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Examining Regionalization Efforts to Develop Lessons Learned and Consideration for Department of Defense Medical Facilities

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THESIS

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EXAMINING REGIONALIZATION EFFORTS TO DEVELOP LESSONS LEARNED AND CONSIDERATION FOR DEPARTMENT OF DEFENSE MEDICAL FACILITIES

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Abstract

The increase in competition locally and globally has forced companies to become more efficient. One way for companies to gain efficiency is by regionalizing their facilities by either consolidating or collocating to a particular location. A comprehensive literature review addressed the advantages and disadvantages organizations have used in the past when regionalizing. This insight was used on a case study looking at military hospitals in the National Capital Region. The case study was used to find potential cost savings for three surgical procedures by consolidating each procedure to the lowest cost hospital. Future years were then forecasted to find cost savings for these hospitals to look at for future reference.

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EXAMINING REGIONALIZATION EFFORTS TO DEVELOP LESSONS LEARNED AND CONSIDERATION FOR DEPARTMENT OF DEFENSE MEDICAL FACILITIES

I. Introduction

1.1 Background on Regionalization

Growing competition among organizations is highlighting the need for increased efficiency within the organizations themselves. Efficiency within an organization can refer to increased output, decreased costs, or both. Regionalization has been used in the past as the way to gain efficiency. This process has been used throughout the private and public sectors with common objectives. Organizations that look to regionalize are looking to consolidate or collocate facilities into a certain region. Organizations regionalize for multiple reasons such as lower costs, reduce redundancies, and achieve a more experienced work force.

1.2 Research Questions

The goal of this research was to find common methods used during regionalization. Questions posed throughout this research were:

1. How has regionalization affected organizations?

2. What were the similar regionalization themes that are used across organizational sectors?

3. How can regionalization be applied to a case study?

1.3 Research Objectives

This work examines previous literature on regionalization effects from different industrial sectors. The goal is to highlight common advantages and disadvantages for regionalization to help future organizations in their decision to regionalize. The presumption is that success, or failure, in regionalization by an organization carries certain characteristics of the effort that support its success, or failure. This work extracts these characterizations from various regionalization efforts to compile a lessons learned for future regionalization initiatives.

1.4 Assumptions and Limitations

Regionalization has been around for decades and studies have found advantages and disadvantages with this transition. Various industrial sectors were examined to see what joined these organizations together, what were their unique objectives, and how might regionalization affect them differently. This paper strives to give a starting guide to what leadership in these organizations should look at when deciding whether or not to regionalize.

1.5 Benefits/Implications of Research

Previous literature has focused on one specific area when considering regionalization such as maintenance, production, etc. This paper highlights the common effects of regionalization across multiple organizational sectors. Most organizations focus on multiple sectors, such as creating products and also having to transport those products to consumers. The knowledge gleaned from the literature review and the subsequent case study will hopefully lead to healthier research in regionalization efforts towards the goal of greater efficiency among business entities.

1.6 Report Format

The remainder of the Thesis focused on two distinct parts, the Literature Review and Case Study. The Literature Review looks into previous work on regionalization among different organizational sectors. Common themes were outlined among the sectors at the end of the section to show general guidelines organizations may follow when considering to regionalize. The Case Study looks into the military hospital system to find potential cost savings by regionalizing certain medical procedures.

II. Literature Review

This literature review examines the advantages and disadvantages of regionalization for sectors of an organization such as logistics, production, and maintenance. Logistics involves the flow of resources to and from facilities as well as to the customers. Production is focused on the assembly of goods. Maintenance is focused on repairing various goods and systems. Academics, Research, and Hospitals were also added to the scope of the research.

2.1 Production

Advantages of Regionalization.

Companies strive to increase their efficiency to operate on less resources while still completing the company mission. Decreasing fixed and/or operational costs allow companies to sell products cheaper to their customers. Ernst [1] looked at the effects of regionalization on Japanese electronics firms in the Asian marketplace. He observed that today the "proliferation of competing international production networks are beginning to change the rules of competition" [1]. Companies engaged in free market competition strive to sell a better quality and more affordable product than their counterparts. This forces companies to look for ways to increase efficiency and reconsider traditional strategies. Globalization in the marketplace lends itself to regionalization on a large scale. Companies look for cheaper ways to make their products and in return decrease prices overall. Pickles & Smith [2] looked at the European Clothing Industry and how it was effected by the creation of The European Union and the subsequent changes in regulations in the region. Clothing companies found that certain regions had lower labor costs, taxes, and regulations than neighbors regions close by. Companies could look to regionalize to get out of high cost environments

where their facilities were currently operating.

Location is becoming increasingly important as companies look to decrease costs. Globalized and even local companies are finding countries, or even states or counties within some countries, that have lower costs to produce products. Colovic & Mayrhofer [3] observed optimal locations for production activities in the automotive industry. Automotive companies had to choose locations based on proximity to the market and costs in those regions. Picking a specific region also depends upon non-economical factors such as customer service, community outreach and philanthropy.

Kraemer & Dedrick [4] looked at Dell Computer and how the company globalized their production network. They pointed out that call centers were located regionally to optimize communications by having closer network connections between customer and Dell support. Regional call centers also helped with language differences and difficulty of understanding a foreign dialect either with customer or support staff.

Companies are continuously looking for advantages in economies of scale to increase revenue. "Dell selects specific locations based on a combination of factors including labor costs, transportation and information infrastructure, market access, proximity to markets and government incentives" [4]. Labor costs can be a large percentage of the total costs in creating a product. Regionalization can consolidate facilities into low wage regions or rely on more experienced workers than before. Pickles & Smith [2] observed that clothing companies were focused in low wage European countries. Along with low wages, industry regulations were more relaxed in certain countries and therefore companies would incur less compliance costs.

Disadvantages of Regionalization.

Globalization of the marketplace brings negative effects as well. Increased globalization brings additional competition to the local marketplace. Ernst [1] explained

that more competition among the marketplace forces innovation. Innovation can be a positive effect of regionalization but also a detriment to a small company who has little capital to put towards innovating. An increasing globalized environment can bring in bigger companies than before. Companies that regionalize need to be careful not to create a void in a local market that can be exploited by bigger companies. Another potential problem with regionalization is that local governments might change regulations or taxes in their districts. Pickles & Smith [2] found that clothing companies were located mostly in low tax and low labor cost regions. Governments can increase their regulations and a newly regionalize facility is less flexible from avoiding these costs than many local facilities in the area.

