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Implementing COTS and TQM Concepts in Healthcare Equipment

Glenn C. Ajero

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Submitted by

Glenn C. Ajero

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EMPA 396 Graduate Research Project in Public Management

Golden Gate University

San Francisco, California

Faculty Advisors

Dr. Joaquin Gonzalez and

Dr. Mick McGee

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Abstract

Veterans Health Administration (VHA) equipment management system relies on antiquated technology and have limited functionality to track medical equipment. Its ability to identify equipment asset is limited, which may pose risks to veteran's safety and limit VHA's cost effectiveness. This study will determine if implementing a commercial off-the-shelf technology and applying Total Quality Management (TQM) concepts will improve accountability of medical equipment within a VA medical center serving approximately 350,000 veterans situated in a large size urban community in the western United States. The investigator will use data collected from key informant interviews and surveys on the topics of commercial off-the-shelf and total quality management concepts. The result of the study may be use to promote a change in organizational policies or be use as a model for VHA to pursue this route of innovation. Consequently, this study may be used to find other means of managing equipment throughout the 152 medical centers within Veterans Health Administration.

Chapter 1 - Introduction

Imagine an average citizen is admitted to a healthcare facility for some discomfort and healthcare staffs are unable to facilitate timely admission because of a lack of equipment resources such as wheelchairs, gurneys, hospital beds or vital sign measuring equipment. These exist when a healthcare facility does not have a robust equipment management infrastructure. This occurs due to the lack of equipment accountability within a medical facility. Over the past decade, the Government Accounting Office (GAO) reported on several occasions that many of the Veterans Affair (VA) medical centers audited lacked a reliable property control database and had problems with implementation of VA inventory policies and procedures. VA needs to be doing a better job in managing and safeguarding all of its equipment resources and minimize unnecessary expenditures. VA's organizational business process and continuous use of antiquated software module in Veterans Health Information System and Technology Architecture (VistA) appears to be the source of its inefficiencies when it comes to asset accountability. An instance of a business process where it's flawed is its inability to readily identify equipment availability for use. There are times equipment is not readily available for use because the equipment is either missing or transferred to another location without the knowledge of the responsible official. Also there are occasion hospital resorts to leasing equipment because existing equipment is not functional. Depending on the lease duration, equipment rental can become expensive as compared to having readily available equipment. These kinds of equipment ranges from portable units like surgical equipment to large expensive units like Magnetic Resonance Imaging (MRI) medical equipment. Another example of inconsistent business process is the lack of planning on the part of the organization use in maximizing equipment useful life cycle. There are instances existing equipment is replaced because organization

substitute existing equipment for the sake of new or improved equipment technical capability without taking into consideration the useful life cycle of existing equipment. There's always the organizational mentality that all funding that is available before the end of fiscal year must be exhausted in fear that the organization will receive less funding for equipment in the upcoming years if current funds are not depleted. Some examples include: hospital beds, infusion pumps, laptop computers and cellular phones are routinely replaced before its useful life cycle.

Purpose of the Study:

This study focused only on the management of equipment use within a medical center on how it correlates to accountability of equipment asset in a VA medical center. The study provides an examination of the existing methodology of equipment management in a VA medical center between the current method in comparison to implementing commercial-off-the-shelf products and applying Total Quality Management concepts to improve accountability of equipment assets within the medical center. A research hypothesis for this study would implementation of COTS product and applying TQM concepts improve accountability of medical equipment within the healthcare facility.

Research Assumption:

There are two assumptions for this research study. The first assumption is several attempts have already been made in implementing COTS technology in VA regarding equipment management without success due to the poor management rollout of these system causing delays which eventually increase cost and created a budget shortfall that could no longer support funding the program for the upcoming years.

The second research assumption is that all 152 VA medical centers nationwide have a unique way of conducting their own business processes when it comes to asset management. What may

work for one VA facility may not work for the others due to many factors. Staffing issue is one factor that can influence the workload and this may vary depending on the geographic area.

Research Question:

The main research question is: Will implementing Radio Frequency Identification /Real Time Location System (RFID/RTLS) and applying Total Quality Management (TQM) concepts improve accountability of equipment assets in the VA medical center? This author is reluctant to believe that implementing COTS will be successful, as this has been tried over the past decade in attempting to implement Core Financial and Logistic System (CoreFLS) in the late years of 1990's and Finance and Logistics Integrated Technology Enterprise (FLITE) in the mid years of 2000 timeframe. Interoperability between different software systems seems to be the challenge in implementing a new technology to the VistA (existing) legacy system.

Sub-questions:

1. How will implementing RFID/RTLS and TQM, streamline the management of medical equipment? This sub-question is derived because a different business process must be adapted in implementing RFID/RTLS. Whether or not the business process will streamline the management of equipment is yet to be seen.
2. What impact will it have in organizational practices in adapting the use of RFID/RTLS and TQM? This sub-question is derived because organizational culture may change in adjusting certain TQM concepts in adapting the use of RFID/RTLS.
3. What effect will this have in providing patient care? The sub-questions above were derived from the fact that any change in the organizations current business practice will have an effect in patient care.

Background and History

The Department of Veterans Affairs (VA) operates the country's largest healthcare system with more than 1400 hospitals, nursing homes and clinics nationwide. Veterans Health Administration (VHA) provides health care services to various veteran populations including an aging veteran population and a growing number of younger veterans returning from military operations from Afghanistan and Iraq. VHA's 152 medical centers offer outpatient, residential, and inpatient services, ranging from primary care to complex specialty care, such as cardiac surgery and spinal cord injury care. In providing these health care services to veterans, clinicians at these medical centers use a variety of medical supplies and equipment, which must be appropriately managed in order to help ensure safe and cost-effective care.

A brief overview of VHA's Logistic Program Organizational Structure:

The functions carried out by VHA's logistics program include the management of medical supplies and equipment in VA Medical Centers (VAMC) inventories and the standardization of these items. At the VA headquarters level, several offices are involved in the logistics programs. VA's Office of Acquisition, Logistics and Construction develops policies related to department-wide inventory management and standardization of medical supplies and equipment. VHA's Procurement and Logistic Office develops requirements, based on VA's policies, some of which are applicable to networks and some of which are applicable to the many VAMCs. Each of the 21 Veterans Integrated Service Networks (VISN) is responsible for complying with applicable VHA requirements and ensuring compliance with VHA's requirements by the VAMCs within its network. Also, logistics department at each of the VAMC are responsible for inventory management and must comply with applicable VHA directives

A brief background of VA's business processes in the enterprise asset management:

As health information technology was adopted in the healthcare industry, particularly with the implementation of electronic health records by providers, the Veterans Health Information System and Technology Architecture (also known as VistA) information system was created and used by the Veterans Health Administration (VHA) of the Department of Veterans Affairs. VistA had its origins in the collaboration of VA clinicians and staff who capitalized on the 1970's and 1980's emerging technology capabilities and created a better informed way to serve Veterans and the Public's health. A group of clinical and Information Tech Specialist deployed locally developed computer application to enhance patient care. This made it possible for local development teams to integrate diverse applications and later evolving into VistA commencing in 1996.VistA is an electronic health record information technology system with approximately 200 program modules or application packages that share a common data store and common internal services. One specific module, the Automated Engineering Management/Medical Equipment Reporting System (AMES/MERS) will be discussed in this paper as the module used for asset management. AMES/MERS facilitates the management of information needed to effectively keep track of all medical equipment assets.

VA relies on an assortment of business systems, including those used to manage its assets and finances. As commercial of-the-shelf technology became more increasing accessible, VA has considered upgrading AMES/MERS to a more user friendly software application system. This is because AMES/MERS module in VistA has become increasingly inefficient and no longer is effective to meet mission needs. For instance, manual entry of information of equipment asset is labor-intensive and business processes are not standardized amongst other VA medical facility. Majority of the processes and systems require multiple entries of business information and result in untimely financial reporting. In addition, the lack of an integrated

financial management system has been reported as a material weakness. In order to address this material weakness and to improve stewardship and accountability over its resources, VA has been pursuing improvements in its business processes and replacement of its existing financial and asset management systems with an integrated financial management system.

In 1998, VA's first effort began to replace its financial and asset management systems, called Core Financial and Logistic System (CoreFLS). The goal of this modernization was to develop a single system to integrate the many financial and asset management systems used across the department. CoreFLS consisted of three commercial off-the-shelf software applications. Oracle Financials – this was an application for accounts receivable, accounts payable, contracts, budgeting, general ledger, and reporting enterprise planning, was used to meet financial systems requirements. This was purchased in May 2001 for $19.5 million. DynaMed – an asset and inventory management system. This was purchased in September 2001 for $12.4 million. Maximo – this was a comprehensive asset life cycle and maintenance management system. Its use is to meet asset management system requirements; it was purchased in June 2001 for $5.9 million. Following pilot tests of CoreFLS, it was determined that it did not fully support the department's operations thus terminated its development of the system. An independent technical consultant assessment determined that various deficiencies had undermined the success of the initiative in acquisition management, where there was inadequate management of extensive contractor support. In the program management, there was poor management execution and in the technical and functional issues, there were deficiencies in interfaces, data requirements and security.

In an effort to improve stewardship and accountability over its resources, VA once again work on its new financial and asset management initiative. In September 2005, Finance and

Logistics Integrated Technology Enterprise (FLITE) was introduced as to be the system that is to replace the department's legacy financial and asset management system. The overall plan for developing FLITE were: To effectively integrate and standardize financial and asset management data and processes across all VA offices; provide management with access to timely and accurate finance, budget, asset and related information on VA-wide operations as well as on specific programs and projects; establish an advance technology environment that provides the greatest capability and an extended life cycle. Though the inception of the FLITE initiative, the program has run into major setbacks from the program office. Schedule slippage, cost overruns and the lack of specificity and details to key planning documents and concept of operations to guide its efforts for all activities had cause FLITE to be derailed to include not being able to adequately fund the program for fiscal year 2008. It was determined that the preliminary life cycle cost estimate implementing FLITE for fiscal year 2006 through 2014 was at $385.7 million. An increase of almost $184 million FLITE was estimated to cost $570 million due to slippage and cost overrun.

Chapter 2 – Literature Review

The scholarly literature collected in this study is concentrated in three areas. These are: implementing COTS, RFID/RTLS application, and use of TQM related concepts on how it affects organization.

Implementing COTS:

Commercial of-the-shelf technology describes a "ready-made" product that can easily be obtained through government contracts. This is usually a computer software and/or hardware product tailored for specific uses and made available to the general public. Such products are designed to be readily available and user friendly. Scholarly reviews also indicate there are economical pros and con that can impact its use in healthcare. Majority of the literature reviews indicate RFID technology provides savings to time and costs and increased productivity. As RFID is used to track and monitor medical assets, thus preventing the theft and loss of equipment. Also since the medical equipment is tracked, doctors and nurses have easier access to the equipment and can treat patients efficiently. The result is increased staff productivity and quicker treatment for patients. This can cause a savings of $1.2 million dollars a year for a New Jersey hospital according to Health Management Technology (2013). However, this author challenges the claim that RFID saves time and cost as well as increase efficiency of the organization. This author believes the benefits reap from saving time, cost and efficiency in implementing RFID technology depends on the organization. An organization must be willing to accept and adapt to change with the implementation of RFID technology. In any industry, incentives play a role in organizational performance. In the case of healthcare industry, the main difference between private (for-profit) and public healthcare (non-profit) is that private

healthcare has a monetary incentive directly associated to ensure the implementation of RFID technology provides an immediate return-on-investment swiftly. Organizations within private healthcare industry are able perform and adapt relatively quickly to minimize losses in revenue and eventually increase its profit. On the other hand, non-profit healthcare organization must rely on other means to motivate their staff. Moreover, implementation of RFID/RTLS system is not inexpensive and therefore it should be design to take full advantage of its features and capabilities. The costs for active and passive RFID tags vary as the technology mature over the years. There is also a significant cost in purchasing tag readers and supporting backend systems as well as designing a total RFID solution. Because RFID is relatively new technology, those that could manufacture RFID components and those that would adopt the technology may be reluctant to fully implement it because of the possibilities or risk associated with any new technology and may be unwilling to invest in RFID. This is a normal risk for companies that upgrade or implement new IT systems. Companies must be able to balance long term savings over the cost of installing RFID technology.

RFID/RTLS application:

For the purpose of this study, the focus on COTS will be on Radio Frequency Identification/Real Time Location System (RFID/RTLS), how it's applicable in a healthcare environment. Scholarly work and practitioner studies revealed that there are many ways in which RFID/RTLS technology have been used in different industries. The use of RFID technology increased largely due to technological advances. The growth of RFID technology was largely due to Wal-Mart and the U.S. Department of Defense. According to Hunt & Puglia (2007), Wal-Mart started requiring their main merchandisers to tag their pallets and cases with RFID tags to allow inventory tracking at the pallet level. After this, the Department of Defense asked its main

suppliers to follow suit. Because of the size of both organizations, their requests for suppliers to use RFID created an expansion and brought it into the commercial mainstream. In the healthcare industry, RFID provides several benefits such as patient safety by eliminating medical malpractice. This author shares the same belief in that RFID technology can save a patient lives by eliminating medical negligence thus benefit patient safety. RFID/RTLS can be used for providing patient information and location rapidly to increase the accuracy of identifying the patient and the medication being prescribed for treatment. Patient information can be contained in an RFID bracelet and the patient is monitored so that the location and any medication prescribed to the patient are known. RFID can also allow for monitoring alerts due to a healthcare provider error. For instance, if surgical instruments were used during a surgical procedure, the healthcare staff could be alerted that surgical instruments may be missing at the end of a surgical procedure and thus, preventing a fatal mistake to a patient as well as prevent possibility of legal liabilities for the healthcare facility. Another benefit that RFID/RTLS technology provides is the savings to time and costs in equipment accountability and efficiency of the organization. RFID/RTLS usage to track and monitor medical equipment asset are less likely to be loss from the routine movement of all medical equipment within a healthcare facility. Since the medical equipment are track actively or passively using the RFID tags, physicians and clinicians have easier access to the equipment and can provide patient care more efficiently. The result is increase staff productivity and quicker treatment for patients. RFID/RTLS also creates an increase in efficiency by providing the ability to automate the way medical data is retrieved. Procedures that use manual processes can now be automated with the way data can be stored and captured. This also produces operational improvements in the way that patients are admitted and release from medical care.

TQM concepts:

The TQM concept for this research study will be limited and solely focus on continuous improvement and thru the use of standardization. The word, "kaizen" also known as continuous improvement, or change for the better, is the practice that focuses on the continuous innovation or reinvention of a process in manufacturing or operations. The application of kaizen in healthcare is centered in continually progressing in terms of functions that should involve everyone from the executive leadership to the lowest staff members in an organization. Kaizen is the embodiment of lean thinking and aims to eliminate waste. Protzman, Mayzel and Kerpchar (2011) stated that kaizen in itself is the idea that every employee is "contributing ideas and small improvements everyday" (p.159). Also, an important component of the kaizen idea is that supervisors and managers are given the authority to implement policies that are derived from the input of the employees, and these small ideas turn into thousands of suggestions and significant bottom-line profitability on an annual basis (Protzman, Mayzell, & Kerpchar, 2011). Furthermore, the author used the book written by Charles Kenney in 2011, titled, "Transforming Health Care" as the basis in relating continuous improvement and standardization in this research study. For an organization to succeed in implementing RFID/RTLS, all stakeholders from top to bottom must be brought to the mindset that implementing RFID/RTLS technology will enhance productivity by eliminating waste and make their job easier. After all, who in their right minds wants to work harder? The book also suggest that other continuous improvement processes may not have been embrace by all of the organization within the medical center as it was simply too difficult to modify as it takes all stakeholders to ensure it is maintained. However through the culture describe by the rigorous and consistent application of the tools and methods, all processes

and work flows at Virginia Mason Medical Center ultimately have become more efficient, resulting in higher quality care and improved patient safety. The book is relevant to this author's research as it provides a comparison on what an effective healthcare environment setting requires and how it used the concept of Total Quality Management (TQM) as a means for continuous improvement in implementing RFID/RTLS technology to transform healthcare business practices. Another TQM concept that organization can benefit in terms of RFID/RTLS implementation is the use of standardization as a proven method of simplifying processes. "Any variation in a process represents an opportunity for error (AORN Journal P. 258)." Equipment accountability in terms of business processes from the beginning of its acquisition phase to its final phase of its life cycle has many variations. If this process can be standardize in such a way that it minimize the variations thru the use or RFID/RTLS, then, equipment accountability can significantly improve. Contrary to other scholarly literature review, a journal article authored by Mosadeghrad (2013) discussed the obstacles to TQM success in healthcare systems. The journal explains why TQM in an organization fails due to an ineffective TQM organizational model and methods as well as inappropriate environment for TQM implementation within an organization. The journal article was intriguing as it provides a contrasting viewpoint of TQM as it applies to the healthcare industry. It's important to understand the factors that are likely to obstruct TQM implementation. In understanding these barriers, it increases the probability of TQM success in avoiding those barriers during TQM implementation. As a result, this provides direction and guidance in developing strategies for an effective and efficient TQM implementation. Some or all of the reasons use in the journal article may substantiate this research study on why implementing TQM concepts may not be suitable for a medical center.

