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Reducing costs in the clinical laboratory through waste reduction

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REDUCING COSTS IN THE CLINICAL LABORATORY THROUGH WASTE REDUCTION

by

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ABSTRACT

This AMDR analyzes alternatives to reduce costs in the clinical laboratory through waste reduction. As a prior employee of a large clinical laboratory, the researcher is seeking ways to reduce costs in the clinical laboratory while maintaining quality of service offered to physicians and patients.

The scope of this report focuses on how costs can be reduced by eliminating or reducing waste. The waste of the laboratory will be considered to be both waste of work time and waste of supplies and equipment.

The alternatives to be considered will include waste reduction within the laboratory information system, supplies and equipment, quality assurance, test selection, employee staffing and employee retention. Each of these alternatives will provide some cost reduction by eliminating waste. The researcher will identify the alternative which will provide the greatest cost reduction in the shortest period of time.

The researcher has shown that concentrating on cost reduction methods which involve personnel staffing and retention is the best alternative at this time. The highest costs in the laboratory budget are those related to personnel salary and benefits. The ability to efficiently

staff and retain qualified personnel demonstrates the greatest cost reduction through the elimination of continued and duplicated training.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

REDUCING COSTS IN THE CLINICAL LABORATORY THROUGH WASTE REDUCTION

Introduction

For many years clinical laboratories operated with minimal cost restraints. Such factors as technological development, increasing labor costs, and state-of-the-art capital equipment purchases escalated the cost of laboratory service. These increasing costs were accepted as part of the operating expenses and were passed on to the patient or absorbed by the insurance company. This method of operation, however, was soon to change because of several important influences.

In 1983 the federal government, through legislation, changed the method of payment to health care providers. This Federal Legislation forced health care institutions to examine their methods of operation. In addition, the introduction of health maintenance organizations and additional changes in Medicare effected the realization that cost containment had to become a top priority for health care managers.

No longer was the health care provider, including the laboratory, able to charge the price it determined was warranted and receive that amount from the payor. Instead, the outside governing organization determined what they

would pay for the treatment of a patient with a particular diagnosis at the time of admission to the hospital. This method of payment is known as diagnostic related groups (DRGS). Under this method of payment, the federal government determines the amount of money it will pay for a particular hospital admission. If the providers are able to treat and release patients at a cost less than the DRG payments, they make money. If it costs more to treat Medicare patients than the DRG payments, the health care provider loses money.

This change in the external environment has changed the management concerns in health care. There continues to be a commitment to quality of service, but cost containment has become an equal concern. Since health care in general and laboratory medicine specifically is a service industry, the techniques successfully used in other service industries have an application in the clinical laboratory. These methods can be used to improve and maintain quality while reducing costs through waste reduction in a clinical laboratory.

HISTORY AND BACKGROUND

The first laboratory test of clinical significance was the blood sugar determination, developed by researchers Folin and Wu in 1919. In 1922, additional research produced the discovery of insulin. It was ascertained that insulin

would control the level of blood sugar. This demonstrates a use of the clinical laboratory service and the information it generates. For example, it is of little value to be able to test blood for sugar if there is no ability to control or utilize the information. Elevated blood sugar indicated a disease state. If the blood sugar level has been determined to be elevated, insulin can be administered to the patient to lower the blood sugar level. The blood is then tested to monitor the level of blood sugar. The laboratory information becomes a valuable tool to the physician treating a patient. Present day clinical laboratories provide test result to physicians to assist in diagnosis, treatment, and prognosis of disease.

From the introduction of the first clinical laboratory test in 1919 until the mid 1940s, individual laboratories, researchers, and scientists operated independently of each other (Cembrowski and Carey 1989). In 1946 the introduction of external proficiency testing introduced a desire to insure similar results by different laboratories. The testing involved a sample being submitted to various laboratories for analysis. This sample was of a known value to the testing agency. The reported values from the participating laboratories were compared to the known value. The desired response is to receive values from the laboratories which are equal to or close to the known value, which indicates the testing accuracy of the participating

laboratory. This is done to assure that test results done by different laboratories produce similar results. Accuracy is important to the physician who uses results from different laboratories.

Initially, participation in proficiency testing was voluntary. Its goals included self-improvement and education. This voluntary component was changed with the enactment of Medicare regulations in 1966 and the Clinical Laboratory Improvement Act (CLIA) in 1967. These acts made federal reimbursement for testing contingent upon acceptable scores in federally approved proficiency testing programs. Because much of the reimbursement is regulated by these Federal Agencies, it was necessary for a laboratory to become a participant in a federally approved proficiency testing program. In 1988 the Center for Disease Control and The Health Care Financing Administration implemented internal changes to update the proficiency testing process. It remains a requirement for clinical laboratories to belong to the testing program. The laboratory pays a fee to participate in the testing programs.

In addition to a program which incorporates the comparison of laboratories, statistical quality control is also governed within a laboratory. This process uses the methods of standard deviation and regression analysis. Quality control most commonly is understood as the

statistical comparison of laboratory results. Material of a known value is analyzed in conjunction with patient samples. The values of the known material must be statistically within a predetermined range. This range is usually two standard deviations. If the control material is within this control range, the patient sample results are reported. This assumes that if the test material value is within the control range, the accompanying patient samples are correctly evaluated.

Every procedure in the laboratory is monitored by a statistical control procedure. The purpose of these quality control procedures is to detect potential problems. If a problem is detected, the testing process is stopped. The problem is investigated, remedied, and the process is restarted. The patient results which were being processed when the problem was detected are reanalyzed to ensure the quality of the results. This concept of quality control was introduced in the 1950s, and over the years, has become more sophisticated and computerized.

To demonstrate a laboratory's proficiency, accreditation by the College of American Pathologists is desired by clinical laboratories. This organization parallels the federally approved regulations. The American Society of Clinical Pathologists also certifies individuals as meeting the criteria to successfully work in a clinical

laboratory. This accreditation, in addition to proficiency testing and statistical comparison, are the foundation for quality clinical testing.

A model for laboratory operations was introduced nearly thirty years ago by A.V. Frigenbaum (Westgard and Barry 1989). It is described as the agreed, organization-wide, detailed operating work structure of technical, scientific, and managerial procedures for guiding and coordinating the actions of humanism, equipment and information to the institution in the best and most practical ways to assure patient and physician satisfaction at reasonable cost. This is a broader description of quality control than what is usually considered in health care laboratories.
This broader definition introduced by A.V. Feigenbaum includes quality definition and evaluation, quality planning, purchasing material evaluation, product control and evaluation, special process studies, information feedback, information equipment, training, and organization wide quality control and waste reduction.