The location that a product is made can have a cultural effect on the demand for that product. One example is the Made in America tag that American consumers might prefer over foreign made products. This is particularly important in the automotive industry. Company location choices are guided by obligation to produce locally [3]. Companies need to look at who buys the products and any applicable customer loyalty. The automotive industry, for example, either makes cars in the United States or ships parts into the United States for final assembly to qualify for the Made in America tag.

2.2 Maintenance

Advantages of Regionalization.

Production lines are where a good is manufactured in a set mechanical or manual operation. This allows companies to mass produce that same good. Logistic centers are used as a middle point for organizations transferring their goods from factories to the customer. Fedex, for example, sends all packages to logistic centers before getting the item on the truck for delivery to the customer. Maintenance depots are similar

to both the logistics center and production line. The maintenance depot is a regional hub that receives broken goods which are then repaired, or even re-manufactured, before returning back to the customer.

Maintenance depot consolidation may yield the same potential benefit as logistic centers and production lines in saving labor costs. A company with multiple maintenance depots can consolidate facilities or functions to reduce possible redundancies in the process. Mitchell & Pasch [5] looked at whether regionalizing calibration laboratories should be consolidated or collocated. They found potential cost savings in consolidated calibration laboratories by decreasing the number of workers needed to fulfill the maintenance obligations. Excess labor hours or redundancies can be diminished by regionalizing facilities that address the same mission. A GAO (General Accounting Office) report by Warren [6] found that the Air Force military depots had forty-five percent excess labor capacity. The report looked at outsourcing effects of military maintenance depots. They found maintenance depots were not working at full capacity and in some cases privatizing the depots cost more than Department of Defense (DoD) controlled depots. Companies will need to assess the workload of each facility and the similarity of each facility in a particular region.

With the consolidation of facilities, workers have the ability to gain more experience as efficiency increases in the facility. The consolidated facilities pool together resources by grouping more assets together. "Pooling has been shown to increase the efficiency of a queuing system by lowering the total time a customer spends in the system" [5]. More experienced workers are more efficient at their job and have faster servicing times. A regionalized maintenance center has the ability to cover most servicing calls and is less likely to have to send products to other facilities. Mitchell & Pasch [5] discuss the decrease in overflow costs by servicing more complex issues within the regionalized facility than in smaller local facilities. Training

benefits are another positive effect of regionalization. Employees can cross-train on multiple components with a larger facility rather than focusing on individual servicing calls. "Calibration technicians at a consolidated maintenance site would be exposed to components from all the different aircraft types serviced by the consolidated site, rather than just the components peculiar to the aircraft serviced" [5]. Employees can be trained over multiple maintenance components and easily move to different departments within a regionalized facility.

Consolidating maintenance facilities into a larger more encompassing complex can have the benefit of reducing fixed and marginal costs. Reducing fixed costs can be very important. Mitchell & Pasch [5] examines the potential benefit of decreasing fixed costs by using less overall space to get the same job done. This reduces the chance of having multiple equipment or personnel doing the same job. Regionalized facilities have the ability to cut inventory by having a more efficient servicing line than multiple smaller facilities. Tripp, et al., [7] looked at the Air Force Maintenance network and improvements particular aircraft maintenance programs could undertake. They concluded that regionalizing facilities would speed up the entire maintenance process for certain aircraft. "It is more effective because consolidation can speed the flow of aircraft through inspections, which means that fewer aircraft are tied up in maintenance processes at any given time and, thus, more aircraft are available to the operational community" [7]. They also conclude that the Air Force will have less aircraft in maintenance along with a greater operational capability. A company can focus more resources on the mission when less products go into maintenance.

Disadvantages of Regionalization.

Before regionalizing, companies must decide who will manage the new facility that encompasses multiple departments. This can cause problems since each sub organiza-

tion has different goals and these might conflict among organizations. "Parochialism between the warfare areas is embedded deep in Navy culture and goes back to its early roots." [5]. It can be extremely difficult to consolidate departments that have had to fight against one another for resources in the past. Companies that wish to regionalize need to look at the impact of the consolidated departments and if a common goal can be achieved. Funding differences can also affect regionalization. Mitchell & Pasch [5] discuss the need to standardize and simplify funding sources. Private or public funding sources are another factor companies must look at before regionalizing. Warren [6] found that there were differences in DoD maintenance programs that were restructured into public or private control. In some cases, privatized programs were costing more than previous calculated. Organizations need to address which funding sources will have the greatest overall benefit.

Companies choosing to regionalize need to look at short term costs versus long term costs. Building a new facility or providing new modifications to an existing facility incurs a cost. Transporting equipment and closing down facilities also incurs a short term cost. Organizations need to weigh these short term costs versus the added benefit of the regionalized facility. Mitchell & Pasch [5] found that regionalizing calibration laboratories might affect the readiness of the organization as a whole. Regionalized facilities will not have the benefit of moving supplies as easily when something goes wrong. This increases the chance for a catastrophe in the whole process if any component fails. A local facility that shuts down can push all work to another facility. A regionalized facility that shuts down might not be able to push all work to another facility and therefore be out of service until fixed. Mitchell & Pasch [5] added that there could be a customer service impact consolidating local facilities into regionalized centers. Maintenance centers are fixing products from their customers and need to have strong customer service networks to ease any complications.

2.3 Logistics

Advantages of Regionalization.

Regionalizing distribution networks centralizes the command structure by consolidating facilities or even sub organizations within the organization. Israel et al., [8] observes in research centers in New York City and Seattle the effects of an organization adhering to collaborative principles. Businesses consolidating their logistical networks may not be merging facilities with similar missions. The different missions and objectives of the facilities, once combined, can potentially negatively affect the entire organization. The need for a common mission among the component sub organizations helps advance the organization as a whole. By regionalizing these sub organizations, common ground may be found. The need for oversight has the ability to reign in the problem of information logistics. Information logistics is the process of moving information up and down an organizational hierarchy. Leavell [9] researched the need for counterterrorism networks to integrate into one national counterterrorism system. This will affect how information will be passed through the organization by changing the logistical network. Oversight in the form of new management or committees forces the integration of sub organizations. The combination of a common mission and oversight helps ease the transition of the newly consolidated facility and minimizes isolation among groups.