Chapter 3 - Research Methodology

This research will be conducted in a qualitative design format using case study analysis to capture various data from three medical centers in the use of RFID technology and applying TQM concepts to improve accountability of medical equipment asset in a medical center. From the three medical centers observed, each healthcare facility is in a different phase in the implementation of RFID/RTLS. One facility has had RFID/RTLS installed and operating for the past three years, while the second healthcare facility is in the process having the RFID/RTLS infrastructure installed in the facility in the past 3 months. While the third facility currently does not have the RFID/RTLS technology within its facility and operating using the standardize AEMS/MERS software module of VistA for asset management.

Primary Data:

It is the intent of the case study to collect primary data from various sources to come about with a reasonable preliminary conclusion about the study. Key informant interviews within three VA medical facilities of similar size will be used to collect primary data. These key informants are in department head level positions subject matter experts in the field of logistics management and TQM concepts.

Surveys:

In addition to key informants, a survey will be sent within the logistics front-line staff who would normally be utilizing the RFID technology on a routine basis in managing equipment inventories as well as the end-users in which the medical equipment are sub-custody to the relevant areas within the medical facility. Sampling size of logistic front-line staff generally

average to three to four personnel as it may varies from each medical facility. Attempts will also be made to reach approximately twenty end-users roughly equates to 25 percent of all end-users within a medical facility.

Personal Observations:

The author had conducted an observation of how VA medical center manages its equipment through the general workflow process (figure 1 & 2) and through the use of algorithm (figure 3) while conducting annual equipment inventory which include steps in the event that equipment is either lost or missing and a Report of Survey is required.

Workflow Process

Receipt of equipment: Figure 1 provides a simplified overview on how equipment is process once it arrives from a vendor. In step #1 warehouse staff receives the equipment in the warehouse floor and reviews the invoice for accuracy. Warehouse staff prepares a template for the required information needed to input the equipment information into AEMS/MERS which then forwards the template to either Bio-Medical Engineering or Office Information & Technology (OI&T) to determine where the equipment will be utilize. In step#2 Bio-Med or OI&T provides the additional information required to the template and send the template to a property manager. In step #3 property manager then completes all the required fields into the AEMS/MERS database using the information gathered from the template. Property manager generates and issues a barcode label to warehouse staff to affix the barcode label with the equipment in order to account for the equipment. Property manager also designate the equipment to an Equipment Inventory List (EIL) to the respective department, In step#5 warehouse staff delivers the equipment to the respective department.

Turn-in/Excess Equipment: Figure 2 provides a simplified overview on how used or broken equipment is turned-in to be excess or removed from the facility. In step#1clinical or support staff will provide a written documentation notifying property manager of equipment to be turned-in. In step#2 property manager reviews the request from the clinical or support staff. If property manager deems that the equipment is unserviceable, property manager will change the status of the equipment in AEMS/MERS to indicate the equipment will no longer be active and turned-in for final disposal. If property manager deems the equipment may be serviceable, it's then forwarded to BioMed for evaluation whether or not is beyond economical repair. If the equipment is OI&T related equipment, OI&T for privacy and security reason will ensure the equipment is sanitized of all patient or personal information. In step#3 once BioMed or OI&T evaluates the equipment, it then, goes back to the property manager for final disposition. In step#4 property managers provides disposition instruction to the warehouse staff on the current location of the equipment based on the evaluation received from either BioMed or OI&T. In step#5 warehouse staff then pick-up the turned-in equipment from the clinical or service area and stage the turned-in equipment inside the warehouse for final disposition. Final disposition is contingent in making arrangement with an outside agency to pick-up used equipment. Once the equipment leaves the facility, property manager is notified by warehouse staff and property manager enters the final disposition date entry into the AMES/MERS record for accountability that the equipment has been removed from the facility equipment inventory listing.

In conducting annual inventory of equipment, a flowchart in figure 3 indicates equipment inventory timelines from the start when a property manager initiates a request from the department that it's time to conduct annual inventory. On the average, departments are given ten to twenty days in completing an Equipment Inventory List (EIL). This is dependent on the

number of line items within the EIL's. Any discrepancies associated with the inventory should be corrected within 30 days. If for some reason equipment is lost or unaccounted, the person conducting the inventory shall immediately notify the supervisor to initiate Report of Survey (ROS) documentation for the lost or missing equipment. Logistics department will review the ROS. Depending on the circumstance of the lost or missing equipment and the value, a Board of Survey (BOS) committee may be required to be assembled. Once a BOS is convened, it will review and investigate all documentation pertaining to the lost or missing equipment. Upon completion of the investigation, the chairman of the BOS will then make a recommendation to the facility Director if pecuniary liability is warranted. The Director will then make the final determination to whether or not to hold the Responsible Official accountable for the lost or missing equipment based on the investigation provided by the BOS committee. Once a decision is reached, the property manager updates the record in AMES/MERS to reflect the outcome of the lost or missing equipment. Once a ROS is initiated, the time required to complete a BOS should not be greater than 60 days. VA Handbook 7002/1 is the governing policy directive used throughout the VA for equipment accountability.

Research Question:

The main research question is: Will implementing Radio Frequency Identification /Real Time Location System (RFID/RTLS) and applying Total Quality Management (TQM) concepts improve accountability of equipment assets in the VA medical center? This author is reluctant to believe that implementing COTS will be successful, as this has been tried over the past decade with CoreFLS and FLITE as stated in the introduction of this paper. Interoperability between different software systems seems to be the challenge in implementing a new technology to the VistA (existing) system.

Research Hypothesis:

In most business practices, implementing Commercial-off-the-shelf (COTS) and applying Total Quality Management (TQM) concepts should improve accountability of medical equipment assets in VA medical center.

Independent and Dependent Variables:

The independent variable in this study is: Implementing Commercial-off-the-shelf technology system (COTS) and applying Total Quality Management (TQM) concepts. The dependent variable is: Should improve accountability of medical equipment assets. The correlation between the independent and dependent variable were captured qualitatively through primary data key informants interview and through surveys. The data was analyzed to determine if implementing RFID/RTLS and using continuous improvement processes would improve accountability of equipment asset in the VA medical center.

Operational Definitions

Commercial-off-the-shelf (COTS)

It's a term defining a non-developmental item of supply that is both commercial and sold in substantial quantities in the commercial marketplace, and that can be procured or utilized under government contract in the same precise form as available to the general public. Commercial of-the-shelf technology describes a "ready-made" product that can easily be obtained through government contracts. This is usually a computer software and/or hardware product tailored for specific uses and made available to the general public.

Total Quality Management (TQM)

This is an approach to the improvement of the provision of services based on the premise that the overwhelming majority of quality failures are the result of flaw in processes and that quality can be improved by controlling these processes. TQM replaces traditional methods of quality management based on the identification and correction of problems as they occur and requires the participation of all members of an organization in improving processes, products, services and the culture in which they work. TQM involves creation of an organizational structure for identifying and improving processes, the use of data-based statistical analysis to study processes, and the empowerment of employees to take responsibility for their own tasks in a way that encourages both continuous learning and personal responsibility. In a healthcare setting, this means a shift from an emphasis on tasks to an emphasis on outcomes of care, which provide the data.

VA Medical Center

This is an integrated health care delivery system, offering a comprehensive array of medical, surgical, rehabilitative, mental health and extended care to veterans. VA Medical Center (VAMC) provides veterans access to an extensive range of health and specialty services. VAMC are categorized according to the complexity level. This is determined on the basis of the characteristics of the patient population, clinical services offered, educational and research missions and administrative complexity. VAMC are classified into three levels with Level 1 representing the most complex facilities, Level 2 moderately complex facilities, and Level 3 the least complex facilities. Level 1 is further subdivided into categories 1A-1C.

Medical Equipment Assets

This refer to all physical medical equipment in a medical facility use by all clinical staff for the purpose of examination, diagnosis and treatment of patient's physical or mental condition.

Implementing

For the purpose of this study, implementing refers to begin to do or use, such as a plan and/or to make something active or effective by using COTS.

Accountability

This is a policy of holding public officials or other employees accountable for their actions and results. The obligation imposed by law or lawful order or regulation of an officer or other person for keeping accurate record of property, documents, or funds. The person having this obligation may or may not have actual possession of the property, documents or funds. Accountability is concerned primarily with records, while responsibility is concerned primarily with custody, care, and safekeeping. Within VA Medical Center, accountability of medical equipment assets are specified to the heads of the Department or Services, they are also known as Responsible Officials/Officers. Responsible Officials may delegate the responsibility of the management of medical equipment sub-custody within the department/services to a subordinate member within the department/service. However, delegating this responsibility does not relieve the Responsible Official as the Accountable official for the medical equipment.

Improve in accountability of medical equipment assets

For the purpose of this study, an improvement in accountability represents all Responsible Officials are in compliance in completing all scheduled medical equipment

inventory at the prescribe timeframe without delay and to ensure all required documentation in conducting an inventory is 100% in accordance with applicable directives.

Controlling for Validity:

There are potential factors that may affect the internal validity of this study. Key informant interview data where gathered from each of the three VA medical centers. Each VA medical facility is in different phases of RFID/RTLS implementation. One medical center had RFID/RTLS implemented for over couple of years, while the second medical center is in the process of acquiring and installing their hardware infrastructure and the third facility has no RFID/RTLS installed in the medical center. To control the validity, the only medical center that did not have an RFID/RTLS installed were survey to gather data to determine the organizational climate if implementing RFID/RTLS and applying continuous improvement will improve accountability in the medical center. A sample population of 60% participated in the survey. This study may have external validity of a medical center of similar size nationwide across the VA medical centers. It can be expected that other VA medical centers are soon or may also be in the process of implementing RFID/RTLS technology within their facility. Results of this study may be helpful in identifying the challenges encountered with the implementation of this technology.

Controlling for Bias:

The survey used in this study to control the bias was made to target specific sample population that have a vested interest in equipment accountability within the medical center. These individuals took on the job title of healthcare clinicians directly involved in patient care, support staff, supervisors and management that are considered responsible officers for the equipment they maintained within their department. In selecting the sample population to

conduct the survey, a fair amount of time was used to carefully review and subjectively select those individual that would more than likely provide a feedback in the survey. The survey was sent out via email and the sample population was provided one week to complete the survey. Of the 50 individuals selected to participate in the survey, twenty three individuals provided feedback to the survey within the first week and another seven individuals provided feedback upon reminding them of the importance of the survey. The remaining ten are presumed to be not available at the time the survey as there were auto email reply of their non-availability and the other ten presumably are not interested in providing any feedback to the survey even after reminding the sample population the second week thereafter.

Research Limitations:

One of the limitations of the study is the approach employed. Qualitative approach could be subjective as it only focuses on opinions and perceptions of a limited number of data that was provided. In addition the results are not tested statistically; thus interpretations were left solely to this author. The limited number of the sample population for the survey and key informant interviews put into question the validity of the results. In qualitative studies, the findings may not represent the whole population and thus findings cannot be generalized. Lastly, the lack of time is the most limiting factor in conducting this research study. The study only concentrated on one COTS, particularly, RFID/RTLS. There may be other aspect of COTS technology that may be better suited in implementing to improve overall equipment accountability in a medical center.

Chapter 4 - Results and Findings

The purpose of the study was to focus only on the management of equipment use within a medical center on how it correlates to cost-effectiveness and accountability. The study provides an examination of the existing methodology of equipment management in a VA medical center between the current method in comparison to implementing commercial-off-the-shelf products and applying Total Quality Management concepts to improve accountability of equipment assets within the medical center. A research hypothesis for this study would implementation of COTS product and applying TQM concepts improve accountability of medical equipment within the healthcare facility. The main research question is: Will implementing Radio Frequency Identification /Real Time Location System (RFID/RTLS) and applying Total Quality Management (TQM) concepts improve accountability of equipment assets in the VA medical center? Along with the main questions, sub-questions were as follows:

- How will implementing RFID/RTLS and TQM, streamline the management of medical equipment?
- What impact will it have in organizational practices in adapting the use of RFID/RTLS and TQM?
- What effect will this have in providing patient care?

A copy of the key informant interview questions is provided at Appendix A. Depending on the answers provided on one of the questions, the interview questions consisted of anywhere from 7 to 13 questions. Also, in order to get candid answers to all the interview questions, all three key informant interviews were guaranteed that the answers given would be kept strictly confidential and anonymous. The responses will only be used for the sole purpose of this research study and

not to be release in public. By keeping their identity anonymous, each key informant will be identified as subjects X, Y, and Z respectively.

Questions#1 and #2 concerned how long the subject has been employed within the medical center and their current duty/office position.

Subject X has been working for a Level 1B medical facility for 8 years and is currently the Facility Chief Logistic Officer. The medical facility does not currently have an RFID/RTLS installed in the medical center.

Subject Y has been working for a Level 1A medical facility for a little over10 years and is currently the Facility Chief Logistic Officer. The medical facility is currently in the process of acquiring RFID/RTLS technology and undergoing hardware infrastructure installation in the past 3 months.

Subject Z has been working for a Level 1A medical facility for 10 years and is currently the Acquisition & Materiel Management Section Chief and the immediate assistant to the Facility Logistic Officer. The medical facility has had RFID/RTLS technology in the past 3 years. It's one of the few medical centers selected 3 years ago for a pilot program in the implementation of RFID/RTLS in VHA.

Analysis: From this author's perceptions, two Subject X and Z have previous logistic management experience in the military, while Subject Y is very knowledgeable about Supply Chain management. All three respondents are well qualified for their current position

Question#3 asked if implementing RFID/RTLS technology could impact equipment accountability.

Subject X believes that by implementing RFID/RTLS in the medical center in the future it will add visibility of equipment and can aid patient flow. Thus reducing patient transfer times

between acuity levels in instances where equipment needs to be located. Additionally, Subject X commented that through increased security and accountability of assets, it reduces theft/loss/misplacement as well as reduced physical effort in tracking and locating equipment for inspection. In some instances, [RFID] tags can assist in ensuring proper climate parameters are maintained. Subject Y believes that by implementing RFID/RTLS in the medical center, this will help all around the medical center. It will aid in visibility of all assets particularly its usage, no wasted time chasing/locating for equipment. It will significantly change/increase accountability. A change in mind-set will have to take place and the focus will be in proactively managing assets. Subject Z believes that by implementing RFID/RTLS technology in the medical center it assisted in real time location and movement of assets throughout the facility. It also facilitates inventories by utilizing radio frequency identification to conduct quick inventory sweep of many different inventory accounts. This allows for continuous inventory updates. RTLS can be utilized to extract data that can be utilized to view usage and track maintenance.

Analysis: Subject X and Y is looking forward to the the future on the benefits of implementing RFID/RTLS and how it will increase equipment accountability. Subject Z on the other hand is already reaping the benefits of real time information RFID/RTLS in conducting equipment inventory.