MISSION AND STRATEGY OF THE CLINICAL LABORATORY

The practice of clinical laboratory medicine is essential to patient care. The College of American Pathologists describes the purpose of the clinical laboratory service to include, but not be limited to, the examination of clinical specimens, interpretation,

consultation, appropriate scientific investigation and education in the prevention, recognition, diagnosis and treatment of disease. Such services shall be available to meet the needs of patients and their physicians. Specific functions shall include the proper identification, collection, transportation, storage, processing and examination of clinical specimens with subsequent reporting of results.

The mission of the clinical laboratory is to aid in patient care by providing laboratory service to physicians. The laboratory views its service to include all functions from the physician ordering the appropriate test to reporting the result. Patients benefit from laboratory service primarily through their physicians. The laboratory does not directly serve each patient. An order from a physician is required to perform a laboratory test. Even if the result of a test is reported directly to a patient, he or she seldom has the resources to understand the result. Medications and treatments need to be ordered and monitored by a physician.

The laboratory strategy must therefore be to serve the physician. In view of the external environment changes, it is now also appropriate to add the objective of cost containment to this strategy.

MARKET DESCRIPTION

Historically, the clinical laboratory was a department within a hospital or clinic. Its services were available to affiliated physicians, and the laboratory was staffed by employees of the facility. These employees completed all laboratory testing by using the facility's equipment. Today however, a new independent laboratory service has become available. The independent laboratory is located outside of the hospital facility and it provides laboratory service to many physicians both locally and nationally.

Independent laboratories range in size from small local operations to large national corporations. Examples of large independent laboratories include Mayo Medical Laboratory and Smith-Kline Laboratories. These laboratories provide a total laboratory service which includes all laboratory tests. A local independent laboratory, CBC Clinical laboratories, has an ever increasing market in performing drug testing for employers in addition to the routine lab procedures it performs.

Because medical technology is advancing so rapidly, it is difficult for any facility to provide all lab tests available. Hospitals and clinics which have an internal laboratory often supplement their services by utilizing independents. For example, a hospital laboratory may provide only routine testing for its medical staff. Tests

which are infrequently requested may be discontinued by the hospital laboratory, and, when needed, sent to an independent laboratory for analysis. In this way the hospital laboratory is able to provide the needed information without the additional expense of seldom used equipment, reagents, and trained personnel to perform the test. By contrast, the independent lab can serve the needs of many facilities by gathering enough samples to warrant performing a specific test at a reasonable cost. The independent lab serves a segment of the laboratory market.

In the past, a community hospital laboratory would provide testing for the hospital patients and affiliated physicians would send patients to this laboratory for their laboratory work. This work generated revenue for the hospital. Now, however, physicians' offices provide some laboratory testing or collect of specimens from patients and forward them to an independent laboratory. The patient no longer is referred to the hospital laboratory. Although this practice decreases the hospital test volume and revenue it increases the market share for the independent laboratory. The physician also benefits because the physician's office collects a service charge for collecting and processing the specimens forwarded to the independent laboratory. An additional advantage afforded to the physician's office is that this outpatient testing, is not reimbursed through the payment method. This allows the

provider of outpatient testing control in determining what it will charge of its service.

The October 12, 1989 NBC Nightly News reported that 45 percent of independent laboratories are physician owned. Independent laboratories, on an average, charge three times more than hospital laboratories. Physicians refer their patients to laboratories they have ownership in, thereby controlling the market distribution. The physician has the ability to control the ordering of the test as well as where the testing will be done. In fact, a medical secretary testifying before Congress reported that the physician she worked for never ordered a brain scan on a patient in the first five years of her employment. After he became a shareholder in a radiology group, he ordered five brain scans through that particular radiology group during the first month of his ownership. Although a brain scan is not laboratory procedure, this same practice has occurred in laboratory test ordering.

Laboratory testing revenues exceed ten billion dollars a year. All providers of laboratory testing compete to gain business by providing quality testing and service to the physician. It has become a fiercely competitive industry, with a potential for high earnings. This can be obtained through effective management with dedication to quality and cost containment.

The following are the approximate number of tests and revenue produced by selected medical tests performed in hospitals and doctor's offices in 1987 (Ruffenach, 1989).

TABLE 1 NUMBER OF TESTS PERFORMED

Medical test	Number of times performed (in millions)	Total revenue (in billions)
urinalysis	200	$ 3.0
blood Cholesterol	200	3.0
blood chemistry profile	100	4.2
blood count	100	2.0
chest x-ray	42	2.7
pap test	40	.8
electrocardiogram	25	1.2
stress test ekg	5	1.0

This information illustrates the large number of test procedures completed and the total revenue generated.

The manager of a clinical laboratory must develop a marketing strategy to obtain and maintain customers. Marketing strategy is composed of several interrelated elements (Corey, 1978). The first element is market selection. The laboratory must decide what market it chooses to serve. To accomplish this, the laboratory manager and pathologist decide on a product package which benefits the physician. This would include the range of services, their availability, technical assistance, sales financing arrangements, and the reciprocal relationship that develops between the laboratory and physician. Secondly, the strategy needs to include what services will be offered. A method must also be developed for telling physicians about the service. Finally, pricing is an important element of the marketing strategy. Price structure is simply establishing the price at which the service will be sold. This strategy may include quantity discounts. This is a method of pricing under which a unit price is reduced as the number of units ordered increases. Another method of pricing is functional discounting. This allows the seller, the laboratory, to offer different prices to different groups of buyers physicians. An example of functional discounting in the laboratory market is offering a physician's office laboratory one price for its service, a hospital laboratory paying a different price for the service, and a company's employee health service paying yet a different price. The pricing strategy to be decided upon

can be a single method of pricing or a mix of several pricing methods.

Because of the competitiveness of the clinical laboratory industry, laboratory management must consider the concept of "the customer is king" in order to grow and profit. The customer is king concept states that the customer must be viewed as the most important part of a business (Harrington, 1987). The physician is not dependent on a laboratory, but the laboratory is dependent on the physician. Customers are a necessary part of a profitable business, not outsiders to it. They deserve courteous and attentive treatment. Customers are the lifeblood of this and every other business. Without customers there is no business, and we can never forget it. Customers are not only discouraged by the price of a service, they are discouraged by apathy, carelessness, and discourtesy. There is much to gain by recognizing that the customer is king. Although patients benefit from quality laboratory service, the physician is the true customer of the laboratory. The pathologist and laboratory manager must jointly work to meet the needs of the physician.

FINANCIAL INFORMATION

The financial position of any business must be continually monitored by its managers. This monitoring allows managers to evaluate the present position of the

business, compare the present position of the business to its established goals, plan for change and take corrective action. This is particularly important for health care institutions in general and laboratory service in particular.

Health care providers' income is derived from a number of sources. Patients pay for the services they receive through private insurance, medicare and medicaid reimbursement and personal funds. In a pay for service situation, a patient is billed for the service they receive. The insurance carrier pays the amount as outlined by the insurance contract. If there is a difference the patient is responsible for the remaining payment in most cases.