The economic effect of regionalization can force companies to become more competitive not only among each other but also within each company. Leadership will look for more efficient ways to integrate their organizations and therefore sub organizations will have to compete among themselves in order to prove their relevance to the company. Notteboom & Rodrigue [10] looked at the impact of regionalizing shipping ports. They found that companies should regionalize shipping ports to reduce costs. "With a more efficient access to the hinterland, mainly through modal

shift, port competitiveness is thus increased" [10]. The increase in competition will weed out past financial waste in the company and increase efficiency overall. This process can also be used in the public sector among government resources. Leavell [9] looked at fusing multilevel private sector and government resources together. Governments have their own goals and can be used in conjunction with the private sector. The example Leavell [9] uses is joining government intelligence agencies with private intelligence companies to eliminate information sharing barriers.

Increasing efficiency in an organization can also target redundancies in their supply chain or supply chain system. Logistically this can decrease resources available to move supplies from facilities or optimize the path for these supplies to be delivered. Ellmyer [11] looked at centralizing the Air Forces logistics centers into regionalized centers to decrease redundancies. "This transformation into a smaller, more agile force will eliminate redundancies within the MAF and CAF while possibly fielding a more capable force of military, civilians, and contractors while freeing up resources for recapitalization" [11]. A company can then focus more resources on critical issues and increasing sustainment over the long run. Consolidating facilities potentially can lead to sharing reduced resources among multiple departments within the company by introducing more competition over fewer resources.

After organizations have consolidated or regionalized their networks, long-term commitment for organizations focused on the core mission can reap more positive results. Israel et al., [8] observed the need for long term goals after regionalization. Larger facilities have more objectives to adhere to and the overall mission can be lost after changes in management occur over time. Leavell [9] found that organizations were trying to broaden the core mission to handle too many problems compared to the intended purpose of the organization. Regionalized centers need to focus on the long term goal for the company and keep the best interests of the company in mind

when tackling problems.

Disadvantages of Regionalization.

The first challenge with regionalizing logistical networks is noticing the problem. Just because regions exist does not mean that regionalization should occur. Bogard [12] looked at how government agencies can best consolidate to respond to natural disasters. "Formal regionalization only occurs when a leader within a region recognizes the need for improved command and control and executes a plan or a structure for the counties within his or her region to collaborate through a formal mechanism" [12]. Smaller organizations dispersed in a region might be more beneficial logistically than creating a regional center with too few customers. Efficiency is the main objective when organizations regionalize and efficiency can be lost by regionalizing too much. Bogard [12] also observes that bureaucracy in the organization can inhibit improved efficiency. Leadership might have other interests in keeping a center in one part of the region even if it decreases the organization's overall efficiency.

Regionalized logistical centers may lead to positive benefits but also can negatively affect the company if the centers take on responsibilities they are not designed to handle. Larger organizations tend to have more responsibilities than smaller ones but oversight can be harder to achieve. Regionalized networks might want to take on extra tasks that the network was not designed to do or force more operations through the companys regional center. Leavell [9] stressed that centralized command is not always relevant. In the case of government agencies, opening up more communications between each other can help alleviate problems.

Organizations that regionalize are moving out of certain areas to a centralized center. This can lead to longer wait times, less benefits, and other advantages that were obtainable when the organization was in that area. Bogard [12] detected that

regionalized centers are less able to deal with emergencies from isolated areas that use local centers. The organization that is looking to regionalize must look at the costs of moving out of certain areas and the impact of other organizations moving into those regions.

2.4 Academics/Research

Advantages of Regionalization.

Academic institutions have long partnered with companies to create a learning environment outside of the classroom. Regionalized facilities can offer a broader knowledge base for students or researchers compared to smaller specialized facilities. Henderson [13] examined the possibility of introducing a center of excellence program at Fitzsimons Army Medical Center. The center would partner with local universities to give real world teaching that is required as a medical student. Larger facilities will have a better chance of teaching more students from different backgrounds compared to smaller specialized facilities. Organizations with these relationships can also benefit from recruiting purposes. "The military GME (Graduate Medical Education) programs have always been one of the primary recruiting and retention mechanisms for military physicians" [13]. A company drawing more students will have a greater pool to recruit from and retain those employees longer.

Research and Development are important aspects of organizations positioning for future growth. Regionalized facilities have the ability to attract more researchers to a particular location. Universities and research organizations want to locate around areas that give them the most benefit. A regionalized facility can give those organizations maximum benefit in one area. Regionalized facilities can use the money saved from consolidating and invest in more research than before. Israel et al., [8] explains that some urban research centers were able to work with local universities

with funding and sponsorships.

Academic institutions and research companies have the ability to regionalize into larger organizations to gain market power. Large research organizations are able to pull more money and contacts than being individual organizations. A large organization may have a greater chance of making a partnership deal with other organizations due to the power the organization has.

Disadvantages of Regionalization.

The literature provides common negative themes that can be applied to academics and research. Organizations that choose to regionalize, run the risk of distancing themselves from local communities that lost a facility. Local academic institutions or research companies may find it more difficult to work with companies that pulled out of their local areas. Academic institutions that regionalize might lose the community ties that local teachers once had. Schools that teach younger students tend to have more community interaction than schools that teach young adults.

2.5 Hospitals

Advantages of Regionalization.

The main driver for hospital regionalization appears to be the effect of volume on the quality of care. The theory is that the more procedures performed in the hospital, the greater the skill developed, and, the lower the mortality rate of the patients that are undergoing those procedures. Gordon et al., [14] looked at the effects of regionalization on cost and outcome for a general high-risk surgical procedure. They found "the high-volume regional medical center achieved superior outcomes at a lower cost" [14]. Their explanation was that the surgical team were more experienced due to the higher number of procedures performed. Regionalizing hospitals consolidates

surgical procedures into one medical center and increases the total volume of those procedures. Brevig et al., [15] summarized literature on fourteen medical procedures and found no low-volume hospitals had more favorable outcomes than high-volume hospitals. They note that previous research gives a threshold of how many annual procedures surgical teams should be doing to offer the best outcomes.