Question #4 asked how implementing RFID/RTLS affect the management of equipment assets within the department or clinics.

Subject X responded real time location should reduce the level of effort in inventory and for location purpose. There is also a potential for business rules being applied to locations.

Subject Y responded, a lot easier tracking equipment asset across the spectrum.

Subject Z responded, the ability to track equipment through automation helps identify lost assets and recover them for continual use.

Analysis: All three respondents agreed using RFID/RTLS would assist other departments in tracking and recovering equipment much easier. This is especially true in many cases in which sometimes many moveable equipment such as infusion pumps, laptops are often moved from one area to another. At times frustration sets-in because clinicians would have to take extra time in trying to locate equipment that moves from one room to another room. RFID/RTLS can readily provide the visibility of equipment around the clinical areas.

Question #5 asked, how does RFID/RTLS technology impact the business process of logistics and support staffs within the agency/medical center?

Subject X responded the intended iteration at this location will assist in asset management, as well as consumable and medical device tracking from the point of storage to patient use.

Subject Y responded by being proactive in disposition and utility of equipment. Also, assist in funding/approval equipment request from the departments.

Subject Z responded, it identifies last known location and list them by inventory accounts for better visibility. Also, assets can be grouped by metric data for easy removal and replacement.

Analysis: All three respondents are already exploring ways to leverage this technology to the next level to increase efficiency in the healthcare by modifying the business process of logistics and support staffs within the medical center.

Question #6 asked how does RFID/RTLS impact the workload of clinical staff within the agency/medical center?

Subject X responded, in some instances for consumable management, the workload and complexity will increase, as two separate systems will require management. RTLS technology at

the point of care is cost prohibitive for a rollout across many commodities. In asset management, the initial rollout will be labor intensive to tag/relate equipment. Once rolled out, the physical inventory through interrogation should reduce staff effort in physical scanning.

Subject Y responded increase efficiency for clinical staff, particularly when it comes to not having to chase/locate equipment as well decrease time in conducting inventory of equipment.

Subject Z responded while RTLS facilitates visibility of data, it creates additional work maintenance. For active tags, batteries must be replaced regularly or the equipment will not be tracked. Replacing batteries is time consuming usually taking 5 minutes per tag to replace battery. There is also a requirement to ensure adequate batteries are available on hand. For passive tags, these tag can accidently be associated with the wrong asset record. The RFID frequency may capture another passive tag unintentionally. Furthermore, current RTLS system only communicates one-way to Maximo database system. If the location is updated in Maximo, the update will not be forwarded into the RTLS.

Analysis: Initial implementation and rollout of RFID/RTLS technology will definitely require staff to be train to take advantage of the benefits the technology offers. There will be a learning curve associated to overcome with the implementation of this technology. Logistics and support staff will be burden in adapting the technology to existing inventory system. Once RFID/RTLS system is running and clinicians are trained, clinician's workload will become more efficient and additional attention can be given to providing patient care.

Questions #7 & #8 relates to whether or not RFID/RTLS is installed in the agency/medical center and how long it's been installed. The answer provided by Subject Y is currently "in progress" and continues to the next question. The answer provided by Subject Z is "yes" and have been installed for the past 3 years.

Analysis: Subject Z healthcare facility is one of the few medical center that were selected as the pilot site in implementing RFID/RTLS technology in the VA before a national contract was awarded.

Question #9 asked, what ways, if any, does RFID/RTLS technology affect patient care?

Subject Y responded, RFID/RTLS affects patient care in many ways and clinician confidence is extremely high providing the care needed.

Subject Z responded, has it helps track/monitor patient elopement and wander status in two floors of the facility. Ankle bracelets are affixed to the patients and monitored at the nurses' station. The system alerts staff if the patient wanders or loiters close to an egress door. Also, monitors if patients are in other patients areas that are not allowed. Additionally, temperature and humidity monitoring captures and reports ambient temperatures to monitor indoor temperatures for spaces and temperature controlled equipment such as refrigerators and freezers for departments. Also, for recalls, it helps tracks and identifies defective items by lot number and expiration dates.

Analysis: Clinicians will no longer waste time looking for equipment. Time spent looking for equipment can now be use more efficiently to provide more attention to patient care. Also, leveraging the technology, RFID/RTLS has many other uses in the clinical environment.

Question #10 asked what challenges, if any, were encountered during the implementation of RFID/RTLS?

Subject Y responded user acceptance and operational expertise; the ability to adapt and leverage the technology. Training can be a challenge depending how well it will be absorbed. Other challenges include contractual limitations as there may be a desire to leverage the technology but road blocks exist at the national level.

Subject Z provided several challenges. RFID scanners can accidentally associate wrong RFID tags with asset record. There is not an option to disassociate manually grouped tags. Tags must be disassociated from their records one-at-a-time. Flexibility is advantageous to process several items and less time consuming. Additionally, scanners are not user friendly for a novice user. The programs are small and difficult to understand. The only way to be familiar with the scanner is to routinely use the scanner. Those who do not use the product on a daily basis will have a difficult time using the scanner. Clinicians and administrative staff are relied upon to conduct their own inventories and the difficulty in the use of equipment causes delays or manual options while accurate are not always preferable.

Analysis: Subject Y brings out a good point with regards to leveraging the technology for future expansion. Organizations are sometimes bounded by contractual limitations. Training should be address immediately even before implementing the system to preclude any problems associated with interoperability issues between the legacy and new system. On the other hand, Subject Z may have hardware issues that may need to be updated or replace to prevent the problems the facility is experiencing with their scanners. The RFID/RTLS system is already three years old and it was considered to be one of the first RFID/RTLS system initially tested for the VA.

Question #11 asked, in general, how receptive were all the staffs from Logistics, BioMed, OI&T, Engineering & Facilities Maintenance and Administrative & clinical support in the implementation and use of RFID/RTLS?

Subject Y responded, all were very receptive. Subject Y educated and engaged all the departments and had a vested interest of the capabilities of the technology - its potential. Subject Z indicated all departments were excited and accepting of the concept of the technology. However, realistically, the technology added more maintenance and monitoring. More emphasis

has been placed on monitoring the technology instead of the intended purpose of monitoring assets.

Analysis: It's important that all the stakeholders from other departments in the facility understands the benefits of RFID/RTLS in order to maximize its potential capabilities. Everyone from the facility director to end users must be involve and willing to accept and adapt this technology into the organization.

Question #12 asked what benefit does RFID/RTLS technology provides for patient care?

Subject Y responded supply availability and actual care is immediate.

Subject Z responded by indicating it provides visibility to track and monitor patient location in lock-down areas. It also provides quick access to recalled items and expiration dates. It has the ability to identify locations and quantities for rapid sequestering of products and patients without violating privacy regulations.

Analysis: Respondents provided similar answer as in question #9.

Question #13 asked, what cost savings, if any, was realize in the implementation of RFID/RTLS technology?

Subject Y responded, generally huge depending on the application of the technology. There is a substantial cost associated depending on time saved by nurses and doctors. Additionally, automation in purchasing quickly identifying patient care needs as well as able to quickly identify medical expiration and recalls.

Subject Z responded by tracking assets and locating in last stamped location. This helps to recover lost equipment. It monitors mobile assets such as beds and infusion pumps utilized constantly.

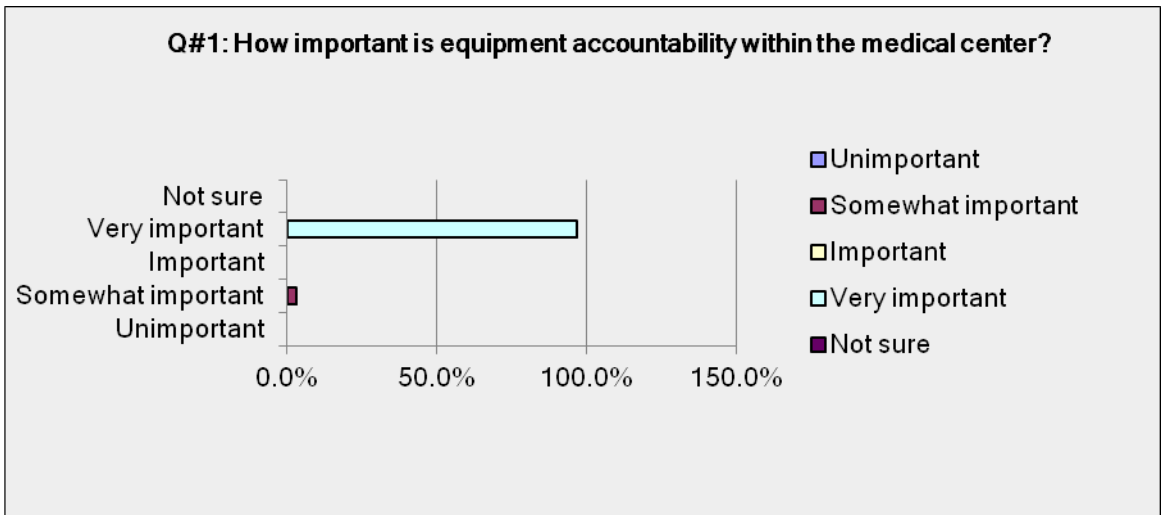
Analysis: Both respondents indicated huge potential for cost savings. However, none can provide a dollar figure associated to cost savings. This may be due to the fact that it's taken for granted the cost saving may be an intangible amount when it comes to patient care. In terms of equipment accountability, the cost saving may be realize in the decrease in the amount of lost equipment by write-offs or surveys for the facility. This amount can be substantial but was not provided by Subject Z.

Question #14 (only refers to subject X in answering "no" to question#7) asked, what affect do you think RFID/RTLS technology will have on patient care?

Subject X responded it reduced patient record error through system transfer of information (i.e. implants/medical device implants). Also, reduced staffing effort in handling and decrease time in transfers of patients between levels of acuity or from areas of care through effective equipment management.

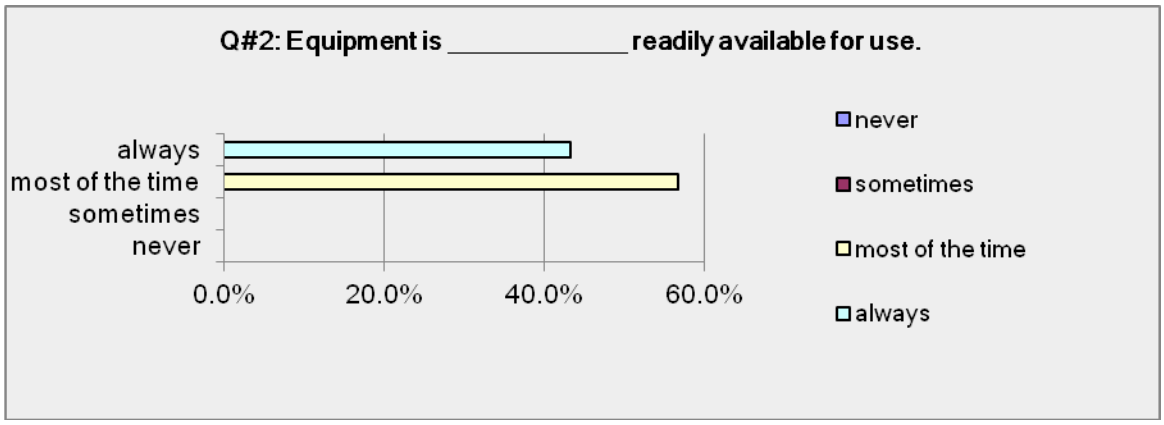
Analysis: Respondent answered this question in a manner on how RFID/RTLS can be used to benefit and provide patient care. Once RFID/RTLS is installed and barring any contractual limitations, the system can be leverage within the facility to perform such functions mentioned by the respondent.

A survey questionnaire (See Appendix B) was distributed to fifty (50) Level 1B medical center employees in which RFID/RTLS technology has not been implemented. Thirty (30) employees responded (60 response rate). The sample population included healthcare clinicians who are directly involved in patient care, support staff positions, supervisory staff as well as management staff within the healthcare facility. Below are the graphical representation and data analysis:



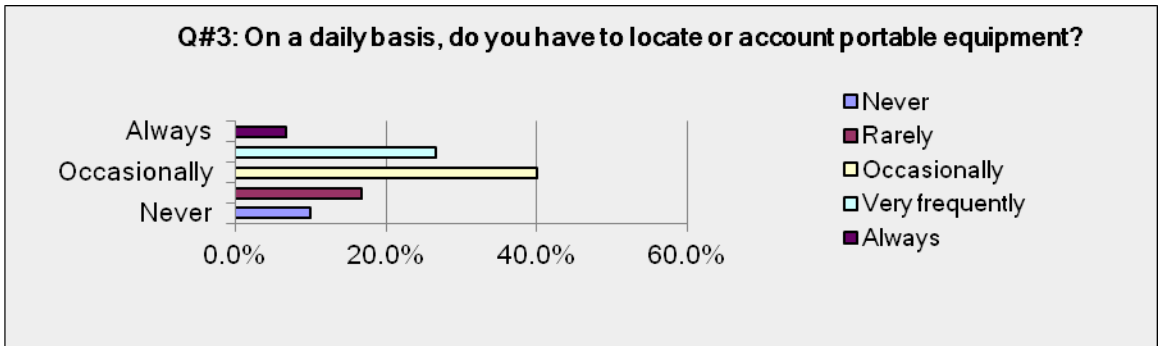
Analysis:

Graph Q#1 shows 29 out of 30 (97%) respondents felt that equipment accountability within the medical center is considered VERY IMPORTANT.



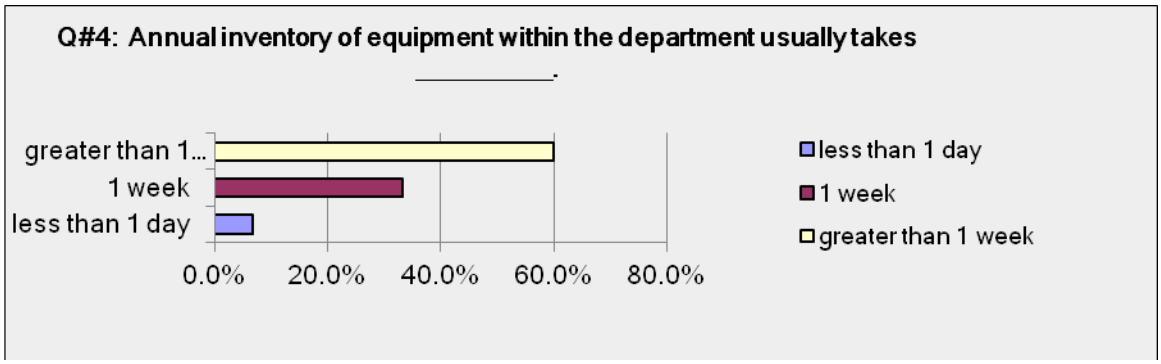
Data Analysis:

Graph Q#2 shows all of the respondents indicated that equipment is available either MOST or ALL THE TIME which indicates equipment availability is not an issue as the equipment is available within the facility.



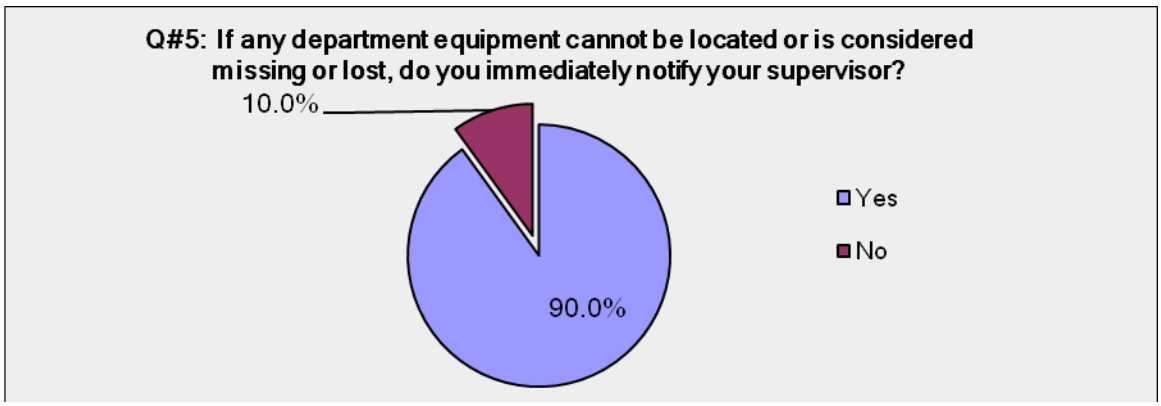
Data Analysis:

Granted the equipment may be available within the facility (as noted in the preceding Graph Q#2), Graph Q#3 represent employees are spending unusually extra time on a daily basis searching for equipment readily available for use.