Medicare is the federal health care insurance program for people age 65 and older and for the disabled. Medicare reimbursement pays, on average 79 percent of the billed charges (Ruffenbach, 1989). Medicaid is a federal-state program that helps pay for health care for the needy, aged, blind, disabled and low income families with children. Medicaid reimbursement pays, on average, 59 percent of the billed charges (Ruffenbach, 1989). Since patients who receive Medicaid, and some who receive Medicare are often unable to pay the remaining charges, the health care facility only recovers the payment that Medicare or Medicaid contribute. In 1983, the federal government established the

hospital prospective payment system. The system which uses diagnostic-related groups, DRG's, establishes a flat rate payment for the treatment of each diagnosis, regardless of the actual cost or length of a patient's stay. The promise is that patients with similar conditions require similar care and use the same amount of hospital resources. If the payment for a DRG exceeds the hospitals actual cost, the hospital makes a profit. If the costs exceed the flat payment, the hospital absorbs the loss. This DRG payment system only applies to inpatient care and treatment. This reimbursement system serves as an incentive for hospitals to limit the length of a stay for a Medicare or Medicaid patient and to reduce costs of the Medicare program and eliminate duplicate services.

Although not welcomed by the governing agencies, many hospitals have instituted a method of cost shifting which limits the effect of this prospective payment system. Because the DRG reimbursements only apply to inpatient care, the shift is to increase outpatient diagnostic testing and overall care. This is demonstrated in the Table II illustrating the number of services provided by St. Joseph's Community Hospital of West Bend, Wisconsin. Between 1988 and 1989 the only two categories which experienced a decrease in percentage of use are admissions and laboratory tests. Hospital revenues are increased if the hospital can

provide the ancillary care for a patient without the added costs of an admission and physically caring for the patient.

TABLE 2 St. Joseph's Community Hospital

West Bend, WI 53095

NUMBERS OF SERVICES PROVIDED

	1988	1989	% change
Admissions	4130	3956	- 4%
Physical Therapy Treatments	27,974	28,998	+ 4%
X-Ray Exams	24,178	26,762	+ 11%
CT Scans	1547	1591	+ 3%
Ultrasound Exams	2738	3114	+ 14%
Outpatient Surgery	4702	5355	+ 14%
Prescriptions	70,631	79,880	+ 13%
Laboratory Tests	339,378	279,021	- 18%
Nuclear Medicine Scans	747	964	+ 30%
Respiratory Therapy	29,887	36,287	+ 21%
Emergency Room Visits	9,645	10,300	+ 7%
Total registered Outpatients	41,874	45,192	+ 8%

This table demonstrates increases in all areas of the hospital except laboratory tests and admissions.

By treating the patient on an outpatient basis, the facility is able to lower the administrative costs of admitting the patient, nursing care, laundry, food, and overall physical housing and care of the patient. The hospital also has more control over the charges billed to an outpatient because the hospital is not bound to the DRG reimbursement allowed by the prospective payment system. This is important because the hospital benefits are twofold. The hospital is able to reduce costs through the absence of the labor intensive physical care required by some inpatients. The hospital also increases revenue through the charges for diagnostic tests and treatment without the control of the external governing organization. The hospital is able to increase income by reducing costs and increasing revenue, if the OP revenue and cost savings exceed the loss of inpatient revenue. For this reason, the trend is to do as many tests and treatments on an outpatient basis as possible.

The number of admissions between 1988 and 1989 decreased by four percent, yet every other category except laboratory tests increased. Especially noteworthy in Table 1 is the comparison between total registered outpatients and admissions. Admissions decreased from 4130 to 3956 between 1988 and 1989. During this same period of time, the number of registered outpatients increased from 41,874 to 45,192. This increase in outpatients in need of services also is

reflected in the increase in each service category except the laboratory. Many physicians' office laboratories now provide testing services and the patient does not need to go to the hospital laboratory for testing.

Tables three and four demonstrate the current sources of income and expenses for a representative hospital. Laboratory service is included within the ancillary service section. In the future as cost shifting continues, it is expected that the ancillary service to outpatients will increase. This will aid in decreasing cost while continuing to provide the needed service and treatment to patients.

St. Joseph Community Hospital

West Bend, WI

Table 3

INCOME INFORMATION FOR 1989

Total Income	$16,852,244
Ancillary service charges to outpatients	5,591,045
Daily room charges to inpatients	3,671,900
Ancillary service to inpatients	7,589,299
Total Operating Expenses	$15,711,244
Salaries and Employee benefits	9,007,265
Medical and surgical supplies	3,934,281
Depreciation and interest	836,079
Medical fees	774,695
Drugs	434,301
Food	167,497
Utilities	346,924
Repairs	210,202

St. Joseph's Community Hospital
West Bend, WI 53095

INCOME STATEMENT

Table 4

Fiscal year ending	6-30-89	6-30-88
Income		
Nursing care, meals, & general services	$ 3,671,900	$ 3,074,722
Specialized ancillary service (Includes laboratory service)	7,589,299	6,012,290
Outpatient & emergency patient billings	5,591,045	3,920,356
Allowances & adjustments	460,185	(699,653
Other operating income	586,725	582,790
Total operating income	16,978,784	14,289,811
Expenses		
Salaries, wages & employee benefits	$ 9,007,265	$ 8,297,775
Food, medical & surgical supplies & other expenses	6,703,979	5,683,171
Total operating expense	15,711,244	13,980,946
Net Operating Income	$ 1,267,540	$ 308,865
Non-Operating Income	246,304	227,890
Net surplus for debt retirement, purchases of equipment, & expansion of facilities	$ 1,513,844	$ 536,755

There is a total operating income increase of nineteen percent from 1988 to 1989. This increase can be attributed to the increase of services to both inpatients and outpatients.

ANALYSIS OF THE PROBLEM

Medical science has the ability to diagnose and treat many medical conditions. The cost of test research and development and testing continues to escalate. The costs include the research costs, the cost of equipment and supplies and the cost of trained personnel to perform the laboratory testing.

All efforts must be directed at maintaining the quality of testing with a conscious effort of reducing the cost of laboratory service. One consideration involves whose responsibility is the reduction of waste in the clinical laboratory. Can one laboratory manager be responsible for the waste reduction of a laboratory, or is it the responsibility of the entire laboratory staff? Is the quality of testing only the test result, or does it expand to the testing which is ordered, the specimen collection, testing, and reporting of results. Each employee can only be responsible for the task they actually perform. Laboratory data must be accurate and secure within the information system. Managers need to evaluate users of the system to minimize transcription errors.

The suppliers of chemicals and equipment must be sensitive to the needs of the laboratory as well as to provide quality products. Laboratory tests cannot be

performed if the supplies are not available. In addition to the supplies being available, laboratory equipment must be operational to ensure test availability.