Regionalizing hospitals has produced cost savings. Hospitals can reduce fixed costs and redundancies by consolidating into fewer facilities. Henderson [13] found that regionalizing cardiovascular disease procedures would save millions of dollars in the Fitzsimons Army Health Service Region. Hospital organizations need to assess if regionalizing every medical procedure could result in cost savings or just certain procedures. Another option is to allocate procedures by hospitals to allow individual hospitals to focus on certain procedures to achieve the high-volume environment.

Hospitals that have consolidated into a regionalized center may also provide a more effective medical and academic training. Hospitals that provide more surgical procedures on average allow for more training of employees in those procedures. Employees also get the benefit of being in a centralized hospital that allows employees to get training on a wider variety of procedures. Brevig et al., [15] noted that academic students may receive better training in a high-volume environment. Medical students require clinical hours in hospitals to get their degree. High-volume environments give students a better chance of learning from surgical procedures compared to low-volume environments.

Disadvantages of Regionalization.

The fundamental responsibility of hospitals is their patients, but making a profit is still important. Regionalization has secondary benefits of cost savings but patient utilization should be the first priority. McGaw [16] evaluated the feasibility of estab-

lishing a regional trauma center at David Grant USAF Medical Center in Fairfield, California. Trauma patients need medical attention immediately to save their life. Hospitals that are interested in regionalizing need to look at the consequences of pulling out of a local area on critical patients. Increased travel times can have severe consequences in the life-threatening cases.

Integration of sub organizations into a consolidated medical center runs the problem of in-fighting among the departments. In-fighting are clashes between departments that have different missions to achieve. Rivalry is common in the other sectors examined in the literature review, but hospitals primarily deal with human patients. Van Hook [17] reviewed the regionalization efforts of the DoD and private sector as well as takeaways from the process. The study found that parochialism and segregated departments were having negative overall effects. Regionalized hospitals need to have a common mission and leadership that integrates departments into this mission. Van Hook [17] also notes that bureaucracy has been a problem that comes with the added efficiency. The larger hospitals get, the more bureaucracy it will take to run the hospitals.

2.6 Conclusion

The five organizational sectors examined provided common benefits and drawbacks of regionalization. The resulting sources found increases in economies of scale and increased efficiency due to regionalization. Organizations benefited from improved productivity and sustainment after facility consolidation. These benefits could come from fixed cost reduction, labor cost reduction, inventory reduction and less redundancies. Possible costs associated to regionalization could be facility modification costs, transportation costs and customer service costs. The drawback to increasing economies of scale is decreasing economies of scope. Regionalization may centralize

too much and lose the benefits of diversification. Funding for regionalized facilities may also affect profits. Companies need to address whether consolidating facilities will affect private or public funding in the future.

Another common characteristic is added labor benefits. Employees gain experience from increased volume and the ability to cross train in a regionalized facility. Consolidating labor increases competition for fewer jobs and results in higher efficiency. Organizations may also see an increased retention rate among employees as well as recruiting benefits. The drawback for employees could be trouble integrating departments and who will be in charge. The resulting sources outlined a need to have a common mission within the consolidated facility and an integrated strategy among the departments. Proper oversight will help the regionalization process to avoid in-fighting among the departments.

The focus of regionalization is to consolidate to a particular location that maximizes the benefits to the company. One location has the benefit of consolidating the supply chain into a centralized facility. The organization has the ability to pick the current optimal facility and build upon that one or construct a brand new facility that has location benefits such as a major highway. Drawbacks to a centralized location is the effect on local communities that lose a facility. Community outreach and philanthropy are usually essential to an organization and centralized facilities may disrupt that connection. Fewer facilities may decrease the chance of dealing with emergencies within the company. Companies will be less able to send parts off to other facilities after consolidating local facilities.

The last common characteristic found from the resulting literature was the effect on management and leadership within the organization. Management must first notice that there is room for improvement in a local area by regionalization. After facilities are regionalized, leadership will need to address who will be in charge of

the new facility, whether to consolidate departments, and a common strategy for the facility. The strategy will come from a common mission among all departments and management to stick to that mission.

III. Case Study

3.1 Background

The sources in the Literature Review outlined common advantages and disadvantages of regionalization. This insight is used on a case study of the Military Health System (MHS). Hospitals and clinics located in the MHS are located around the world and provide care to active and retired military families. The case study focuses on the National Capital Area because of the number of MHS facilities in the area. Brevig, et al., [15] showed that there were competing medical facilities within the National Capital Area on in-patient procedures. Therefore, lessons learned from regionalization are used for this given scenario.

3.2 Methodology

One of the main reasons for companies regionalizing are potential cost savings from greater efficiency. These efficiency increases are obtained through facility consolidation or changing operations within the facilities themselves. Most of the Medical Treatment Facilities (MTF) are located on military bases or have designed missions such as Walter Reed for battle injury recovery. Therefore facility consolidation is an unlikely regionalization method. The case study instead looked at how MTFs within a particular region could change how they operate. One opportunity described in Brevig, et al., [15] was to divvy up surgical procedures by hospitals to reach optimal quality care among surgeons. The review of past studies found the link between higher volume and quality care. Along with higher quality, cost savings can also play a role in the benefits of certain medical facilities specializing in certain specialties. This can be due to different facility costs, medical costs, and location of the facility.

The data for the case study was obtained from the MHS Data Repository (MDR)

which is owned by the Defense Health Agency. The study looked at three MTFs in the National Capital Region, Walter Reed Medical Center, Joint Base Andrews Medical Clinic, and Ft Belvoir Community Hospital. All medical facilities are within thirty miles of the D.C. area. There are MTFs near Norfolk, VA but these were not used because a patient would be unlikely to drive from eastern D.C. down to Norfolk when multiple medical facilities are within thirty miles.

Three in-patient medical procedures were used to further examine which MTF could specialize in a certain area. In-patient procedures were used over out-patient procedures due to the higher costs associated with in-patient medical procedures. Patients are less likely to travel for a procedure that has a very low mortality rate and the government will be less likely to consolidate less expensive medical procedures. The three procedures used in the analysis was Hip Procedures, Knee Procedures, and Lymphoma & Non-Acute Leukemia Procedures. These procedures were performed at all three MTFs and almost all patients spent no days in Intensive Care Unit (ICU). The assumption of this analysis was that patients chose the best medical facility that will perform their procedure. This is not the case with patients that enter ICU because of the immediate attention that is needed.