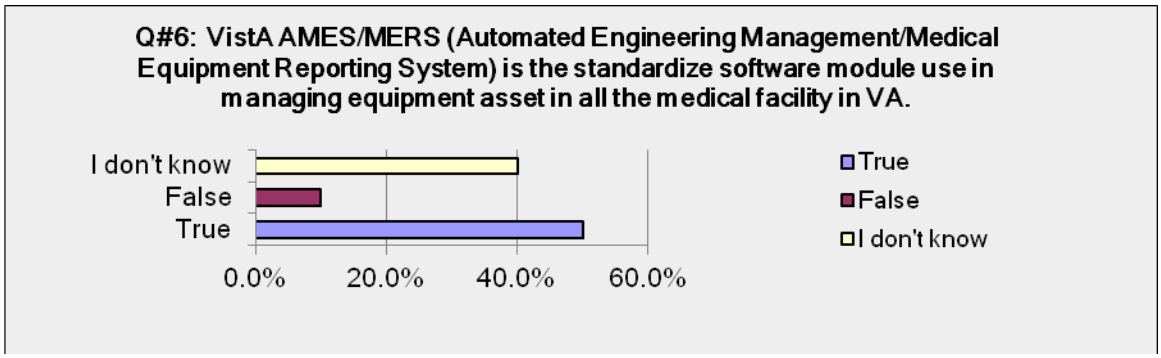
Data Analysis:

Graph Q#4 shows it takes less than a week to conduct annual inventory of equipment. These are more than likely to be the small clinical areas or smaller departments as oppose to those that take greater than one week to conduct an annual inventory. With RFID/RTLS implemented, the time it takes to conduct annual inventory will substantially decrease because of the "real time" location information will be readily available for those conducting the inventory.



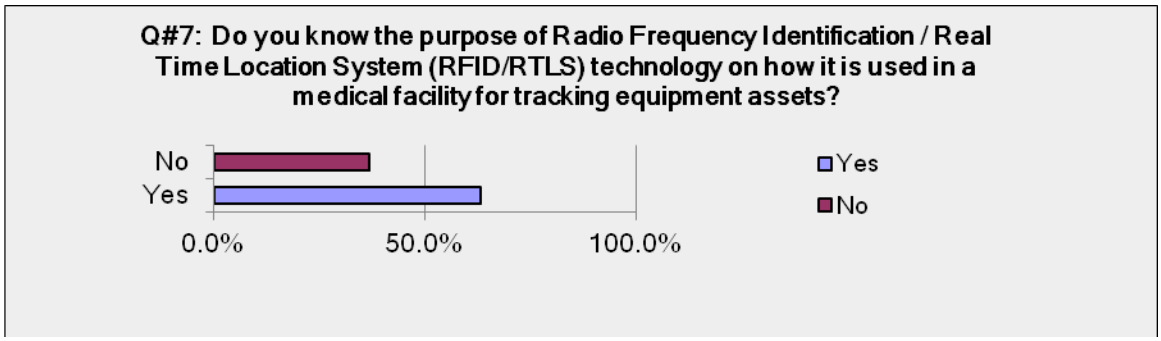
Data Analysis:

Graph Q#5 indicates for the most part (90%), employees are aware to notify their supervisor immediately if equipment is lost or missing.



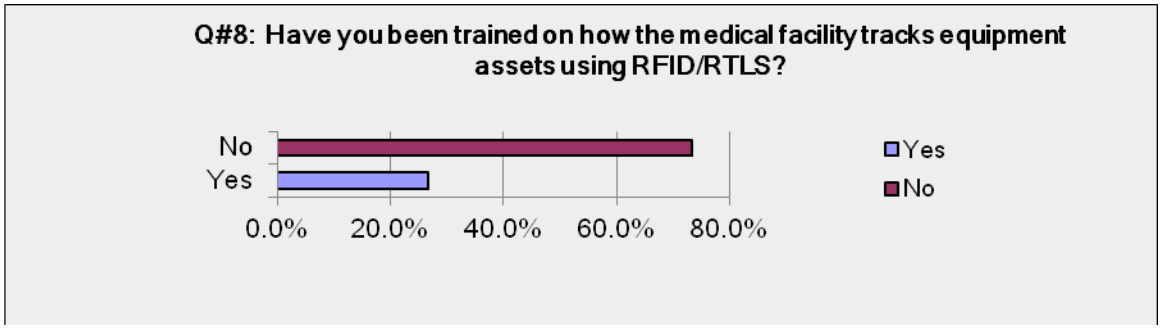
Data Analysis:

This graph Q#6 indicates only half of the medical center staff is knowledgeable when comes to equipment accountability. Organization does not put enough priority or emphasis in equipment management.



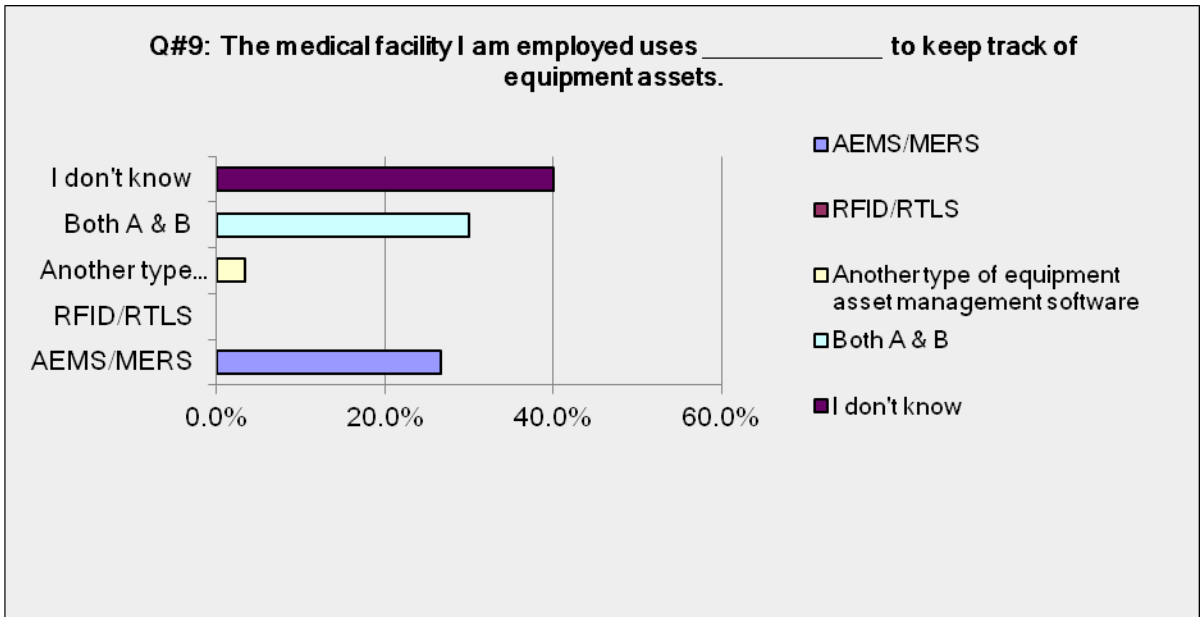
Data Analysis:

Graph Q#7 shows approximately 1/3 of the employees in the facility do not understand RFID/RTLS technology.



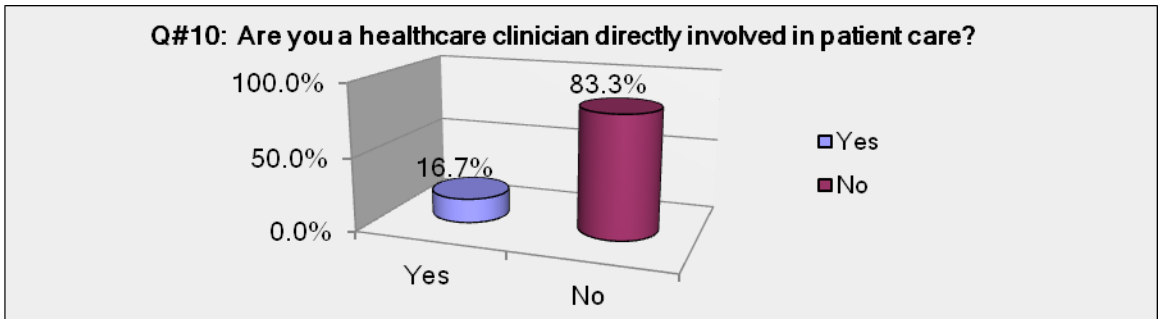
Data Analysis:

Graph Q#8 indicates a need for training to be incorporated with the implementation of RFID/RTLS in the facility.



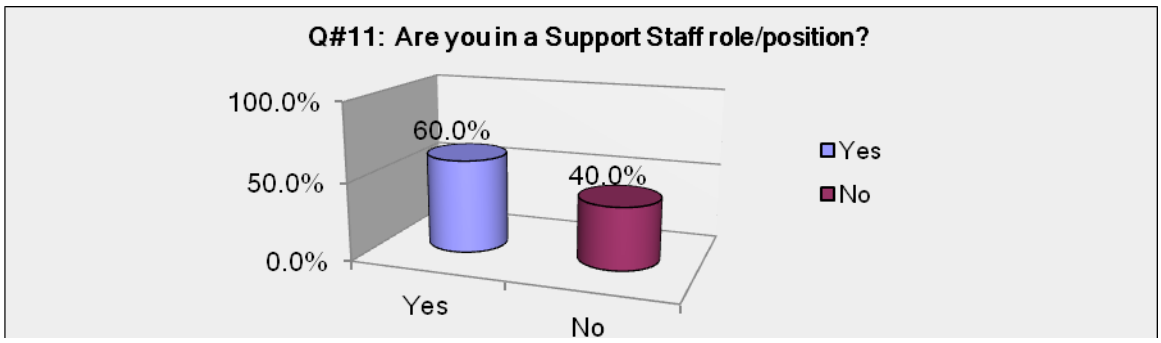
Data Analysis:

Graphs Q#6 thru Q#9 measures the organizational knowledge level with regards to equipment management within the facility. Graph Q#9 indicates training for the facility must be conducted to raise the level of awareness when it comes to equipment accountability for the facility.



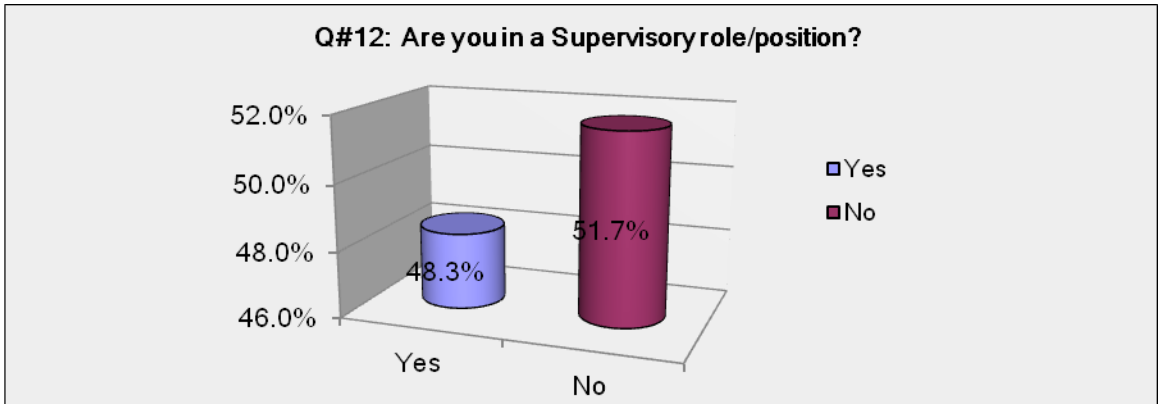
Data Analysis:

Graph Q#10 indicates 5 of the 30 that responded are Clinicians.



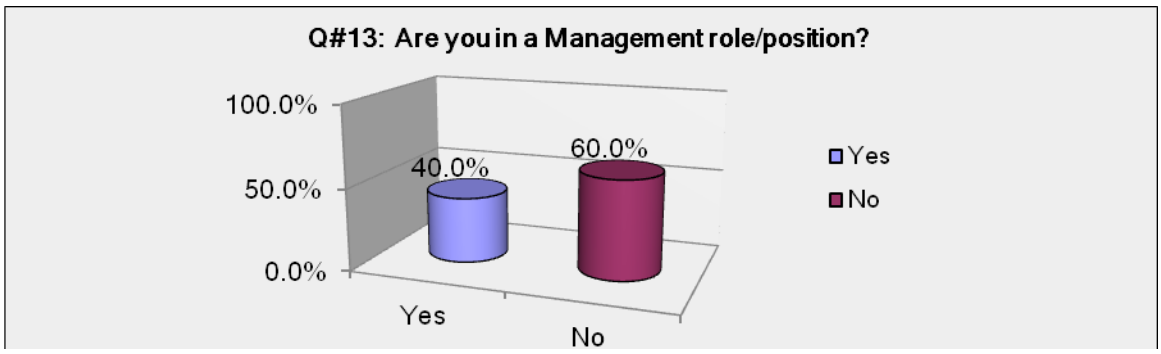
Data Analysis:

Graph Q#11indicates 18 of the 30 that responded identified themselves in a Support Staff role.



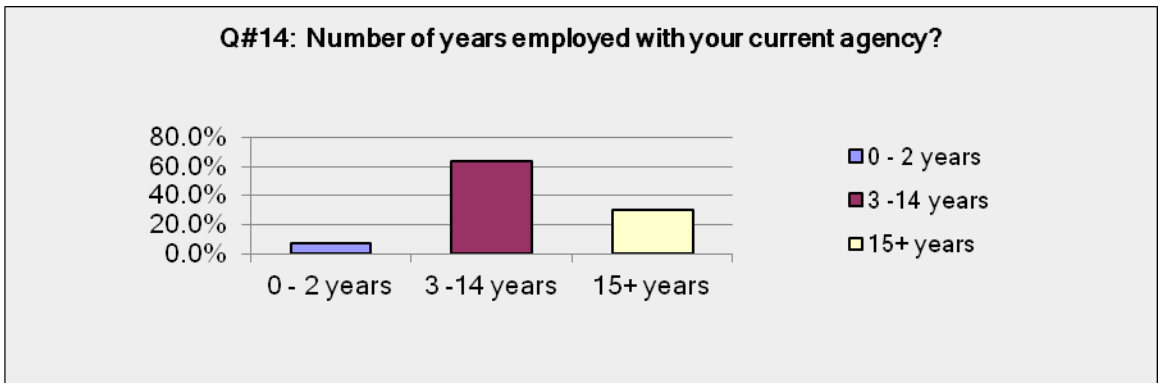
Data Analysis:

Graph Q#12 indicates 14 of the 29 that responded to this question identified themselves in a in a Supervisory role/position. For some reason one responded who took the survey skip this question.



Data Analysis:

Graph Q#13 indicates12 of 30 that responded identified themselves in a Management role/position.