A contributor to the cost of laboratory service is the utilization of the personnel. In large laboratories it is common to differentiate the laboratory into sections which do similar testing. To improve the overall productivity of the personnel and encourage an entire laboratory philosophy, managers must utilize the laboratory personnel in the most efficient way to meet the laboratory goals.

Laboratory managers must evaluate the service they provide and how to provide this service with regard to lowering costs. Considerations need to include efficient use of personnel to provide testing without duplication, quality supplies and equipment at a reasonable cost, quality control procedures which meet regulations, and information systems which ensure correctness and confidentiality.

The technology is available in health care to do remarkable things. The costs of these procedures and testing becomes the barrier between the service and those who would benefit from it. Reimbursement programs, insurance and personal payment cannot keep pace with the escalating costs of health care which includes laboratory service. Costs must be contained through waste reduction in

time, personnel and supplies to continue to provide a laboratory service which aids in patient care.

ALTERNATE SOLUTIONS

Laboratory Information System

One aspect of providing laboratory service is to convey the laboratory results to those who use the results. The correct and effective dissemination of information is a part of the total quality of the laboratory service. Most laboratories utilize an information system. It would appear that once the information system was in place and operational, the cost would be known. There are daily performance costs connected to the information system. Effective managers recognize that all areas of the laboratory can strive to improve the quality of their service and in the process reduce costs.

Computer errors can be attributed to computer system malfunctions, operator error, or tampering. Once a computer error is recognized, the correction is made. To minimize further mistakes the origin of the error needs to be identified. Of the possible areas of error the most difficult and costly to remedy is of operator error.

Because of the nature of the laboratory in part, and the hospital as a whole, there is a need for multiple terminals which access the laboratory information system twenty four hours each day. The medical staff and medical records personnel only need to read the information. All

the terminals are the same and technical access codes are easily attainable. Although the medical staff and medical records personnel do not need to access the information system inputs, it is easy for them to accomplish this. All technical laboratory personnel are assigned a three digit number from 001 to 150. This allows them to access the laboratory information system inputs. There is no control system to insure that you use the number assigned to you. If you choose to use a number other than the one assigned to you, you may or may not know who the number is assigned to.

The problem develops when errors are attributed to operator error and there is no assurance the access number used was used by the authorized person. It is important to know if one operator is making numerous and careless errors so that the individual can be counseled in the use and importance of the information system.

There are numerous ways of authorizing use of a multiple user computer system (Zmud, 1983). In a hospital situation the two factors of greatest importance are to insure correctness and confidentiality. Passwords are a common first line method of identifying an authorized user. Passwords may be any combination of alphabetic and numeric characters. Other tests of identity include the use of keys, signatures, fingerprints, hand geometry, voice prints and retinal signature. For the laboratory purposes of

insuring confidentiality and correctness a password system which afforded secure use of a personal word would be sufficient. The user needs to be confident that they alone have the ability to use their personal password. Before an individual can evaluate a persons use of the computer system they must be able to validate who the user is. This is important because errors in result reporting are expensive to correct.

When a user of clinical data suspects an error in a laboratory result they telephone the laboratory. A laboratory employee takes the call and records the possible error. They first investigate by obtaining the worksheet which was completed with the testing process. It is from this worksheet that the result is originally entered into the computer. If a transcription error has occurred, it will be recognized at this point.

Time studies indicated that the average time spent in the initial phone call and identification of a transcription error is six minutes. To delete the error from the computer and enter and verify the correct result is indicated by time studies to take an average of three minutes. The final activity to correct a transcription error is to credit the account for the incorrect test result. This also takes on average three minutes. In total the time spent in correcting the transcription error is eleven minutes of

laboratory personnel time. Based on an average salary of $16.00/hour, which includes benefit costs, each transcription error cost $2.97.

Cost of Correcting a Transcription Error

Initial phone call and identification of transcription error	*6 minutes x .27 = 1.62*
Delete error, reorder test and enter and verify result	*3 minutes x .27 = .81*
Credit and patient account for the incorrect test result	*3 minutes x .27 = .81*
total	*11 minutes x .27 = $2.97*

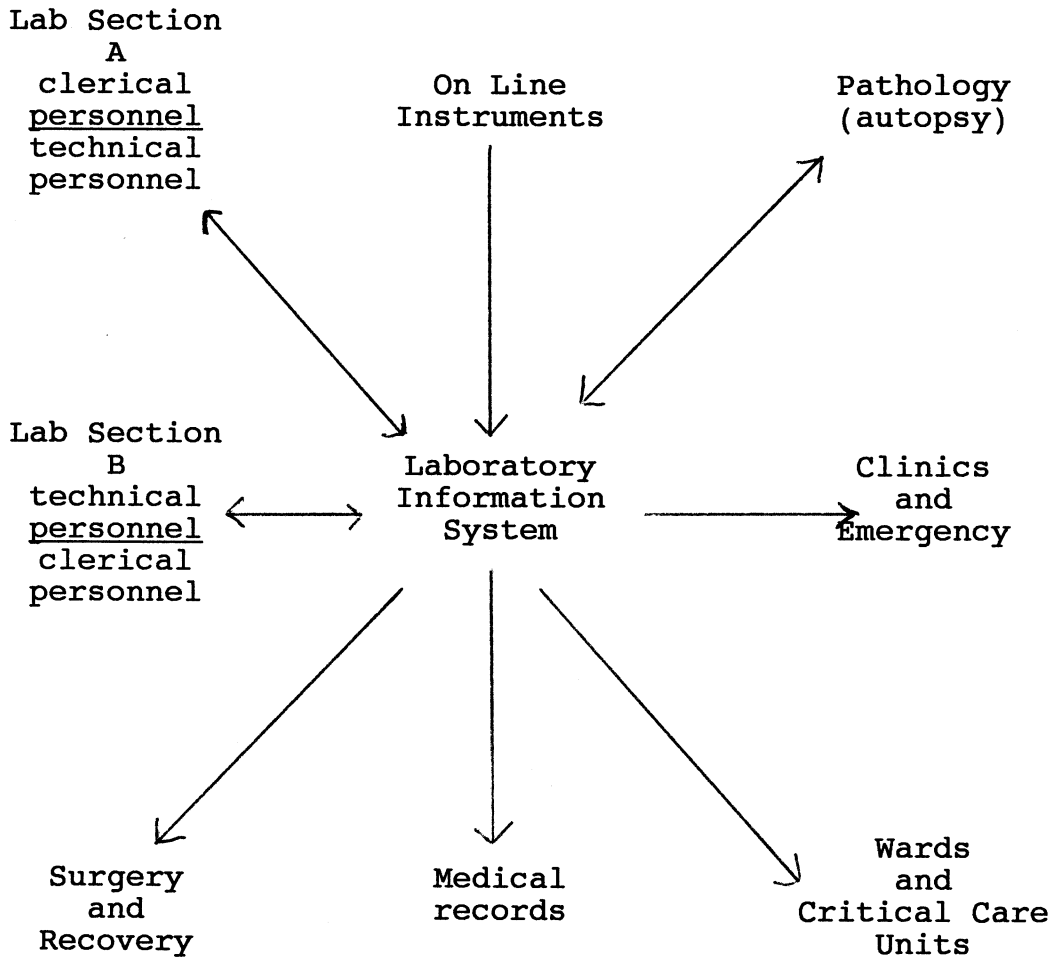
For example, St. Joseph's Community Hospital in West Bend, Wisconsin performed 279,021 laboratory procedures in 1989. If transcriptions errors occurred at a rate of 2%, this would result in 5,580 errors and an annual cost of $16,562 to correct the errors. The ability of a manager to monitor and lower this rate would result in a cost savings.