Table 1 shows the total annual procedures by each year and MTF. JB Andrews has a drop off after 2012 for all procedures because the hospital transferred over to a clinic in 2011. The MTF is still used in the case study to show possible past cost savings for previous years. There is a dip in the number of procedures around 2009 to 2011 and then an increase in procedures. The cause for this is unknown from the dataset.

Table 1. Total annual procedures by year and MTF

Total Annual Procedures										
	Lymphoma			Hip			Knee			Total
Fiscal Year	JB Andrews	Walter Reed	Ft Belvoir	JB Andrews	Walter Reed	Ft Belvoir	JB Andrews	Walter Reed	Ft Belvoir	
2000	0	34	2	9	18	6	9	19	45	142
2001	6	30	0	12	20	6	24	12	38	148
2002	3	24	1	4	23	4	28	14	12	113
2003	5	21	0	8	23	2	16	7	12	94
2004	5	26	1	14	26	3	3	10	14	101
2005	2	36	2	5	26	1	9	15	5	101
2006	0	53	0	4	24	1	4	27	1	114
2007	1	19	0	3	23	0	6	10	1	63
2008	0	29	0	0	40	1	2	22	0	94
2009	0	30	0	1	19	0	2	23	2	75
2010	0	16	0	1	15	0	4	14	0	50
2011	0	23	0	1	14	0	3	7	2	49
2012	0	61	6	0	43	6	0	6	0	119
2013	0	59	2	0	62	10	0	11	0	141
2014	0	118	3	0	64	14	0	15	2	211
2015	0	76	2	0	69	11	0	15	1	171

3.3 Data Cleaning

The data came from a government database that had relatively few problems. There were no blank cells requiring deletion, but the data did have a wide variability on the cost data associated with each patient. The cost data was broken up into patient costs and fixed costs. Patients costs were dependent on what the patient needed for that surgical procedure and fixed costs were dependent on the costs of the facilities during the patient's time in the facility. The variability of the cost data came from the difference in the amount of bed days each patient was in the hospital before or after the surgery. Therefore the patient and fixed costs were divided by the number of bed days that patient stayed at the hospital to get a comparable estimate among the facilities. The average bed days, median bed days, average patient costs, and average fixed costs patients spent in each MTF are seen in Appendix A. Median bed days was used over average bed day due to the skewness of the data to high number of bed days. This effect can be seen when comparing median and average bed days. The cost data was also skewed to higher costs but was not as apparent as bed days.

The present data graphs did not have any outliers removed to show a base model for the cost predictor model in the case study. The cost predictor model had sixteen outliers removed from the data set. The outliers were found by plotting the cost data for each MTF and procedure. Outliers were removed by simply picking out any extreme values. Most outliers seemed to have come when patients stayed in the hospital for only one day. Therefore, all the costs of the pre-operation, procedure itself, and post-operation were compiled into one day. When patients stayed multiple days in the hospital, costs could be averaged out to multiple days. Most of the outliers came from Walter Reed and during a year of high surgical procedure volume. The data did not give any reason for this coincidence.

3.4 Analysis of Present Data

The goal of the case study was to consider potential cost savings by consolidating each surgical procedure to that hospital having the lowest costs. This theory was tested on the current years of data obtained from the MDR from 2000 to 2015. Figure 1 shows the sum costs of each MTF for each year for hip procedures. The figure also shows the total costs which is all costs of the MTFs added together. The costs were calculated by multiplying the median bed days by the average total costs and by the number of annual procedures. The lowest cost solution was calculated by moving all

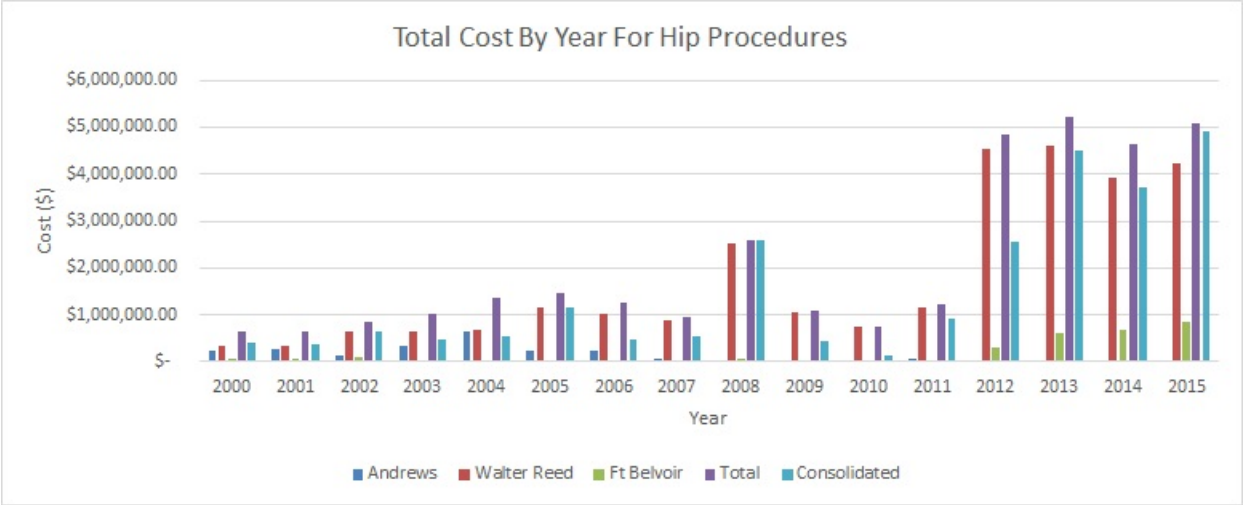

Figure 1. Total costs of each MTF with sum costs of all three MTFs and consolidated solution

procedures for that year over to the least expensive hospital for that year. There was a noticeable difference between total costs for all three MTFs and the lowest cost solution calculated. The other two surgical procedures can be seen in Appendix B and have similar results as the hip procedure. The next objective of the case study was to create a model that would predict future years for each procedure and hospital. The future costs would be compared the same way as before and estimate potential cost savings overall.