Data Analysis:

Given the nature with VA staff reluctance to providing sensitive personal data in collecting demographic information, demographic data was only limited to the number of years each respondent have been employed. Graph Q#14 indicates demographic data in the number of years staffs have been employed divided into three (3) groups. 3 years and above indicates tenure within VA

Summary of findings and analysis:

All key informants provided a solid understanding of RFID/RTLS technology and its capabilities for asset management in a healthcare facility. Subject X and Y had the theoretical concept on the benefits of the implementation of RFID/RTLS within their facilities as the technology would add visibility to all assets and aid in patient flow. All key informants agrees that having an RFID/RTLS system would reduce the level of effort in locating equipment and help identify lost assets to recover them for continual use. Subject X and Y are aware of the impact in a shift of workload and business processes for logistic and support staff. Proactive approach in disposition of equipment assets will be incorporated vice the traditional approach of waiting for an equipment to be inventoried or reported missing or loss. In terms of how it would impact the workload of clinical staff within the medical center, all key informants agree that it would increase overall efficiency of the clinical staff. However, during the initial implementation rollout, RFID/RTLS will be labor intensive for all parties, as it will require tagging all equipment asset. Subject Z further commented that the implementation of RFID/RTLS created additional work maintenance for the use of active and passive tags. Active tags require battery replacement intermittently and passive tags can accidentally be associated with the wrong asset record. Additionally, the interoperability compatibility of RTLS is limited to specific database. RTLS can only communicate one-way to a database system. With regards to how RFID/RTLS technology affects patient care, all key informants agrees that it will eventually have a positive impact in patient care. Some examples cited by all key informant included, reduce patient record error through system transfer of information, reduced staffing effort in handling and decrease time in transfers of patients between level of acuity or from areas of care through effective equipment management. Clinicians will have greater level of confidence in which they provide

patient care. Subject Z provided realistic actions that are taking place within the healthcare facility. Patients are provided ankle bracelets and monitored at the nurses' station. The system alerts staff if the patient wanders or loiters close to an egress door. Additionally, RFID/RTLS is used to monitor controlled spaces of their temperature and humidity for those areas that are crucial in maintaining certain parameters. In terms of challenges encountered in the implementation of RFID/RTLS, Subject Y believes user acceptance and operational expertise will be upcoming hurdle and the ability for staff to adapt and leverage the technology. Also, depending how well staff can easily absorb the new found skills may become a learning curve that needs to be overcome. Since Subject Z has been utilizing RFID/RTLS for the past 3 years, much of the challenges with RFID/RTLS system were hardware issue related and system integration.

Throughout the medical center majority of the departments were engage in the implementation of RFID/RTLS. Subject Y indicates that prior to implementing RFID/RTLS, meetings were held by all department heads and all had a vested interest of the capabilities of the technology and its potential usage for the facility. Similarly w/ Subject Z, indicated all departments were excited and accepting of the concept of the technology. However, since its implementation three years ago, the technology added more maintenance and monitoring. More emphasis has been placed on monitoring the technology instead of the intended purpose of monitoring assets. In terms of cost saving realize in the implementation of RFID/RTLS; Subject Y suggest that huge savings potential depending on the application of the technology. Also cost savings in automation in purchasing quickly identifying patient care needs as well as ability to quickly identify medical expiration and recalls. Subject Z attributes the cost saving by ensuring assets are track continuously thus helps to recover lost equipment. Both key informants could not

give a realistic dollar figure on what cost saving RFID/RTLS technology provided for the medical facility.

Other findings observed during the course of the author's site visit and in conversation relating to the facility organizational culture. According to one of the key informant, the RFID/RTLS system installed did not come without challenges it had to overcome. Much of the challenges with RFID/RTLS system were hardware issue related and system integration. Granted the RFID/RTLS system is functional, it still has its quirks in the area of equipment inventory. All the equipment had to be tagged with "active" and "passive" RFID tags and the tags had to be associated with the existing database. Interoperability compatibility of RFID/RTLS is limited to specific database. RFID/RTLS system installed in the pilot facility can only communicate one-way to a database system. As a result, logistic department was duplicating its work process efforts to associate all tagged equipment to RTLS system as well as ensure the existing database system is loaded with the correct tagged information from the RTLS system. Also, a continuing challenge for this facility is encountered from the end user perspective in the scanner hardware and how it's used. The programs within the handheld scanner were not user friendly particularly for the new user and difficult to understand. The only way to be familiar with the handheld scanner is to routinely use the scanner. Other issue that arises with the handheld scanner is that a user can accidentally scan a piece of equipment nearby where different equipment is intended to be scan. The user must be very attentive to the item being scan to confirm that the item has been scanned properly.

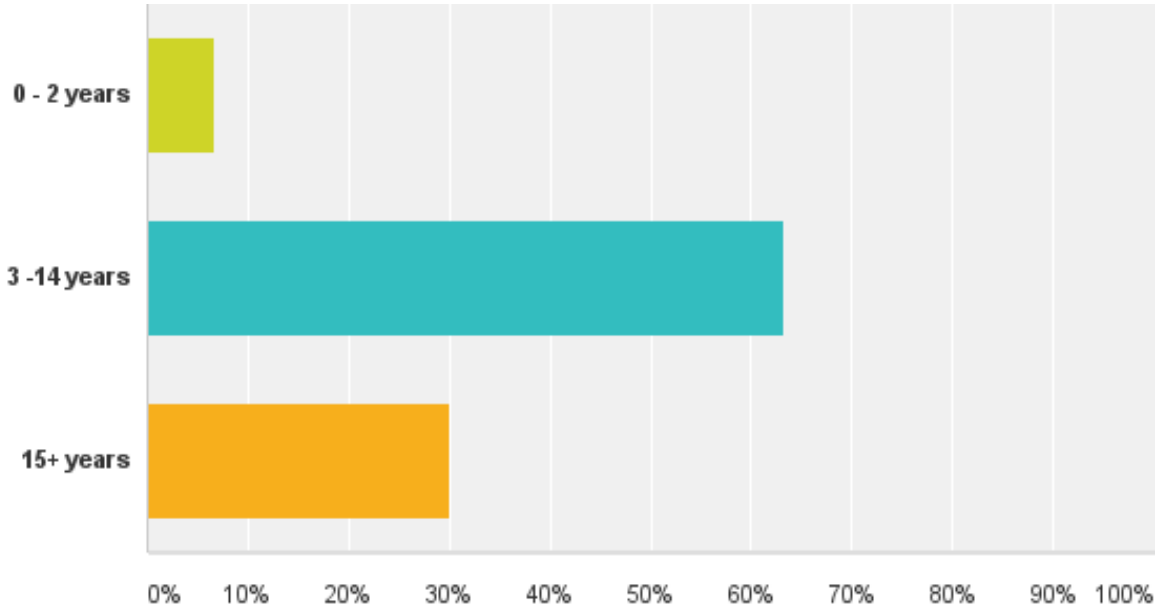
The plan was to initially use the technology for equipment management. During the initial implementation rollout, RFID was labor intensive for all parties involved. At first the organization was reluctant to accept the technology because of the fact that it's a pilot program

within the VA. Organization culture was resistant to change as existing system is working fine. Additionally, some of the manner involve in the implementation was intrusive and affected business processes of other departments and get in the way of patient care. However through the proactive support from executive management and all stakeholders buy-in, everyone work in collaboration to make the implementation of RFID system a reality.

The Facility Logistic Officer indicated that RFID/RTLS definitely provided the visibility of equipment management for the facility. It convince and influence management throughout the facility to become engage because it affected the way their business process throughout the facility. TQM concepts were invigorated; it involved everyone in becoming stakeholders in the facility to be train on what is expected of RFID technology. The need to expand its use for patient care soon became apparent after its pilot program. Thus resulted its expanded usage in tracking patient elopement within the clinical areas. RFID also demonstrated its use in pharmaceutical lab ensuring proper medications were being dispensed to patients. Continuous improvement was embrace by all stakeholders. Healthcare clinicians became more efficient in their routine business in providing patient care. Through the culture of working collaboratively as a team, all processes and workflows at this facility ultimately became more efficient resulting in higher quality care and improved patient safety. The Facility Logistic Officers whose facility is currently undergoing hardware infrastructure installation of RFID is convince once RFID is implemented, business process in equipment management will change within Logistic department. A more proactive approach in equipment management will be accepted due to the "real time" information RFID provides for property managers. Similarly with the Facility Logistic Officer whose facility does not currently have RFID installed in the facility, is looking forward to the RFID technology coming to the facility. Both Facility Logistic Officers are

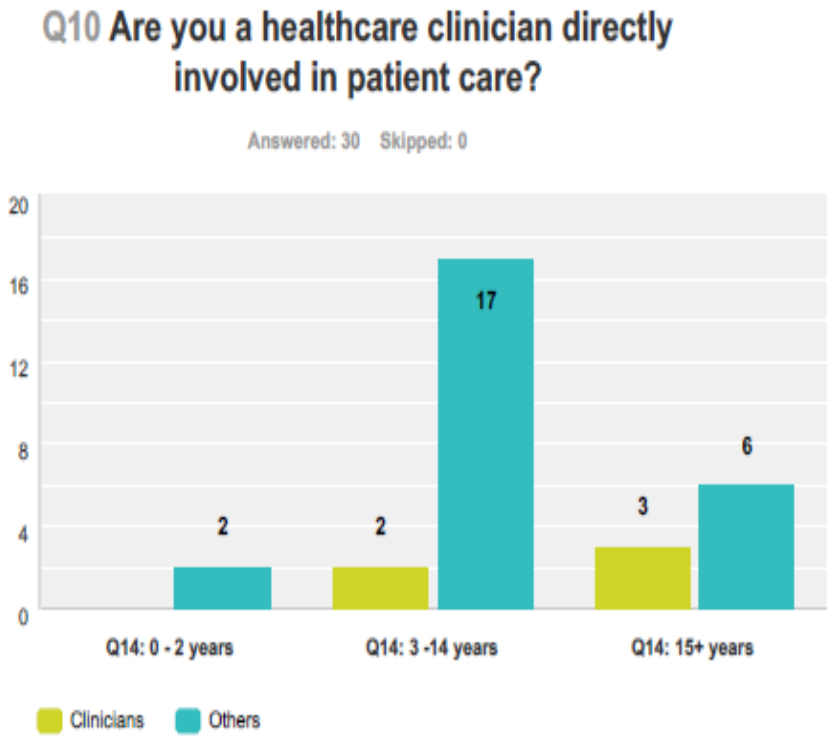
influence of RFID theoretical concept on the benefits of the implementation of RFID/RTLS will add visibility to all assets and aid patient flow. Both also agreed the system would reduce the level of effort in locating equipment and help identify lost assets to recover them for continual use. A proactive approach in disposition of equipment assets will be incorporated vice the traditional approach of waiting for an equipment to be inventoried or reported missing or loss. As noted earlier in this section, 14 questions were provided to a sample population of 50 employees within a level 1B medical center facility that is currently using AEMS/MERS as the means for equipment management in the facility. The sample population took on the job title of healthcare clinicians directly involved in patient care (doctors/nurses), support staff, supervisors and management that are considered responsible officers for the equipment they maintained within their department. However, one key issue must be pointed out. In analyzing the answers received from the survey pertaining to demographics category of the respondent's job title; flaws in the survey questions were discovered. Depending on how the respondent interpreted the question, a respondent may belong to more than one category. This is because depending on the size of a department in which he or she belongs, a respondent can take on a job title of either or both supervisory and managerial role. This is usually the case in many smaller departments within the facility. Therefore, the results of the numbers provided between the supervisor and management may be skewed one way or another depending on how the respondent has answered the survey. Of the 50 surveys sent out, 30 surveys were received which equates to a 60 percent response rate. The following sets of graphs below were cross tabulated to come up with specific finding on the type of staff in each demographic group.

Graph 1 – Demographic Data



Graph # 1 represents demographic data of 30 staff participated in the survey. One of the question in the survey requested information as to how long have the staff been employed in their current organization. It's divided into three groups; newly employed staff with 0-2 years within the VA earns a minimum of 4 hours annual leave per pay period. This equates to approximately 13 workdays per year. Tenure staffs with 3-14 years staff earns compensation of 6 hours annual leave per pay period. This equates to approximately 19.5 workdays per year. And senior tenured staff with 15+ years represents earning a maximum of 8 hours compensation of annual leave per pay period, which equates to 26 workdays per year. According to graph #1, a large majority (~ 93%) of the staff participated in the survey were tenured staff. Cross tabulation of graphs 1-1thru 1-4 used demographic data to determine category or type of staff.

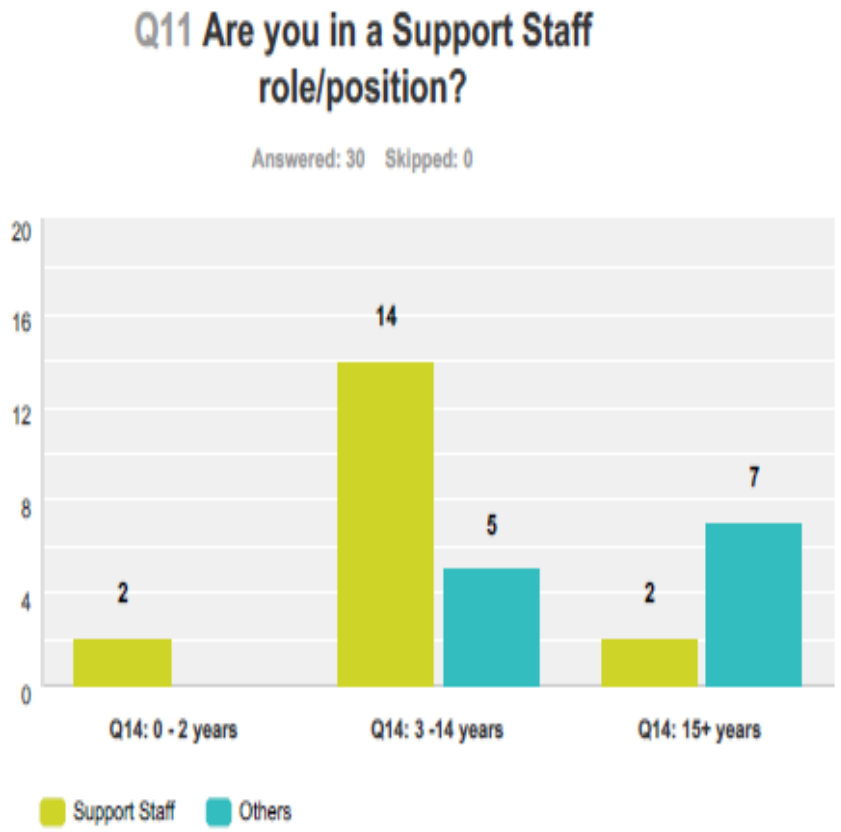
Cross Tabulation of Graph 1-1 used demographic data to determine type of staff.



	Clinicians	Others	Total
Q14: 0 - 2 years (A)	0.00% 0	100.00% 2	2
Q14: 3 -14 years (B)	10.53% 2	89.47% 17	19
Q14: 15+ years (C)	33.33% 3	66.67% 6	9
Total Respondents	5	25	30

Graph 1-1 represents five (5) clinicians, two of which has 3-14 years of experience and the remaining three (3) have 15 plus years experience in the organization.

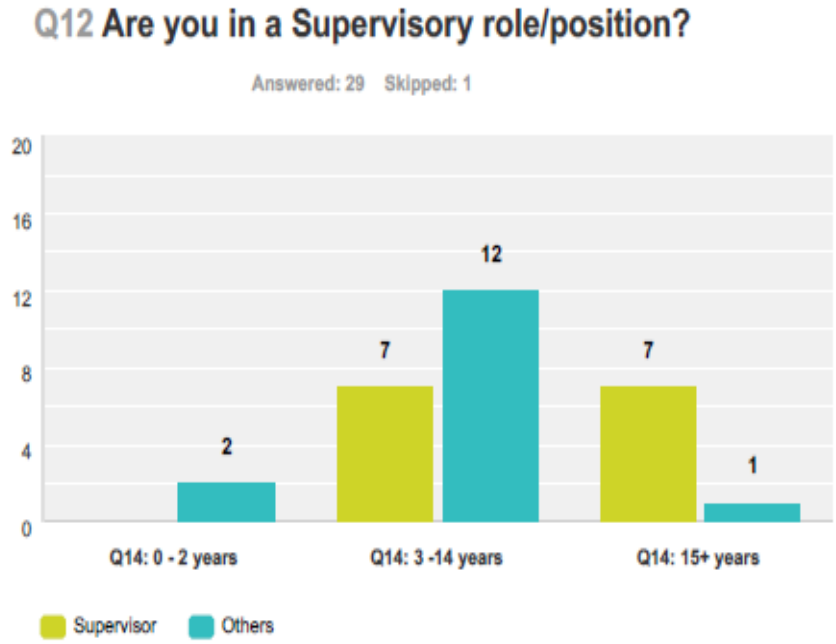
Cross Tabulation of Graph 1-2 used demographic data to determine type of staff.