The information system, which reports the laboratory results, is one step of the clinical testing process. The quality of every step must be maintained or the total quality of the laboratory is diminished. To monitor the performance of those using the system, the manager must be able to identify with a degree of certainty, which individuals are using the system and at what level of proficiency. Secure passwords would allow for additional

controls and assessment of the information systems use and areas to reduce costs.

Figure 1

Pictorial Systems Model of the Laboratory Information System



SUPPLIES AND EQUIPMENT

Quality supplies and equipment are essential for the operation of the clinical laboratory. The primary purpose for maintaining an inventory of laboratory supplies is to guard against compromising patient care by possibly extending a patient's hospital stay or delaying treatment of surgery because chemicals and supplies are not available on demand (Noel and Snyder, 1990). Inventory management has two components. The first component is to have the materials to perform the laboratory tests when they are needed. The second component is to purchase the supplies and chemicals when it is most advantageous in terms of quantity, price and delivery.

The cost of obtaining supplies includes the purchase price of a unit, the cost of placing a purchase order, and the carrying cost of maintaining the inventory. These associated expenses are second only to payroll expense in the total laboratory budget. The ability of a laboratory manager to maintain the quality of laboratory service and reduce supply costs aids in the cost containment of the entire laboratory.

The laboratory must maintain its inventory of supplies and equipment. Different methods of forecasting can be used to predict the demand for lab supplies. These forecasting methods include moving average, exponential smoothing, and

linear regression analysis. All of these methods are based on statistical averages of historical supply use over a number of review periods. The moving average methods predicts demand for the current ordering period by calculating the simple average of use for a chosen number of review periods. The term "moving" indicates that as the next review period occurs, the oldest review period is eliminated from the average. This maintains the same number of review periods in each average. This technique is good for forecasting items with a stable usage.

Exponential smoothing is a calculation of weighted average, with the most recent period assigned the greatest weight. This is followed by an exponential decrease of the weight for each preceding period. This method is beneficial in forecasting items with variable usage trends.

Linear-regression analysis calculates a demand forecast based on the slope and intercept of a "best fit" usage line. This method is also most beneficial in forecasting items with variable usage trends.

The method of forecasting chosen by a lab manager includes the managers preference, the type of item being ordered, and the amount of safety stock the laboratory maintains. The supplies must be available to provide the testing the physicians expect. The same forecasting methods

do not necessarily apply for all items. For example, test tubes are used throughout the laboratory. Test tubes are available in different sizes and do not have a limited shelf-life. If a laboratory runs out of one size, another size can most often be substituted and testing can continue. Also, because there is no specific storage requirement, if there is an excess from one review period it can be used during the next review period. In contrast, sheep blood cells are used for several procedures in the laboratory. There is no substitute for sheep blood cells. When the cells are not available the testing which requires them cannot be done. Sheep blood cells also have a short shelf-life and require special storage. If the sheep cells are not available, it can limit the availability of a test. This can compromise the quality of service the laboratory provides. If a laboratory order is in excess of the usage and the cells are not used before the expiration date, they must be discarded. This expense becomes waste. All industries attempt to reduce cost by minimizing waste. The objective of the lab manager is to use a forecasting method which will provide the necessary supplies at the right time and also reduce costs. These methods can differ for each laboratory item and section of the laboratory.

After the anticipated amount of an item is forecast, the manager must then incorporate the ordering costs and carrying cost to determine the total inventory cost.

Ordering costs include expenses such as stationery, postage, order preparation, accounting, inventory review, receiving, inspection and warehousing. Carrying costs are the cost associated with holding supplies in inventory from the time an item is purchased until it is used. These costs include tests and insurance related to inventory, rental or depreciation of space and materials devoted to inventory, security, maintenance, interest, and obsolescence of supplies due to excess and outdating and opportunity cost.

Ordering costs and carrying costs are opposing pressures in inventory management. Ordering costs decrease per unit as the size of an order increases in units. Carrying costs per unit increase as the size of the order increases. The challenge a manager faces is to minimize ordering costs by placing fewer orders while minimizing carrying costs by keeping inventories as low as possible. One method of determining this optimum balance is to calculate the economic order quantity for an item. This is determined by considering the total relevant cost to include the carrying and ordering costs.

This is represented by the equation:

$$\textit{Economic Order Quantity} = \sqrt{\frac{2DP}{IC}}$$

D = demand (annual usage in units)

P = purchasing cost (cost in dollars of placing an order, industry average = $37.00)

I = inventory cost (annual carrying cost expressed as a percent of inventory cost, industry average = 25%)

C = cost per unit

From this equation, it is demonstrated that the optimum order size increases as the annual usage or ordering costs increase. The optimum order size will also increase when the inventory cost or cost per unit decreases. By utilizing this equation, the laboratory manager can order appropriately to reduce costs.

QUALITY ASSURANCE

Quality assurance commonly is understood in health care laboratories to be statistical quality assurance or statistical process control. Total quality assurance includes good policies, procedures, processes, and people to provide a quality testing service. No amount of control, assurance, improvement of planning can make up for the lack of quality practices as the foundation for achieving quality in routine operations. This improved quality and co-operation can also decrease cost by reducing duplication of services which can be considered a type of waste.

Laboratory testing is a complex process. After a physician orders a test procedure a series of events occurs. This begins with the transcription of the order and ends with the receipt of the test result by the physician. After the test is ordered, the specimen is collected, labeled, and transported to the laboratory. The specimen is prepared and tested, and the results are reported to the physician. A problem in any of the steps can cause errors or delays in the result reaching the physician.

Based on the number of individuals involved and the procedures which must be accomplished from a test being ordered to a test result being reported, quality assurance is not a single individual or several individuals responsibility but everyones. This is not only true in the

clinical laboratory, but in business in general. John R. Opel, past president of IBM Corporation, stated,

> "Quality is not the exclusive province of engineering, or for that matter, services, marketing, or administration. Quality is truly everyone's job. Each function, each individual in IBM must assume the responsibility for a defect-free operation."