3.5 Model

A logarithmic regression model was used on the independent variables (Fiscal Year) to predict the costs, bed days, and number of procedures. The model uses least squares to approximate a best fit trend line for the data. The equation for the model is shown in Equation 1.

$$y = \hat{B}_0 + \hat{B}_1 \ln(x) \tag{1}$$

A log transformation was used on the data rather than a linear regression because of the smoother fit of the data. An example of the trend line can be seen in Figure 2. The equation for each model fit was used to predict the costs, bed days, and number of procedures for 2016 and 2017. Fiscal years 2012 to 2015 were only used

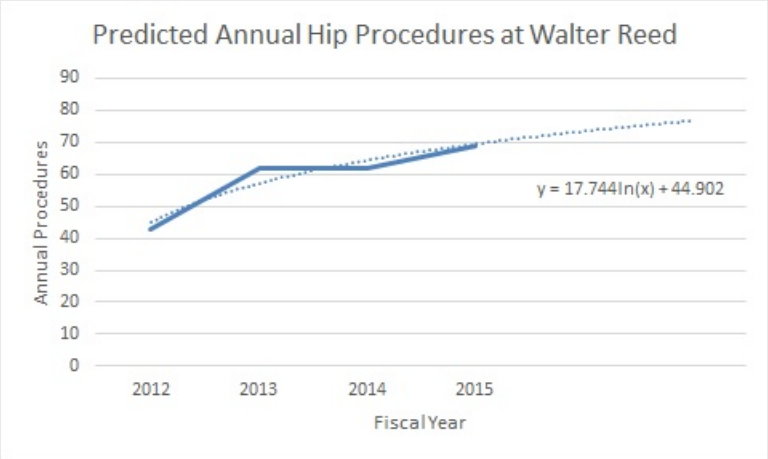

Figure 2. Log trend line of Hip Procedures at Walter Reed with equation and projected two years out

for the model. This is due to a change in the MDR system after 2011. The updated system used different designator codes for each surgical procedure and increased the number of procedures performed overall. The new system will be used for future years and therefore this approach seemed reasonable even though previous data will not be used to predict. The regression model will only predict the first two years

of 2016 and 2017. This is because of the small number of data points used for the forecasting model and the higher chance of extrapolation from this approach. The logarithmic regression model was used for all predictions except Ft Belvoir for knee procedures. Ft Belvoir had knee procedures for 2014 and 2015 but no procedures for 2012 and 2013. Any regression equation would over estimate the predicted costs, bed days, and number of procedures. Therefore the average for 2014 and 2015 was used to predict 2016 and 2017 for number of procedures and costs. Since Ft Belvoir only had one knee procedure in 2015 which was nineteen bed days long, the 2014 median bed days of three and one half were used to predict future years.

3.6 Results

The regression model predicted the number of annual procedures and average costs for each MTF by procedure. Table 2 and Table 3 show these results. Annual Procedures were rounded to the nearest whole number because a fraction of a procedure was not feasible. Table 3 the predicted cost per patient which was calculated by multiplying median bed days by average cost. Joint Base Andrews was not used in the analysis because from 2012 to 2015 there were no procedures performed in any category. This coincides with the change from JB Andrews to a clinic from a hospital at that time. Therefore it is reasonable to assume JB Andrews will not perform any surgical procedures in future years for any category.

Table 2. Predicted number of annual procedures by MTF

Total Predicted Number of Procedures						
	Leukemia		Hip		Knee	
Fiscal Year	Walter	Belvoir	Walter	Belvoir	Walter	Belvoir
2016	95	1	73	14	17	2
2017	100	1	77	15	19	2

The same analysis was conducted for the predicted years as was used for the

Table 3. Predicted total costs including fixed and patients costs

Predicted Costs Per Patient ($)						
	Leukemia		Hip		Knee	
Fiscal Year	Walter	Belvoir	Walter	Belvoir	Walter	Belvoir
2016	35,236.64	33,092.58	51,006.57	78,391.11	46,471.62	27,823.09
2017	32,426.78	32,306.71	45,965.71	80,009.21	39,256.87	27,823.09

present data from 2000 to 2015. The results are found in Figure 3 as well as Figure 6 and Figure 7 in Appendix C. The results are similar to the previous years analysis in that taking a consolidated approach is more cost effective than using multiple MTFs for a single procedure. The predicted cost savings for hip procedures is $383,383.51 in 2016 and $510,652.54 in 2017 by moving all procedures in the area to Ft Belvoir.

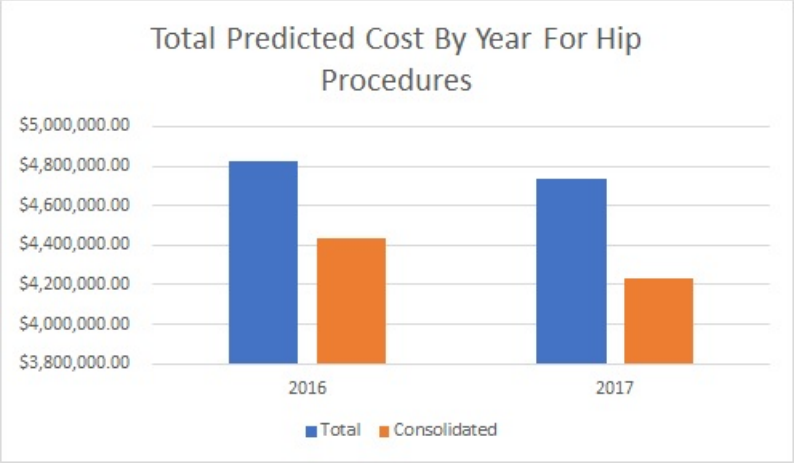

Figure 3. Total predicted costs of each MTF with sum costs of all three MTFs and consolidated solution

3.7 Assumptions and Limitations

The three hospitals used in the case study were assumed to be taking in similar patients. This would allow an equal comparison among the three. The cost data was skewed to the right because of the high costs associated with patients only staying one day in the MTF. The number of bed days were skewed to the right due to certain patients staying in the hospital for extended lengths of time. The data did

not distinguish if these patients were also at the MTF for other procedures or any other health risks. These problems with the data were only worsened with the low amount of data points for each MTF and year.