	Support Staff	Others	Total
Q14: 0 - 2 years (A)	100.00% 2	0.00% 0	2
Q14: 3 -14 years (B)	73.68% 14	26.32% 5	19
Q14: 15+ years (C)	22.22% 2	77.78% 7	9
Total Respondents	18	12	30

Graph 1-2 represents total of 18 Support Staffs, two (2) of which has 0-2 years experience, fourteen (14) has 3-14 years of experience and the remaining two (2) have 15 plus years experience in the organization.

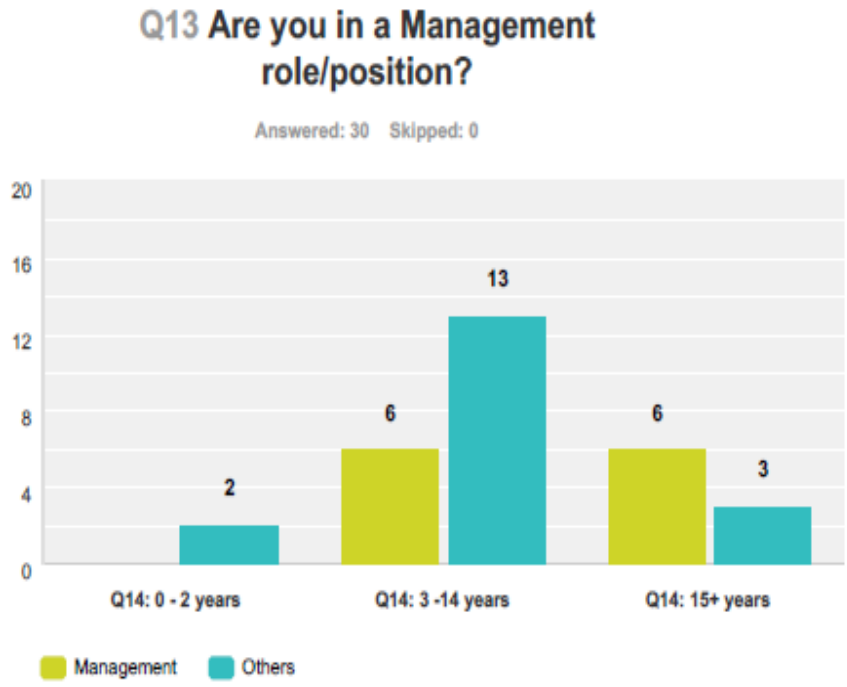
Cross Tabulation of Graph 1-3 used demographic data to determine type of staff.



	Supervisor	Others	Total
Q14: 0 - 2 years (A)	0.00% 0	100.00% 2	2
Q14: 3 -14 years (B)	36.84% 7	63.16% 12	19
Q14: 15+ years (C)	87.50% 7	12.50% 1	8
Total Respondents	14	15	29

Graph 1-3 represents total of 14 Supervisors, seven (7) has 3-14 years of experience and the remaining seven (7) have 15 plus years experience in the organization. As noted earlier, numbers may be skewed depending how many respondent may have misinterpreted the question between the role of supervisor and management.

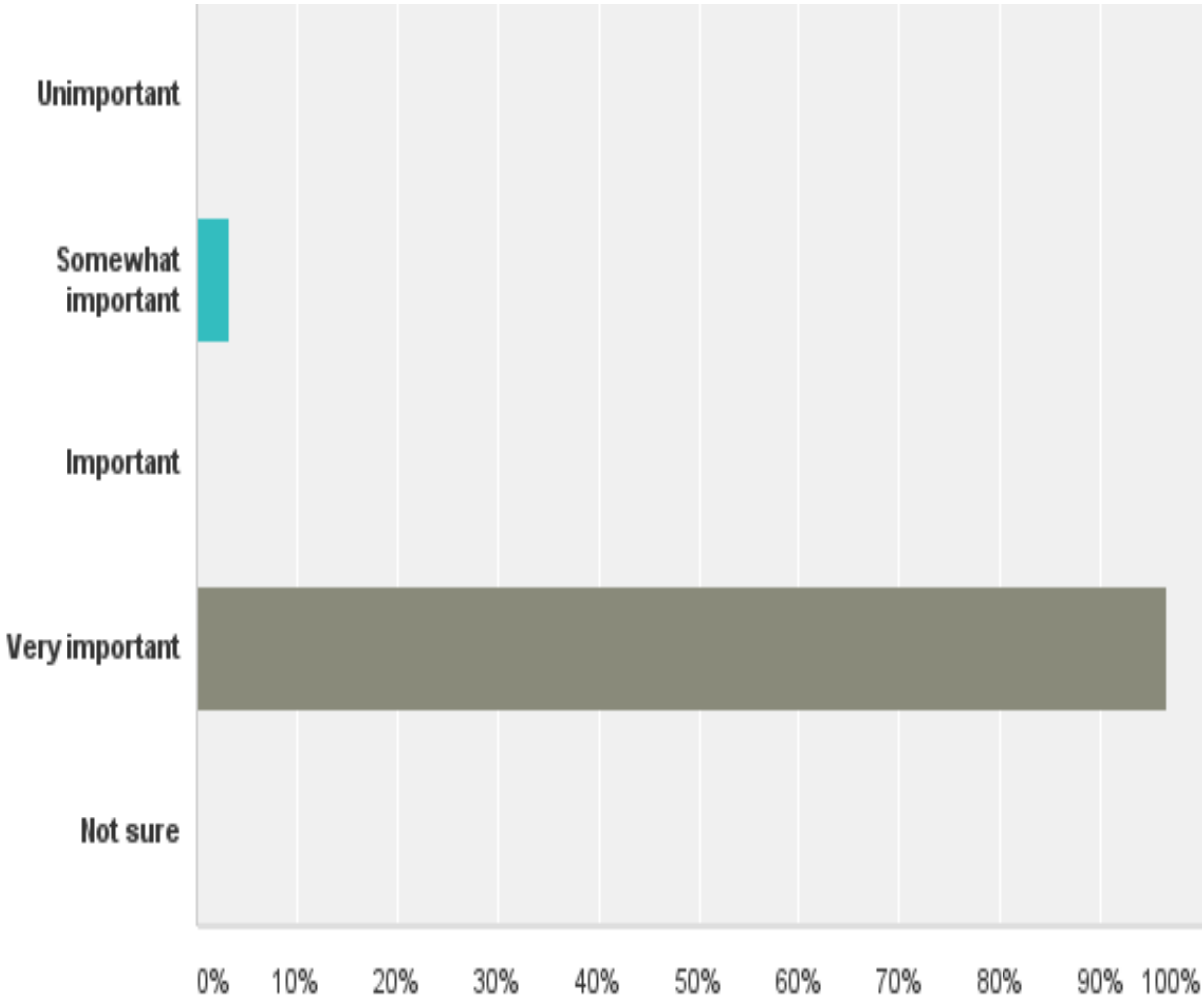
Cross Tabulation of Graph 1-4 used demographic data to determine type of staff.



	Management	Others	Total
Q14: 0 - 2 years (A)	0.00% 0	100.00% 2	2
Q14: 3 -14 years (B)	31.58% 6	68.42% 13	19
Q14: 15+ years (C)	66.67% 6	33.33% 3	9
Total Respondents	12	18	30

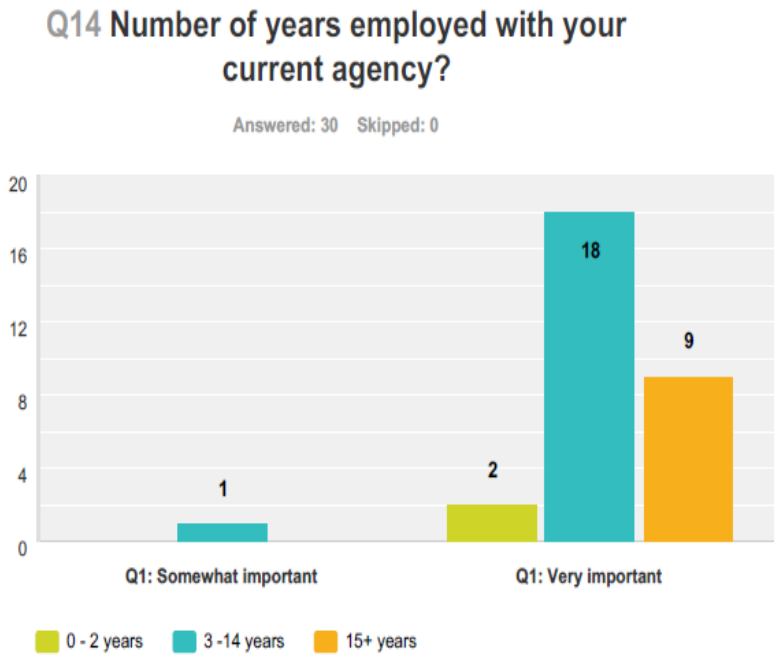
Graph 1-4 represents total of 12 Management, six (6) has 3-14 years of experience and the remaining six (6) have 15 plus years experience in the organization. As noted earlier, numbers may be skewed depending how many respondent may have misinterpreted the question between the role of supervisor and management.

Graph 2 – Organizational Climate to equipment accountability



Graph #2 from the survey, depicts the organizational climate relating to equipment accountability. As the data indicate, approximately 97 percent considers equipment accountability "very important" within the organization whereas only 3 percent considers equipment accountability, "somewhat important."

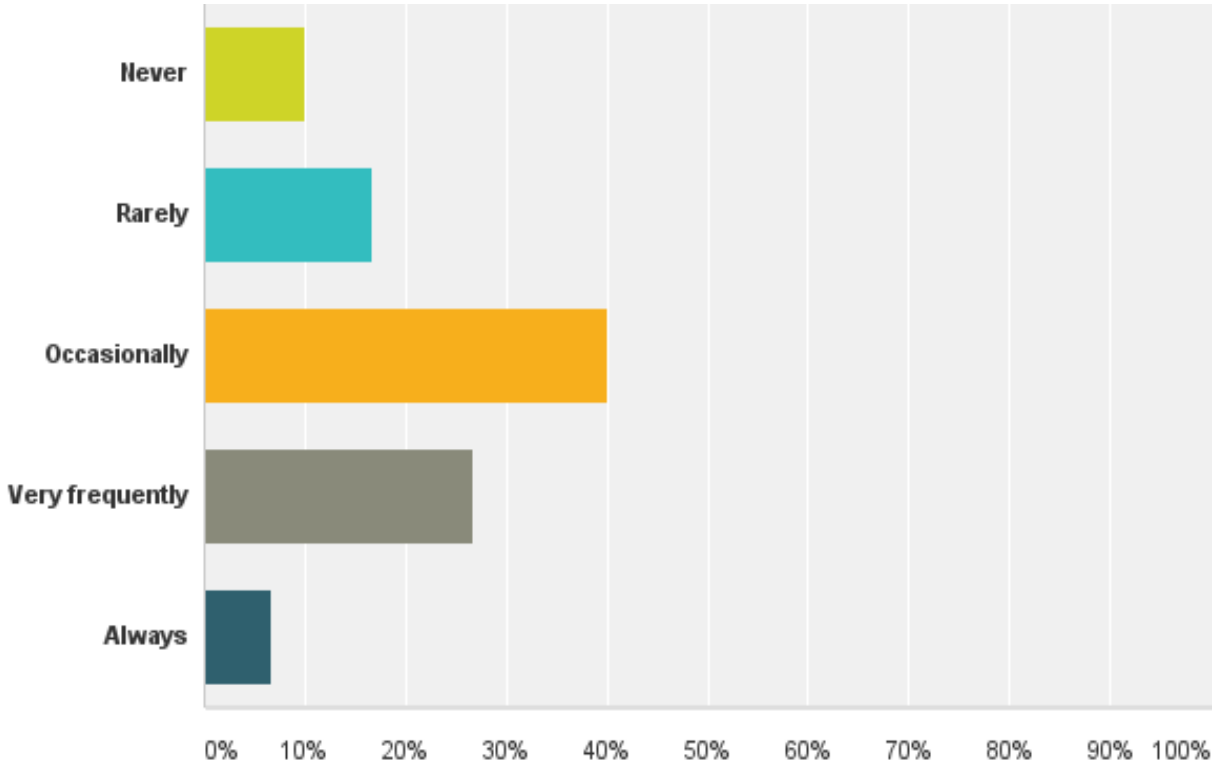
Cross Tabulation of Graph 2-1 used demographic data to determine organizational climate in relation to the importance of equipment accountability in the organization.



	0 - 2 years	3 -14 years	15+ years	Total
Q1: Somewhat important (A)	0.00% 0	100.00% 1	0.00% 0	1
Q1: Very important (B)	6.90% 2	62.07% 18	31.03% 9	29
Total Respondents	2	19	9	30

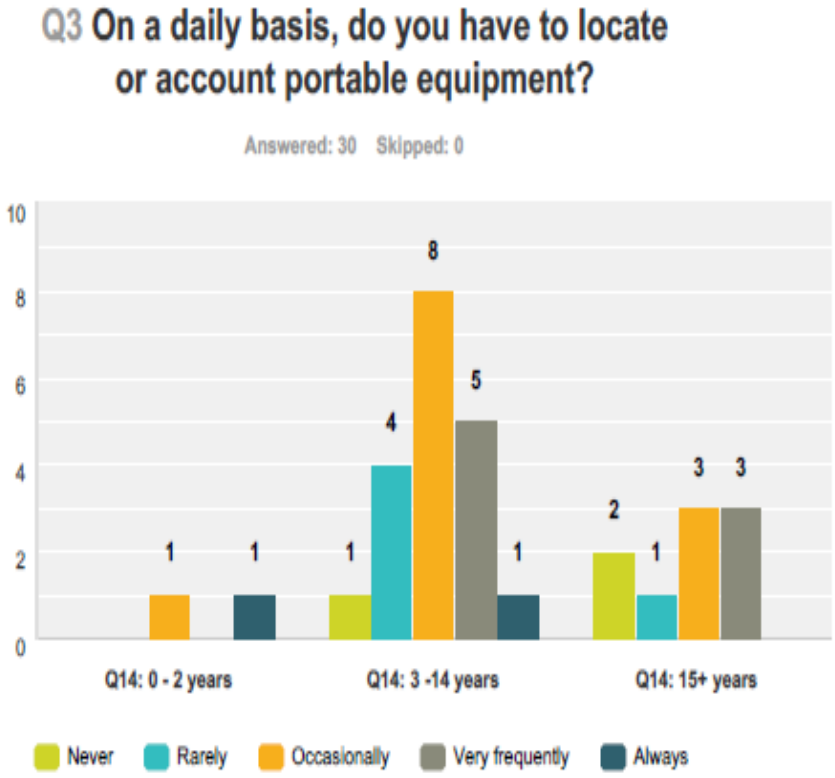
Cross tabulating the responses, shows the majority of the tenure group in the 3-14 years of experience considers equipment accountability very important; twice than those in the category of 15+ years within the organization. For this organization, it would appear there's a disproportionate number in the demographics which suggest there's a lack of collaboration among the three category groups with regards to equipment accountability.

Graph 3 – Daily incidents in locating equipment



In terms of equipment accountability, graph #3 represents the frequency of having to locate equipment on a day-to-day basis for usage. Summing the percentage for the frequency (occasionally, very frequent, always), represents approximately 75 percent of the staff have to locate a piece of equipment on a daily basis for use. On an average, it takes anywhere from 10 - 30 minutes to find an equipment. This is wasted time which could have been put to better use. This is the variation that must be removed or minimize in order to work efficiently.