To achieve this total quality commitment, managers must solicit the involvement and commitment of the employees, (Reid, 1989). A quality policy commits each employee to provide the customer with quality service, on schedule which includes not only the end service delivered to the physician but also in co-operation with other employees within the laboratory.

For example, the laboratory is often perceived as a single entity, but often operates as separate sections with a common goal of providing laboratory service to the physician. Each section can be viewed as a production task group (Szilagyi and Wallace, 1987). The hematology section works at hematology tasks, the chemistry section works at chemistry tasks, and so forth for each section. These individual sections interact as groups within the organizational design of the laboratory. There is often conflict between different sections of the laboratory as well as conflict between the shifts within a section. The conflict most often arises from the perception that each

section or group is the busiest or the most responsible, and the others are less productive or less responsible.

An example of a common problem is when a patient sample must be shared by several sections, of the laboratory. A sample is drawn from a patient during the third shift. The blood sample is taken to the central laboratory where the initial testing is done. Later in the day, during first shift, another section realizes that they have not received a sample for testing that should have been sent from the central laboratory. The first shift section calls the main laboratory in an attempt to locate the sample. A first shift employee in the main laboratory takes the call and attempts to find the sample. This transaction involved three separate groups. Each group believed that the other group had not acted responsibly. It is a common and cost effective practice for different shifts and departments to share samples and utilize results from other sections. This sharing eliminates the need to have someone recollect an reprocess a specimen. This interdependence of groups can best be classified as reciprocal. Reciprocal interdependence is when there is a high degree of interdependence among groups with an exchange of inputs and outputs. Group conflict among these groups decreases the productivity of the laboratory as a whole. It also increases the tension between the individuals who communicate between sections.

Uncooperative work behavior increases cost by repetition of duties and the use of additional supplies. To reduce this waste before dysfunctional consequences affect the organization performance, a conflict resolution strategy can be implemented. The confrontation strategy of mutual personnel exchange presents a possible solution to the conflict among these groups. This can be implemented by utilizing personnel from different shifts or sections to cover the overtime that is often available. Instead of working in their usual department for an additional day, the individual would work the overtime shift in another department or a shift other than their customary shift. This mutual exchange of personnel would aid in learning about the other group. Often overtime is welcomed by the employees and they are willing to accept assignment to other areas and shifts for overtime pay. When they return to their original group, the individual will have some understanding of the others problems and how to better interact with each group.

Because all groups will experience both incoming and outgoing personnel for the overtime shifts, there will be an increased exchange of information. Knowledge and an understanding of the other groups and individuals that comprise those groups can lead to decreased conflict and increased cooperation between them. This improved co-operation improves the total quality of service of the

laboratory. Also personnel costs can be reduced. The improved performance level will be reflected in reduced personnel and salary costs.

For example, the ability to reduce the staff by one half of a full time position would provide a savings of $16,640 per year. This is based on the average salary of $16.00/hour and one thousand forty work hours. One thousand work hours is the equivalent of one half of a full time position.

Dr. Joseph M. Juran and Dr. Armand V. Feigenbaum have worked extensively in the field of quality assurance (Westgard and Barry, 1989). Dr. Juran describes quality as the conduct of operations to assure that quality goals are met under routine operating conditions. Improvement is the process for breaking through to new levels of performance, achieving distinctly superior performance to what was achieved in the past. Quality planning is the preparation to meet quality goals with the end result being the development of a process capable of meeting these goals under routine operations.

Quality planning and quality goals are examples of the experience and methods of quality assurance described and utilized in industry. Laboratory managers have not looked to these methods because they believed the clinical

laboratory was different. These lab managers believed that lessons learned elsewhere could not be applied in health care. Only recently have laboratory managers begun to recognize that they have a fundamental commonality with other industries. All organizations are people who must accomplish the mission of their organization. While organizations may differ in the goods and services they provide, they share the same problems in managing resources to accomplish a mission. Managing quality is about managing an organization, to accomplish its mission, whatever that mission may be (Westgard, and Barry 1989).

Harley-Davidson is an example of a company able to rebuild based on industrial quality systems. At Harley-Davidson, they say that if something doesn't relate to improving quality, they aren't going to do it. This is a focus that everyone in the company can understand and relate to. Harley-Davidson has utilized its people in accomplishing its improved quality and securing its very survival.

One way improved quality was accomplished was through employee involvement. Improved quality builds on the premise that quality and waste reduction within an organization is everyone's responsibility. The following nine "musts" for successful employee involvement are from

the Harley-Davidson Employee Involvement Manual (Reid, 1987).

1. Management, through its words and actions, must demonstrate that continuous improvement of quality and efficiency is a way of life, not just another "program".

2. Management must be firmly committed to the people-building philosophy, that is, the belief that employees are thinking rational human beings and therefore should be encouraged to develope and grow.

3. All management must be totally committed to the employee involvement system and by demonstrating that commitment fosters a mutual trust between employees and management.

4. Employees must be thoroughly trained in specific problem-solving and waste reduction techniques.

5. Managers must encourage participation from everyone.

6. Employees must be given responsibility and authority for production, waste reduction, preventive maintenance, and other aspects of their jobs.

7. Individual employees must help each other develop and grow.

8. Employees must attack problems, not each other, that is, there must not be finger pointing when things go wrong.

9. Creativity must continuously be encouraged through a free, non-threatening atmosphere.

These same concepts have a function in the operation of the clinical laboratory. Laboratory managers must recognize that they are similar to other companies and industries and examine methods which have succeeded for others. Some modifications may be necessary to implement a concept from one industry to another, but in principle the concepts share a common function and goal to reduce waste and reduce costs.

TEST SELECTION

Laboratory medicine has the capacity to provide a variety of test procedures. There are approximately 900 different lab tests which can be performed on blood alone. Before a test can be offered to the clinical staff a number of criteria must be met. The required chemicals must be purchased and the necessary equipment must be available to do the test. The chemicals and equipment must be obtained and may require payment even before the test is available for use. Quality control material must be obtained to run with each testing procedure. These chemicals and controls have a limited shelf life. If they are not utilized within the designated time they must be discarded. This potential waste increases the overall cost. The laboratory must participate in a proficiency program which monitors the test results for each procedure. Normal values must be established for the new test procedure, and personnel must be trained to perform the test. All of these criteria must be met before a test can be offered and all generate costs.

The volume of the tests performed must justify the costs of offering the test. When a test is seldom requested the fixed cost of doing the test is applied to a fewer number of tests. For example, the cost of proficiency testing of a procedure remains the same if the laboratory performs 1 test or 100,000 tests. Proficiency testing costs are high if a laboratory only analyzes a minimum number of

samples. The cost of a proficiency test program ranges from $500 to $1000 per procedure per year.