3.8 Future Research

The case study showed potential cost savings by giving a simplistic approach to consolidating military hospital systems. This approach did not take into consideration the actual ability for these MTFs to absorb these extra procedures as well the political action required to do it. Future work could outline a more complex model to cover more procedures or focus on a specialty such as cardiology. Another opportunity would be to look at the difference between private and public hospital costs. Overall cost savings may be greater by moving a particular procedure to the private sector than having the resources available in a military or Veterans Affairs hospital. This case study looked at just consolidating hospitals and not other forms of regionalization as well. Future research could look into regionalized facilities and see if there were cost savings associated with the facility from the previous regional setup. Another result from regionalization discussed in the hospital literature review would be to look at mortality rates. This case study only looked at cost savings and not if there were differences among mortality rates for each procedure. Regionalization could decrease mortality rates by increasing the volume of surgeries a doctor performs and the increased quality associated with it.

IV. Conclusion

This research was designed to outline common themes of regionalization in multiple organizational sectors and test those themes to a case study. The focus of an organization that was regionalizing was found to be for a number of reasons. These reasons could be to increase profit, market share, consolidate the organizational structure, and many others. The literature review outlined the advantages and disadvantages that have been associated with regionalization in five different sectors. These similarities were reduced costs, increased efficiency, cost of moving, reduced inventory, inability of new organization to work together, etc. The common themes with regionalization can be used as recommendations for future organizations considering regionalizing their facilities.

The case study was able to look at military hospital facilities and find past and future cost savings based on consolidating surgical procedures to the lowest cost facility. This approach could shine light on the potential in cost savings in the public sector hospital systems such as military or Veterans Affairs hospitals. Moving surgical procedures that do not need immediate attention are feasible efficiency solutions with multiple benefits. The federal government would be able to save tax dollars by having surgical procedures performed at the lowest cost facility and potentially be able to decrease mortality rates with the increase in volume. The solution offered in this research can be more easily adopted than closing down a public hospital or creating a regional hospital to meet every patients' needs.

Appendix A

Table 4. The average bed days by surgical procedure per MTF and year

Average Bed Days									
	Leukemia			Hip			Knee		
Fiscal Year	JB Andrews	Walter Reed	Ft Belvoir	JB Andrews	Walter Reed	Ft Belvoir	JB Andrews	Walter Reed	Ft Belvoir
2000	0.00	6.47	3.00	8.78	6.39	2.67	1.56	3.32	1.24
2001	10.67	8.37	0.00	5.67	7.25	2.17	3.04	6.17	1.08
2002	6.00	6.17	1.00	7.25	10.39	3.25	2.89	7.50	1.17
2003	2.40	7.38	0.00	6.38	8.13	1.00	1.94	2.86	1.25
2004	3.00	8.77	1.00	5.86	8.68	1.00	1.33	6.30	1.00
2005	2.50	5.31	3.50	12.40	10.69	4.00	1.00	4.87	1.00
2006	0.00	4.75	0.00	7.00	10.58	1.00	1.00	6.48	1.00
2007	1.00	6.53	0.00	4.00	12.74	0.00	4.17	6.60	4.00
2008	0.00	7.45	0.00	0.00	6.85	14.00	1.00	6.59	0.00
2009	0.00	4.82	0.00	3.00	5.74	0.00	1.00	3.48	1.00
2010	0.00	14.75	0.00	5.00	9.13	0.00	1.75	7.79	0.00
2011	0.00	7.30	0.00	3.00	9.31	0.00	1.33	4.86	2.50
2012	0.00	6.34	2.17	0.00	7.51	5.33	0.00	10.33	0.00
2013	0.00	10.52	3.50	0.00	5.23	7.50	0.00	10.73	0.00
2014	0.00	6.3	6.33	0.00	4.97	3.93	0.00	4.20	3.50
2015	0.00	5.60	2.50	0.00	4.94	3.91	0.00	6.07	19.00

Table 5. The median bed days by surgical procedure per MTF and year

Median Bed Days									
	Leukemia			Hip			Knee		
Fiscal Year	JB Andrews	Walter Reed	Ft Belvoir	JB Andrews	Walter Reed	Ft Belvoir	JB Andrews	Walter Reed	Ft Belvoir
2000	0.00	5.00	3.00	5	5.50	2.50	1.00	3.00	1.00
2001	10.00	4.00	0.00	3.50	6.00	1.00	1.50	5.00	1.00
2002	2.00	4.00	1.00	7.00	8.00	2.50	1.00	3.00	1.00
2003	2.00	3.00	0.00	6.50	7.00	1.00	1.00	3.00	1.00
2004	1.00	6.00	1.00	5.00	6.00	1.00	1.00	2.50	1.00
2005	2.50	4.00	3.50	6.00	8.00	4.00	1.00	3.00	1.00
2006	0.00	4.00	0.00	7.00	7.00	1.00	1.00	5.00	1.00
2007	1.00	4.00	0.00	2.00	7.00	0.00	4.00	6.00	4.00
2008	0.00	6.00	0.00	0.00	5.50	14.00	1.00	3.00	0.00
2009	0.00	2.00	0.00	1.00	6.00	0.00	1.00	3.00	1.00
2010	0.00	4.00	0.00	1.00	6.00	0.00	2.00	4.50	0.00
2011	0.00	4.00	0.00	3.00	8.00	0.00	1.00	3.00	2.50
2012	0.00	5.00	2.00	0.00	6.00	4.50	0.00	7.00	0.00
2013	0.00	5.00	3.50	0.00	4.50	6.00	0.00	10.00	0.00
2014	0.00	4	3.00	0.00	4.00	3.50	0.00	3.00	3.50
2015	0.00	3.00	2.50	0.00	4.00	4.00	0.00	4.00	19.00

Table 6. The average patient costs for each procedure per bed day by MTF and year