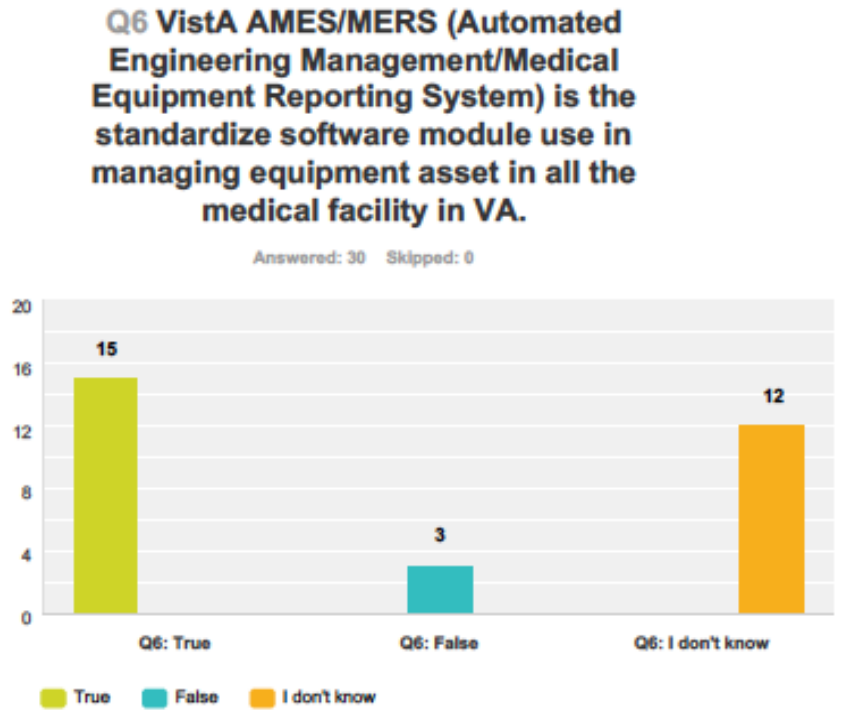
Cross tabulation of Graph 3-1 used daily incidents data to determine which demographics are using their time inefficiently to locate for equipment on a daily basis



	Never	Rarely	Occasionally	Very frequently	Always	Total
Q14: 0 - 2 years (A)	0.00% 0	0.00% 0	50.00% 1	0.00% 0	50.00% 1	2
Q14: 3 -14 years (B)	5.26% 1	21.05% 4	42.11% 8	26.32% 5	5.26% 1	19
Q14: 15+ years (C)	22.22% 2	11.11% 1	33.33% 3	33.33% 3	0.00% 0	9
Total Respondents	3	5	12	8	2	30

Cross tabulating the data further breaks it down by demographics – majority of the tenured staff are the ones looking for equipment. Time spent looking for equipment is wasted time that can be put to good use more efficiently. With RFID/RTLS system, it minimizes these wasted time as equipment can be easily located in “real time” basis.

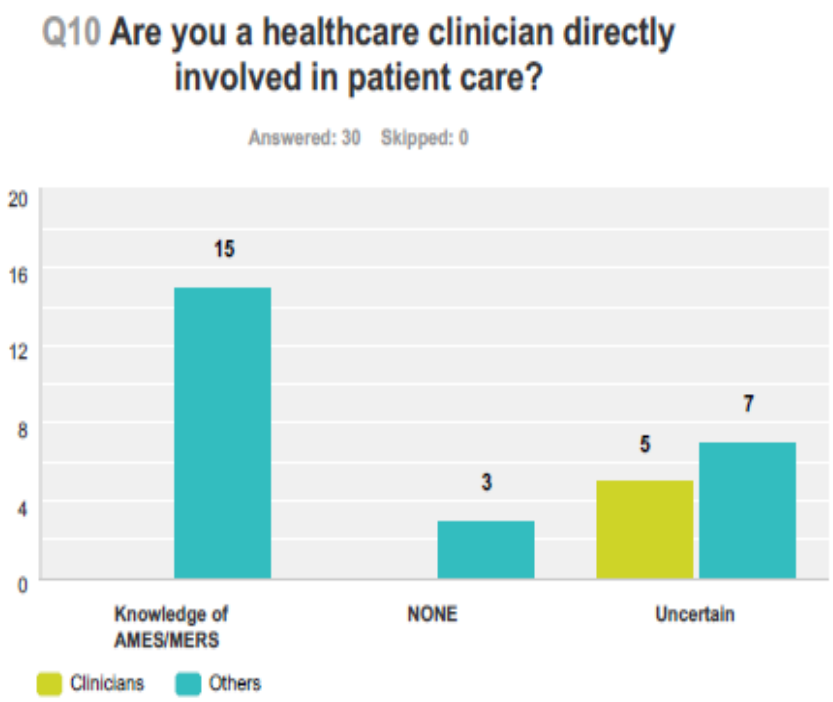
Graph 4 – Organization knowledge of equipment management



	True	False	I don't know	Total
Q6: True (A)	100.00% 15	0.00% 0	0.00% 0	15
Q6: False (B)	0.00% 0	100.00% 3	0.00% 0	3
Q6: I don't know (C)	0.00% 0	0.00% 0	100.00% 12	12
Total Respondents	15	3	12	30

In terms of organizational staff knowledge on the software use for equipment management, graph #4-1 shows 50 percent do not know VistA AMES/MERS as the standard software use for managing equipment asset. What is even more interesting is the disparity it shows by cross tabulating the data breaking it down by demographics. Clinicians (see graph 4-1), supervisors (see graph 4-3) and managers (see graph 4-4) appears the least knowledgeable in managing equipment asset in AEMS/MERS whereas, Support Staff (see graph 4-2) are the most familiar with VistA AMES/MERS as the standard software use for managing equipment asset.

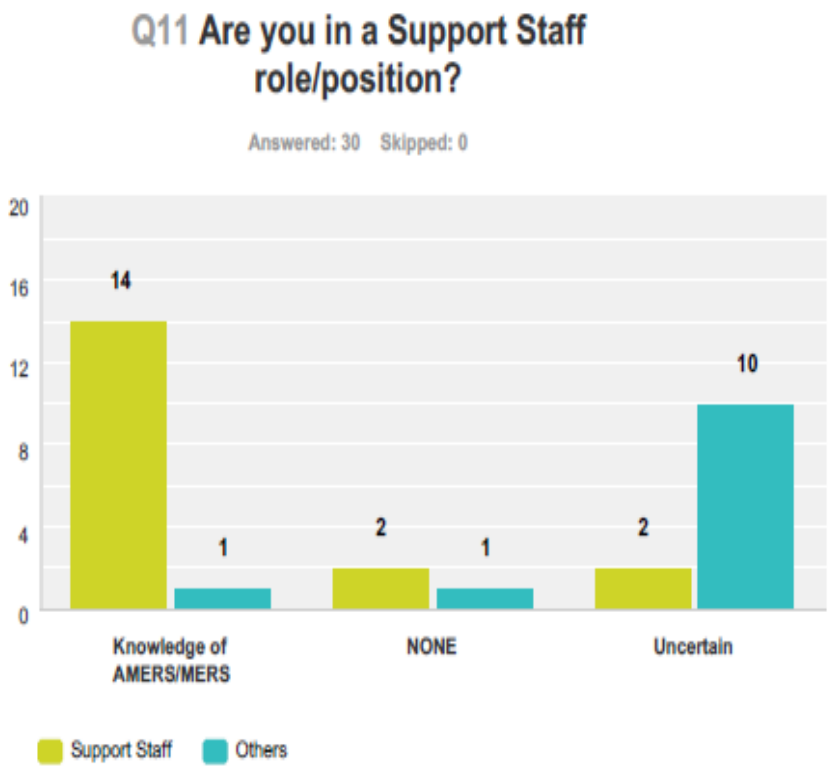
Cross tabulation of Graph 4-1



	Clinicians	Others	Total
Knowledge of AMES/MERS (A)	0.00% 0	100.00% 15	15
NONE (B)	0.00% 0	100.00% 3	3
Uncertain (C)	41.67% 5	58.33% 7	12
Total Respondents	5	25	30

Graph indicates that 5 clinicians on this survey are lack the knowledge of how equipment are managed within this organization. From observation, this graph tends to support the assumption that majority of clinicians tend to focus on their profession and expertise in treatment and providing care to patients. Majority of clinicians are affected only if they do not have the necessary tools or equipment to do their job.

Cross Tabulation of Graph 4-2



	Support Staff	Others	Total
Knowledge of AMERS/MERS (A)	93.33% 14	6.67% 1	15
NONE (B)	66.67% 2	33.33% 1	3
Uncertain (C)	16.67% 2	83.33% 10	12
Total Respondents	18	12	30

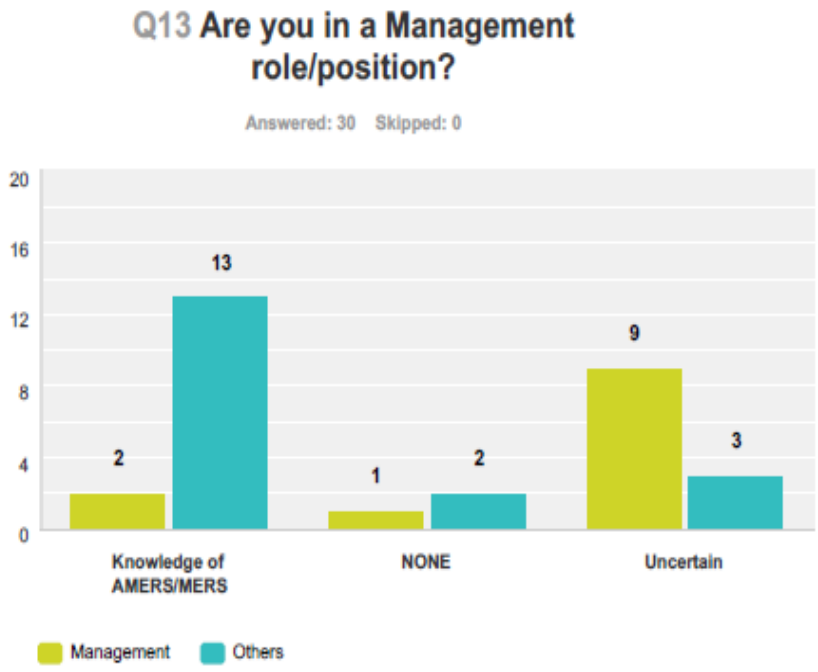
The graph indicates Support Staff are the most knowledgeable in equipment management. From observation, equipment inventory are usually delegated to support staff from their supervisors or managers in their respective department. Once inventory are completed, a supervisor or manager accountable for the equipment merely reviews and signs the inventory as completed.

Cross tabulation of Graph 4-3

	Supervisor	Others	Total
Knowledge of AMERS/MERS (A)	26.67% 4	73.33% 11	15
NONE (B)	66.67% 2	33.33% 1	3
Uncertain (C)	72.73% 8	27.27% 3	11
Total Respondents	14	15	29

Graph shows only one-half of the supervisors/managers lack the requisite knowledge of equipment management. From observation, supervisors tend to delegate their responsibility of equipment inventory to their support staff that is capable in handling the job. This is because most supervisors consider equipment management is not a priority and usually not part of their normal workload routine.

Cross Tabulation of 4-4



	Management	Others	Total
Knowledge of AMERS/MERS (A)	13.33% 2	86.67% 13	15
NONE (B)	33.33% 1	66.67% 2	3
Uncertain (C)	75.00% 9	25.00% 3	12
Total Respondents	12	18	30

Graph indicates a dismal participation of managers when it comes to equipment management. From observation, managers do not view equipment management as one of their competing priorities in their daily workload. This graph is also a representation of the organization culture and indicates the knowledge of management amongst the facility when it comes to equipment accountability. Managers are usually in a reactive mode most of the time and only get involve when high dollar value equipment in their department is unaccounted.

Chapter 5 - Conclusion and Recommendations

This research study was based on a qualitative case study among three VA medical centers on how each facility conducts its business process in equipment management. All facilities chosen for this case study were level 1A & 1B in complexity, based on the characteristics of the patient population, clinical services offered, educational and research missions and administrative complexity. The study provided an understanding how RFID/RTLS technology can be utilize to enhance equipment management within VAMCs.

CONCLUSION

Key informants and survey results provided convincing evidence that an organization must be willing to change and adapt in order to have a successful implementation of an emerging technology. In one particular site observed, the idea of having RFID/RTLS installed at first was not taken lightly. However, this progress provided the incentive for the organization to adapt to change. The idea of having visibility in equipment management for the facility was the catalyst for the organization to act together as a team. It convince and influence management throughout the facility to become engage because it affected the way their business process throughout the facility. TQM concepts were adapted; it involved everyone in becoming stakeholders in the facility to be train on RFID technology. Upon installation of the system, continuous improvement was embrace by all stakeholders. Healthcare clinicians became more efficient in their routine business in providing patient care. Through the culture of working collaboratively as a team, all processes and workflows at this facility ultimately became more efficient resulting in higher quality care and improved patient safety.

Ultimately, in answer to this study's research question: Will implementing RFID/RTLS and applying TQM concepts improved accountability of medical equipment assets within the VA

medical center. The author believes implementing RFID/RTLS and applying TQM concept will improve accountability of equipment assets within the VAMC. The real time location capability of RFID technology proves it provides the instant visibility needed for all staff to engage in the use of medical equipment. The less time it takes to locate and search for an equipment to use, will add efficiency to routine workload. Also, equipment failure will be kept to a minimum due to RFID/RTLS system ability to keep track of all preventive maintenance records. RFID/RTLS system can further assist with budget forecasting for outlying years in equipment expenditures in replacing or upgrading medical equipment assets. Based on the findings from this research, it can be concluded that implementing RFID/RTLS technology and applying TQM concept can improve the accountability of medical equipment assets within the VA medical center.

Recommendations

Therefore, following action items are recommended to prepare a facility in the implementation of RFID/RTLS system:

- Recommendations 1: No later than March 15, 2015, provide a copy of this study to the Director of the medical facility for review. Discussion of this study should be held by the leadership team to consider as plans are formulated to prepare new facility installations. This researcher is available to help formulate an action plan to assist the Director and leadership team.
- Recommendation 2: No later than one (1) month upon notification of the installation of RFID/RTLS to the facility, Director shall instruct Education Department and the Quality Management Board to work collaboratively to facilitate in conducting training on TQM concepts and the benefits of the RFID/RTLS technology for all departments. Education department shall offer traditional classroom and other innovative media resources to

reach maximum staff participation including management. Training should contact all staff in the facility 100% for participation. Head of HR shall monitor progress of training of all staff and report to the Director on a weekly basis on the completion rate of staff's training.

- Recommendation 3: No later than one (1) month upon notification of the installation of RFID/RTLS to the facility, Director shall contact head of Human Resources (HR) and request to solicit for temporary contract hires to support the facility with the rollout/implementation of RFID/RTLS upon arrival. HR shall canvass each department directly affected by the install on temporary staffing requirement. These temporary hires should already have the required skill-set to assist with the installation and be readily available one week prior to the start of installation date. HR shall promptly advice the Director of new development in the hiring of contracted temporary hires.
- Recommendation 4: No later than one (1) month upon notification of installation of RFID/RTLS to the facility, Facility Logistic Officer and other key stakeholder must conduct a site visit to a known RFID/RTLS installed facility in order to gain valuable lessons learned of the implementation/roll-out of RFID/RTLS within the facility. Facility Logistic Officer and other key stakeholders shall debrief the Director and the leadership team of their site visit within 72 hours upon returning from the trip.
- Recommendation 5: Within one week, after debrief from the site visit, Director shall meet with the leadership team to assign a Project Manager to lead the implementation of RFID/RTLS. Project Manager shall create a plan of action milestone timeline to keep all stakeholder committed to their portion of their requirements. Project Manager is to select a person(s) from each department to form a task group for the purpose of this new facility

installation. Task group shall meet on a weekly basis to update progress of the installation. Project Manager shall meet with the Director on a weekly basis in order to provide the Director how the project is progressing given the timeline projected. Project manager shall also meet with the appropriate stakeholders on a weekly basis to mitigate any risk of assignment completion.