For example, if the proficiency testing cost to the laboratory is $500, this cost is applied to the number of tests done annually. If one laboratory performs 500 tests per year the cost of the proficiency testing is one dollar per test. If a second laboratory performs fifty tests per year, the proficiency testing cost is ten dollars per test. Based on the information that all other testing costs equal ten dollars, the first laboratory has a total cost of eleven dollars. The second laboratory has a total cost of twenty dollars. The usual and customary insurance reimbursement for this test may be nineteen dollars. The first laboratory will realize a surplus of nine dollars. The second laboratory will realize a loss of one dollar per test.

Laboratory managers are faced with a difficult decision in choosing what tests to offer. It is unrealistic for a laboratory to attempt to offer all the lab tests available to medical science. Even large medical facilities, such as the Milwaukee County Medical Complex, utilizes outside laboratory services to complement the testing done within the facility.

Test selection is one way to control the cost of laboratory testing. In addition to cost, availability of

outside testing and the needs of the clinical staff are considerations in selecting the tests a laboratory will offer. These needs must be closely monitored as the needs of the clinical staff change. The pathologist plays an important role in working with the clinical staff to offer the required tests.

Laboratories which are part of a facility face a different problem than independent laboratories. These internal laboratories must work closely with the clinical physicians to develope the test requirement needs. Independent laboratories can examine their test selection by using the techniques of market selection.

Market selection is the determination by an organization of what markets it will serve with what products (Corey,1978). The first decision in market selection is targeting a market segment. This is a decision independent laboratories need to make. The first consideration of selecting a market is that the organizations broad goals and those of the market segment under consideration are compatible. The organization and the potential market segment ideally would have similar goals and philosophies to complement their mutual growth. This would include quality and types of laboratory testing.

Secondly, organization would need to evaluate the strengths and weaknesses of its competitors and which segment of the market they serve. Each organization needs to evaluate the possibility of acquiring a significant share of the market, or to focus on a small portion of the market which would not directly compete with other organizations.

The last consideration is to evaluate whether the demand for the service provided is growing, remaining constant, or declining? Is this trend true of the entire service, or is there a portion of what the organization does that is growing, another remaining constant, and yet another declining. All of this information is valuable in planning what the organization will do, and for whom they will do it.

Planning the product line is a key element in a business marketing strategy. The product line is not a fixed entity, but a variable one. Considerations important in planning a product line include the ability of the product line to allow the seller to serve a customers needs profitably. A laboratory, either internal or independent, cannot continue unless it at least meets its expenses. Profits in independent laboratories, and surplus income in nonprofit and internal laboratories, are necessary for retirement of debt, purchasing equipment and expanding and improving facilities.

Product planning and market selection are usually decided together. Managers begin by identifying a customer need which is not being satisfied, a new technical development which offers improved testing, or an opportunity to improve on an already existing test or service. Managers then identify which customers will need the service and developer a strategy to bring the two together. This completes the market and product selection process.

LABORATORY STAFFING

Medical technologists are the individuals who perform the laboratory testing. A recent national survey indicated that seventy percent of laboratory managers reported having trouble filling staff medial technology positions (Castleberry, Kuby, and Bryant, 1989). The survey also reported that there was a national vacancy rate for staff medical technologists of 9.3%, meaning that about one in every ten budgeted medical technologist positions were vacant. This vacancy rate was determined by the equation:

$$\frac{\text{number of full time equivalent (FTE) positions filled}}{\text{number of budgeted FTE}}$$

One way of reducing waste in recruitment and to meet the fluctuating needs of medical technology staffing is to incorporate temporary technologists. Virtually unheard of a decade ago, temporary medical technologists are becoming an important part of the clinical laboratory.

Temporaries help fill manpower needs more efficiently because laboratory managers can staff according to need at a particular time. Laboratory managers can call on temporaries when the workload is at a peak, during vacation periods of the permanent staff, for special projects, and when situations warrant individuals with special skills. This allows the lab manager maximum flexibility in work

assignments while maintaining the permanent staff at cost effective levels.

Utilizing temporary workers is also a cost effective way to audition potential permanent workers. It is not unusual for temporary workers to consider permanent employment if a good opportunity presents itself. A temporary assignment is beneficial both from the employee and employers perspective. This extended interview allows the temporary worker to demonstrate knowledge and skills and performance of the tasks necessary for the position. It also allows the temporary worker the opportunity to evaluate the laboratory and assess if they would like to become a permanent part of the staff. This mutual evaluation between the laboratory manager and the temporary worker greatly increases the probability of a successful long-term employment relationship if it is not prohibited by the temporary employment contract.

Administrative costs are also reduced when temporary technologists are utilized. This is because the temporary help firms generally pay the employee and handle all paperwork associated with payroll and benefits. The laboratory manager only needs to plan for the laboratory temporary technologist needs.

Laboratory managers must monitory their own use of these outside contractors. Because the temporary technologist is only a phone call away, the laboratory manager must be careful to ensure that they are filling a real need that cannot be met by the permanent staff. Careful and efficient use of temporary staff is a means of reducing costs. To be effective in reducing costs, the use of temporary workers must be monitored and evaluated to ensure that their use results in cost reduction.

Considerations the laboratory manager must monitor include the performance of the temporary worker and the expertise of the agency which employs them. Even the most experienced technologist needs a thorough explanation of the workings of the laboratory and its functions. Initially the lab manager will need to observe the temporary worker to ensure that the procedures are followed exactly and that data is accurately gathered, analyzed, and reported. The temporary agency must be knowledgeable about the work the lab manager needs performed, as well as having a large enough pool of qualified personnel to provide an individual with the skills and experience to perform the needed tasks. To eliminate the administrative costs to the laboratory the agency must handle all administrative tasks including payroll, taxes, and worker's compensation insurance. The agency should also offer a guarantee which provides a

replacement if the temporary technologist was not capable of performing the required tasks.

Once the agency is chosen and the technologist reports for the assignment, the lab manager must remember that the technologist is not to be treated differently from other employees. The temporary benefits from an introduction to other workers and a brief orientation to familiarize them with laboratory procedures. In turn the laboratory will benefit both by reducing costs and providing adequate staffing to ensure performance to everyone's satisfaction.

The financial impact of the utilization of temporary employees is determined by the amount of time the temporary employee is used and how many permanent employees will not be required. The industry average annual salary is $24,000. The industry average cost of benefits is $8000. This average salary and benefit package is worth $32,000 per employee, or $16.00 per hour. The average hourly temporary agency fee is $18.00 per hour. Although the hourly amount is higher, the benefit is the ability to reduce the permanent staff and overtime hours. This concept is to maintain a minimum number of permanent employees and supplement the staff with temporary workers at peak times. This differs from current staffing procedures in which the permanent staff numbers meet the personnel needs for peak

staffing. This results in a surplus of employee work hours in routine operation.

