been useful in helping to create unique searches of the database such as “list all items stored in the cold room that cost >\$5,000 and are at a QOH >5.”

Providing Supplies to Off-Site Locations

The clinical laboratory provides supplies to our phlebotomy stations and manages point-of-care testing. The software has allowed us to enter remote sites — which are termed “Ancillary Sites” — and creates packing lists of supplies whenever the site needs replenishment. These packing lists may be easily reviewed to audit supplies provided to locations away from the central laboratory.

For each Ancillary Site, we create a unique list of typically-needed supplies. Whenever a site requires additional supplies, that list is modified and a date-specific list of supplies and necessary quantities are created. The packing list is then used to assemble the supplies. The software application reviews supply usage periodically to ensure that they are being ordered and shipped in a cost-appropriate manner.

Conclusion

The management of supplies, POs, and equipment is critical to the operation of the clinical laboratory. Our facility’s emphasis on material management and the implementation of a structured computerized system have allowed us to focus on each area of the supply chain, as diagrammed in Figure 1. Our material management application has reduced the time needed to manually count inventory, as well as the time required to generate purchase orders.

At the start, assembling the details required by the software application seemed unwieldy and onerous. However, once these data were collected and entered into the application, we recognized an almost immediate benefit by centralizing our supply data. This, along with the use of bar-coded supplies and worklists for counting of the inventory, allowed us to transfer some of our inventory management duties from Clinical Laboratory Scientists (CLSs) to unlicensed personnel. In addition, we have seen a reduction in the time necessary to count our inventory, determine what needs to be ordered, report on usage, and identify those supplies close to expiration. These improvements have

allowed our CLSs to perform other duties, such as patient testing. For the Chemistry, Immunology, and Molecular Diagnostics sections, we estimate that we have gained approximately five hours per week of staff time that may be used for other purposes in the laboratory.

Overall, we have seen approximately an 8 percent reduction in our QOH (from \$550,000 to \$506,000) due to improved management of our supply chain. We also identified products that were routinely overstocked and reduced them to an appropriate DQOH. Additionally, we uncovered a few instances over a six-month period when we had supplies that consistently became outdated before their use — overall wastage was more than \$6,500 per year. The active tracking of lot numbers and reporting of expiration dates is expected to eliminate that wastage.

In conclusion, we found that the implementation of a computerized supply management system has helped us organize all of our supply, vendor, storage location, PO, and equipment data. We have been able to respond more rapidly and accurately to inquiries for information related to our inventory, purchase order activity, and supply usage. This system has proven to be effective and has allowed us to make significant improvements to our material management system with a net savings in operating expenses.

Disclosure

The author serves as a paid consultant to COVE Laboratory Software.

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