Areas for future research

There were many limitations to this study. Methods of distribution of the survey conducted to the facility, lack of opportunity in reaching out to every department and within the other facility and the very limited time provided in conducting the study significantly restricted the scope of the research study. Additionally, since the author is an employee of the Veterans Administration, certain biases may have played a role to this research study. In retrospect, one of the issues that the author has come to discover upon examining the survey for findings is the possibility that the demographics survey question may have been misinterpreted. Depending on the size of the department within the facility, management and supervisor roles may or may not have the same duties, which may have skewed the results in identifying the roles of each position.

This research should be further study to include quantitative case study in collecting supplementary data to test the results statistically to determine the validity of the question raise. Performance metrics data from the facility that had RFID/RTLS installed three years ago can be obtain to determine the feasibility to support the study. Perhaps a comparison can be made to determine if implementation of the system can provide a significant change in equipment accountability for the facility.

Additional research should be considered on the economical benefit in implementing RFID/RTLS technology in VA. Implementation of a major system into a facility must have a cost associated. Cost-effectiveness was not captured in this research study due to the time constraint of the study. Organizations such as the VA find it difficult to associate cost effectiveness in terms of return-on-investment spent in implementing a major system because VA is a non-profit organization. However, intangible benefits may be realized through patient care satisfaction and perhaps this can be associated to economical cost benefit.

Finally, this study briefly investigated on how organization staff is engage in their roles. Further research should consider on how human capital in this organizational culture plays a role in the implementation of RFID/RTLS technology.

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Appendix A

Interview questions on RFID/RTLS Technology

Greetings! This is Glenn C. Ajero, Chief Materiel Manager for VA Northern California Health Care System. I am in the process of completing my Master's degree in Public Administration at Golden Gate University and would like your assistance in getting your personal perspectives on the topic of Radio Frequency Identification/Real Time Location System (RFID/RTLS).

I know your time is precious however this interview should only take approximately 20 minutes to complete. I can either arrange to meet with you personally at your convenience, through phone conference or perhaps collect your answers by email.

Rest assured, your answers will be kept confidential and anonymous. The information collected will only be used by me for the purpose of completing my degree. I will NOT publicly release your responses or other information about you.

Once again, thank you for your participation and for helping me complete this research study.

==========

1. How long have you been employed with your current agency/medical facility?
2. What is your position with the agency/medical facility?
3. In what ways, if any, do you believe implementing RFID/RTLS technology in your medical center could impact equipment accountability?
4. How will implementing RFID/RTLS affect the management of equipment assets in your department or clinic?
5. How does RFID/RTLS technology impact the business process of logistics and support staffs within your agency/medical facility?
6. How does RFID/RTLS impact the workload of clinical staff within your agency/medical center?
7. Is RFID/RTLS installed in your agency/medical facility?
   a. Yes (answer questions 8, 9, 10, 11, 12 and 13)
   b. No (answer question 14)
8. How long have they been installed?
9. In what way(s), if any, does RFID/RTLS technology affect patient care?
10. What challenges, if any, were encountered during the implementation of RFID/RTLS?
11. In general, how receptive were all the staffs from Logistics, BioMed, O.I&T., Engineering & Facilities Maintenance and Administrative & clinical support staffs in the implementation and use of RFID/RTLS?
12. What benefit does RFID/RTLS technology provides for patient care?
13. What cost savings, if any, was realize in the implementation of RFID/RTLS technology?
14. What affect do you think RFID/RTLS technology will have on patient care?

Appendix B

EQUIPMENT ACCOUNTABILITY SURVEY

My name is Glenn C. Ajero and I am currently completing my Master's degree in Public Administration at Golden Gate University. I am inviting you to participate in a brief survey to obtain your personal perspectives on equipment accountability in a medical center. The survey will only be used by me for the purpose of completing my project. **Neither your name nor ID number is required to complete this survey. Your answers will be kept confidential and anonymous.** I will not publicly release your responses or other information about you.

The survey should take approximately 5 minutes to complete and is being conducted via www.surveymonkey.com. You can start the survey now and complete it later; your response will be considered finished only when you press the "submit" button. If you have questions or difficulty completing the survey, e-mail me at g.ajero@yahoo.com. My hope is to have you complete the survey by February 6, 2015.

Your participation and input is very important. Thank you in advance for participating and for helping complete my research study.

==========

1. How important is equipment accountability within the medical center?
   a. Unimportant
   b. Somewhat unimportant
   c. Important
   d. Very Important
   e. Not sure

2. Equipment is _____readily available for use.
   a. Never
   b. Sometimes
   c. Most of the time
   e. Always

3. On a daily basis, do you have to locate or account portable equipment?
   a. Never
   b. Rarely
   c. Occasionally
   d. Very Frequently
   e. Always

4. Annual inventory of equipment within the department usually takes _____.
   a. Less than 1 day
   b. 1 week
   c. Greater than 1 week

5. If any department equipment cannot be located or is considered missing or lost, do you immediately notify your supervisor?

a. Yes
b. No

6. VistA AEMS/MERS (Automated Engineering Management/Medical Equipment Reporting System) is the standardize software module use in managing equipment asset in all the medical facility in VA.
   a. True
   b. False
   c. I don't know

7. Do you know the purpose of Radio Frequency Identification / Real Time Location System (RFID/RTLS) technology on how it is used in a medical facility for tracking equipment assets?
   a. Yes
   b. No

8. Have you been trained on how the medical facility tracks equipment assets using RFID/RTLS?
   a. Yes
   b. No

9. The medical facility I am employed uses _____ to keep track of equipment assets.
   a. AEMS/MERS
   b. RFID/RTLS
   c. Another type of equipment asset management software
   d. Both a and b
   e. I don't know

10. Are you a healthcare clinician directly involved in patient care?
    a. Yes
    b. No

11. Are you in a Support Staff role/position?
    a. Yes
    b. No

12. Are you in a Supervisory role/position?
    a. Yes
    b. No

13. Are you in a Management role/position?
    a. Yes
    b. No

14. Number of years employed with your current agency?
    a. 0 - 2 years
    b. 3 - 14 years
    c. 15+ years

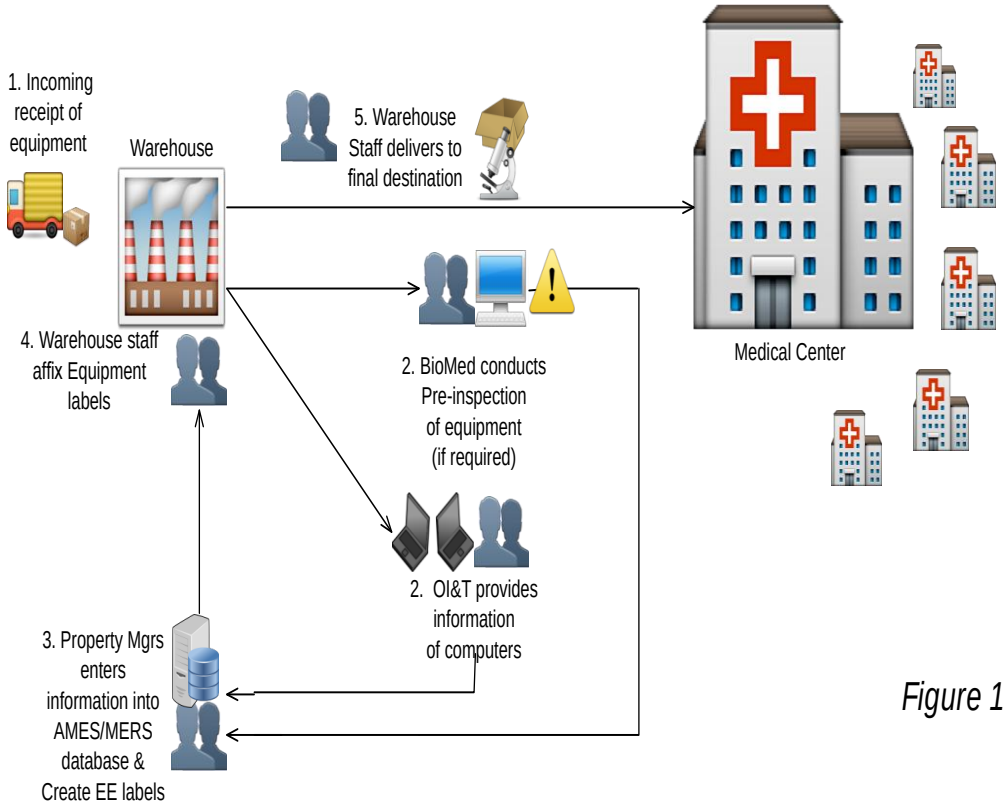

Figure 1

SIMPLIFIED - LIFE CYCLE "CRADLE TO GRAVE" OF HEALTHCARE EQUIPMENT WITHIN VA MEDICAL CENTER

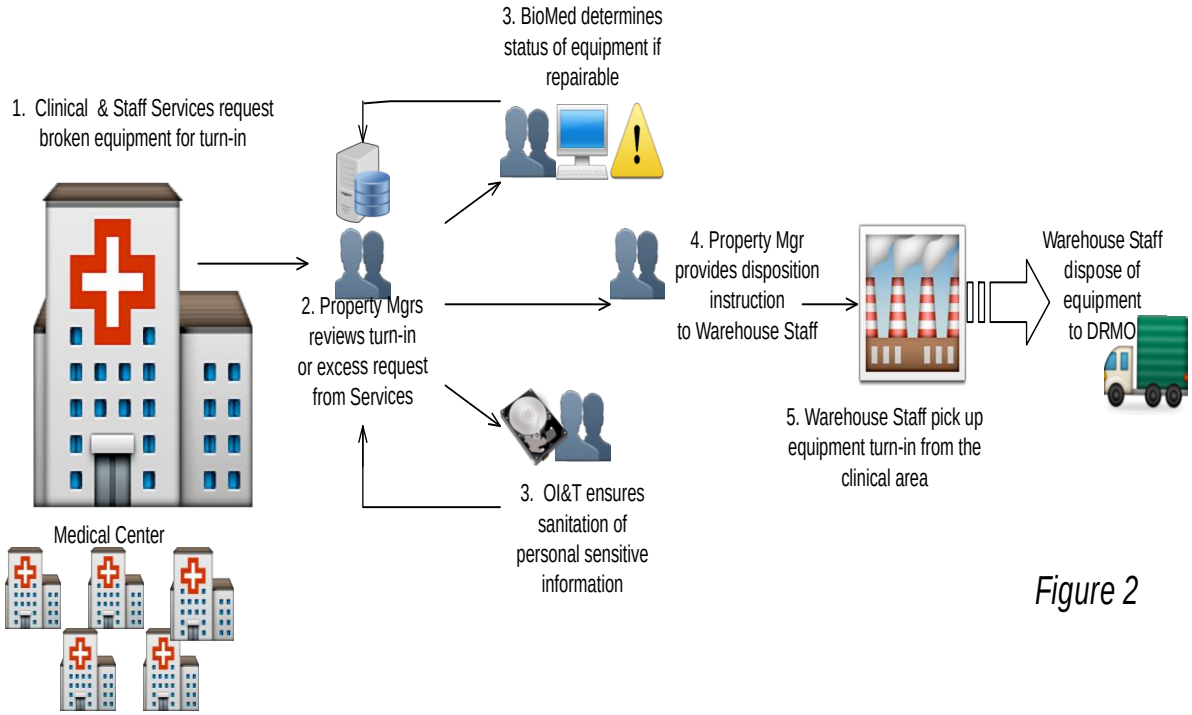

Figure 2

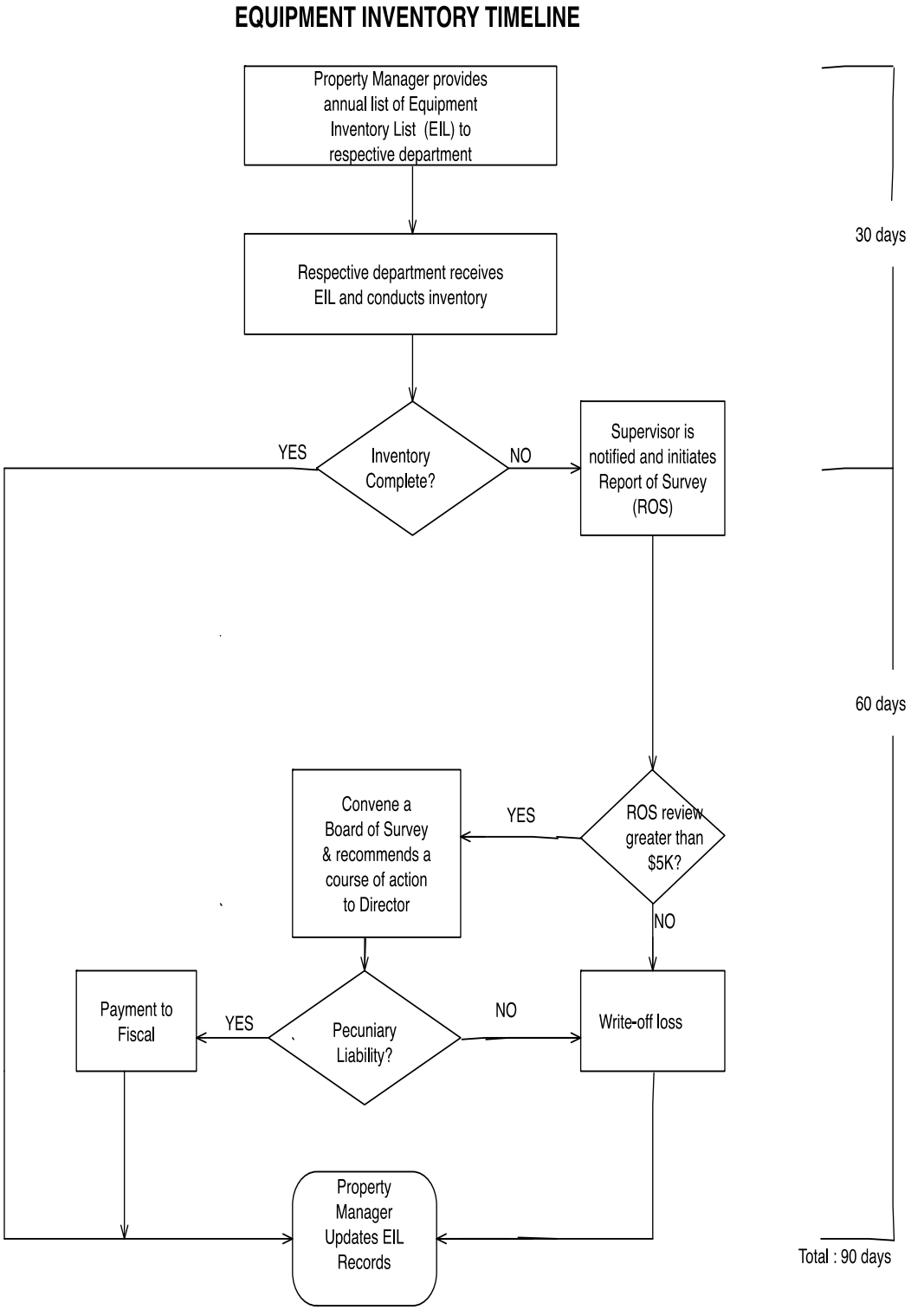
EQUIPMENT INVENTORY TIMELINE
Property Manager provides annual list of Equipment Inventory List (EIL) to respective department
Respective department receives EIL and conducts inventory
Inventory Complete?
YES
NO
Supervisor is notified and initiates Report of Survey (ROS)
ROS review greater than $5K?
YES
NO
Convene a Board of Survey & recommends a course of action to Director
Pecuniary Liability?
YES
NO
Payment to Fiscal
Write-off loss
Property Manager Updates EIL Records
30 days
60 days
Total : 90 days

Figure 3