Some cost containment can be achieved by utilizing part-time permanent technologists. Part-time technologists are most often used for holiday and weekend coverage. These technologists are part of the permanent staff and afford the manager more flexibility in scheduling during periods of high volume. The part-time technologist can also contribute to the surplus of employee work hours in routine operations and are not a substitute for the use of temporary technologists.

For example, an average size laboratory will employee two full time technologists to provide coverage for vacation time, holiday time, and peak work times. This full time employment accounts for 4000 hours of employment at a cost of $64,000. The vacation, holiday, and peak work load can be accommodated with 2100 hours of temporary work hours at a cost of $37,800. This utilization of temporary workers and the reduction of the permanent staff by two, results in a cost reduction of $26,200 without reducing services.

LABORATORY RETENTION

Experienced employees are necessary for the operation of the laboratory. Temporary staff can be a productive complement to the permanent staff of the laboratory, but

temporary technologists are not a substitute for well trained, experienced, permanent employees.

Medical technologists are the individuals who perform laboratory test procedures. They are four year degree individuals who must pass a national registry examination to be certified by the American Society of Clinical Pathologists. As previously mentioned, clinical laboratories are faced with a shortage of medical technologists. This is a serious problem as health care facilities struggle to recruit and retain competent medical technologists from a dwindling resource pool. Laboratory managers must work at retaining permanent employees and reduce the cost of training new technologists.

Even though technologists are registered which certifies that they meet the qualifications to perform laboratory testing, each laboratory has procedures specific to them. There are numerous techniques and instrumentation which necessitates a period of orientation and training for a permanent employee. This can be compared to an information systems use. Most laboratories, as well as many businesses utilize an information system, yet need additional training when in a different department, company, or utilizing a new system.

The usual probationary employment period in most laboratories is six months. During this time the manager evaluates the performance of a new employee. It also takes an employee this time to become orientated to the laboratory and its operation. During this time the new employee works closely with an experienced medical technologist to learn laboratory procedures and operations. After the initial six months, it is not unusual for the new employee to take an additional six months to reach an acceptable productivity level and be able to participate in additional laboratory duties such as taking inventory, trouble shooting problems and performing routine equipment maintenance. Based on this criteria, it is considered to take one entire year before a new technologist can be considered an experienced fully contributing member of the staff.

The financial cost of developing a new employee to an experienced member of the staff is $12,000. This is based on an average annual salary of $24,000 and an overall performance level of fifty percent for the first year of employment.

The laboratory manager must reduce the waste of orientating new personnel by retaining their experienced technologists. Retention of employees can be accomplished through wage incentives, job enrichment, and advancement opportunities. Regardless of the vehicle the lab manager

uses to retain personnel, costs can be reduced by minimizing the waste associated with recruiting, hiring and training an individual only to have them leave before the laboratory benefits.

RECOMMENDATIONS

From the analysis of each alternative presented above, the researcher recommends that the laboratory implement the waste reduction alternative concentrating on laboratory staffing and retention. As demonstrated in Table 2, the total salaries and benefits expense is $9,007,265. This represents 57 percent of the total operating expense of $15,711,244. By concentrating waste reduction practices in the area of the greatest expenses the largest amount of reductions in the shortest period of time will be realized. All of the alternatives offered will provide some level of waste reduction and cost containment. It is the researchers opinion that directing the cost reduction efforts in the area of the greatest expense will provide the greatest return.

Further support for concentrating on staffing issues to provide the greatest waste reduction is demonstrated by the actual dollar amounts saved in each alternative. The cost reduction realized by the temporary staffing alternative is $26,200. This exceeds the cost reduction of the other alternatives by almost two fold. Based on the fact that personnel costs are the highest percentage of the operating expense and the illustration of cost reduction through the use of temporary workers realized the greatest savings, laboratory managers must first implement a strategy to

reduce permanent staff to an operational minimum and supplement their staffing requirements with temporary personnel.

The alternatives of waste reductions in information systems, quality assurance, and employee retention all exhibit similar cost savings. The amount of cost savings demonstrated was approximately $16,000 per year for each alternative. Although these cost reductions would be welcomed by a laboratory manager, the cost reduction of the temporary staffing alternative offers savings greater than this amount. Information systems, quality assurance, and employee retention waste reduction alternatives are similar in that they diminish waste by improving the performance of the current staff. Although these alternatives address the highest expense area, personnel, the cost reductions are not as substantial as the temporary staffing cost reduction alternative.

The alternative of reducing costs through improved inventory management can be beneficial, but not as effectively as the laboratory staffing alternative. As previously noted, inventory and equipment is the second largest expense of the laboratory after personnel costs. The greater reductions will first be realized in the area of the highest costs, namely personnel. Since the laboratory will begin with the implementation of only one alternative,

the choice of an inventory waste reduction method would be a lower priority alternative.

The alternative of reducing waste through the tests a laboratory offers goes beyond the reduction of waste to the very fundamentals of what the laboratory does and how it does it. This alternative is different from the others presented. The other alternatives address reducing costs through reducing waste while maintaining the functions and services of the laboratory. Waste reduction can be accomplished by examining and altering the tests available. This alternative can also alter the very mission and strategy of the laboratory. For this reason, the alternatives which work towards reducing waste without changing the service or mission of the laboratory are preferred.

CONCLUSION

The legislative change in 1983 which changed the method of reimbursement to health care providers has posed many problems and challenges for health care managers. For the first time lab managers needed to reduce costs while maintaining the quality of the laboratory service. Laboratories, as part of the health care system were also impacted by this new legislation. The old ways of doing things could no longer continue because of the mandated changes.

Laboratory managers do not need to design new techniques to reduce costs. They need to change their philosophy as to what role they play in the health care delivery system and to view health care as an industry similar to other service industries. Once laboratories recognize their similarity to other service industries they can draw upon the information and experience of these industries.

Laboratories have a mission and need a strategy to accomplish it. Laboratories have personnel and suppliers that they must work with. Laboratories must develope a market and provide service to that market. This is true for laboratories as well as other service industries and manufacturers. Laboratory managers can selectively borrow

techniques from industry and apply them to a laboratory setting. Although an entire program may not be transferable from one industry to another, one segment of a program may be applicable in a waste reduction program in the laboratory.

Laboratory managers can begin by familiarizing themselves with waste reduction techniques utilized in other industries. Examples of test selection, quality assurance, staffing, personnel retention, inventory method, and information systems have been examined as to their adaptability and waste reduction potential in the clinical laboratory. All of these waste reduction methods have originated in other industry. It becomes the goal of the laboratory manager to select viable alternatives which can be used in the laboratory. By selecting proven techniques that can be adapted to the laboratory, the lab manager can realize decreased costs through waste reduction.

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