Average Patient Costs Per Bed Day in Dollars									
	Leukemia			Hip			Knee		
Fiscal Year	JB Andrews	Walter Reed	Ft Belvoir	JB Andrews	Walter Reed	Ft Belvoir	JB Andrews	Walter Reed	Ft Belvoir
2000	0.0	3492.5	3327.7	2936.4	1911.7	2910.9	5089.0	3108.3	3982.1
2001	3531.4	1664.6	0.0	3567.8	1673.5	5564.9	4937.2	1496.8	5877.7
2002	3146.4	2550.0	6574.3	3050.9	2052.6	4995.2	6667.6	3482.1	8106.2
2003	4498.9	3549.3	0.0	3787.9	2245.3	8112.3	6914.4	3241.0	7348.1
2004	4315.4	3312.9	3406.8	5571.3	2662.1	7093.9	8918.6	4304.5	7449.9
2005	4356.4	4419.7	3940.4	4665.9	3127.9	5003.9	12943.0	4265.7	8677.4
2006	0.0	5053.3	0.0	4994.8	3327.8	9417.6	9148.0	4009.5	10637.7
2007	11050.5	4240.4	0.0	5995.9	3032.1	0.0	3820.9	3844.9	4252.8
2008	0.0	5326.0	0.0	0.0	6354.9	3194.3	15037.3	8026.0	0.0
2009	0.0	5873.2	0.0	12050.2	5272.2	0.0	25482.8	6269.6	11112.7
2010	0.0	5385.0	0.0	4367.9	4824.6	0.0	7153.8	5439.2	0.0
2011	0.0	7894.1	0.0	12173.0	8372.6	0.0	19621.0	8548.6	9104.4
2012	0.0	7289.8	8322.9	0.0	9552.9	6440.5	0.0	7601.9	0.0
2013	0.0	5663.6	7365.8	0.0	9254.3	5720.4	0.0	5404.7	0.0
2014	0.0	7587.4	6667.5	0.0	9395.4	7668.2	0.0	9184.2	4728.9
2015	0.0	6564.3	6308.3	0.0	8509.4	10612.2	0.0	6889.8	4052.8

Table 7. The average fixed costs per bed day for each procedure by MTF and year

Average Fixed Costs Per Bed Day in Dollars									
	Leukemia			Hip			Knee		
Fiscal Year	JB Andrews	Walter Reed	Ft Belvoir	JB Andrews	Walter Reed	Ft Belvoir	JB Andrews	Walter Reed	Ft Belvoir
2000	0.0	2472.1	2501.4	2295.1	1389.0	2152.4	4014.7	2345.6	2979.4
2001	2673.5	1147.5	0.0	2671.1	1141.1	4212.2	3709.6	1032.1	4489.9
2002	2249.0	1689.7	4712.2	2023.9	1371.8	3410.6	4558.1	2406.1	5651.5
2003	3408.7	2782.6	0.0	2847.6	1724.0	6575.5	5238.7	2619.1	5983.8
2004	3005.6	2664.1	2712.2	3736.4	2158.5	5623.2	6048.1	3606.0	5932.1
2005	3327.8	3510.8	3051.0	3656.7	2506.2	3921.5	10249.6	3615.2	6921.1
2006	0.0	4049.8	0.0	3744.5	2694.2	6802.4	6823.6	3354.8	7742.0
2007	8191.3	3379.0	0.0	4187.0	2476.9	0.0	2482.5	3191.6	3175.0
2008	0.0	4229.8	0.0	0.0	5133.9	2435.5	11415.1	6508.2	0.0
2009	0.0	4438.2	0.0	9449.2	4075.3	0.0	20145.3	4989.9	8918.7
2010	0.0	3807.2	0.0	3232.6	3482.6	0.0	5468.3	3981.0	0.0
2011	0.0	5793.4	0.0	9621.4	5997.5	0.0	15579.6	6172.6	7011.4
2012	0.0	6065.4	6805.0	0.0	7991.6	5108.2	0.0	6357.7	0.0
2013	0.0	4360.2	6012.9	0.0	7262.1	4684.8	0.0	4166.5	0.0
2014	0.0	5966.8	5366.5	0.0	7388.4	6317.2	0.0	7155.6	3953.7
2015	0.0	5298.8	5045.7	0.0	6821.8	8633.9	0.0	5424.8	3163.5

Appendix B

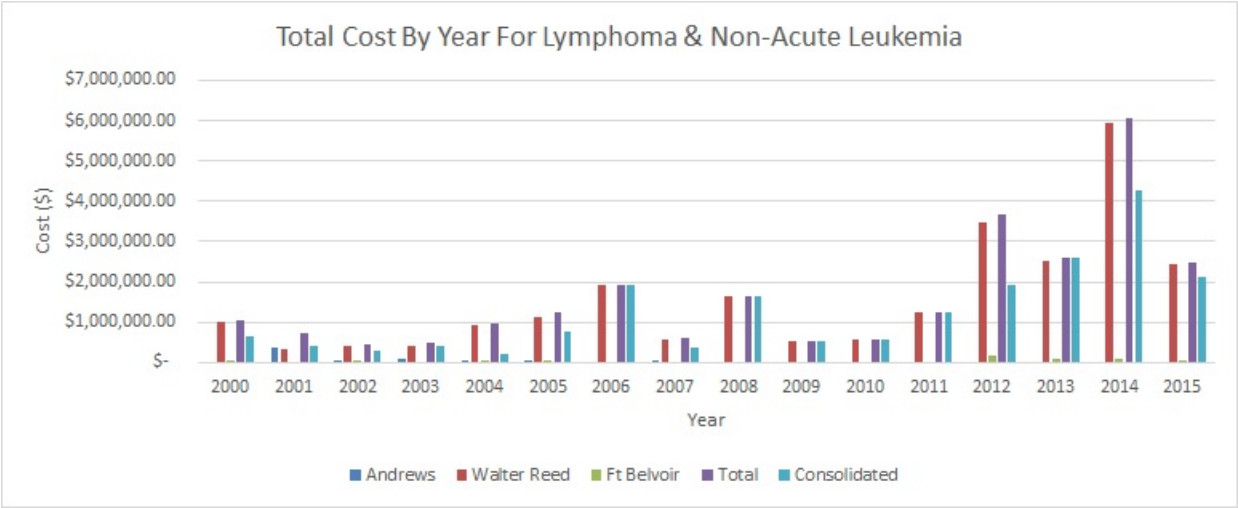

Figure 4. Total costs of each MTF with sum costs of all three MTFs and consolidated solution

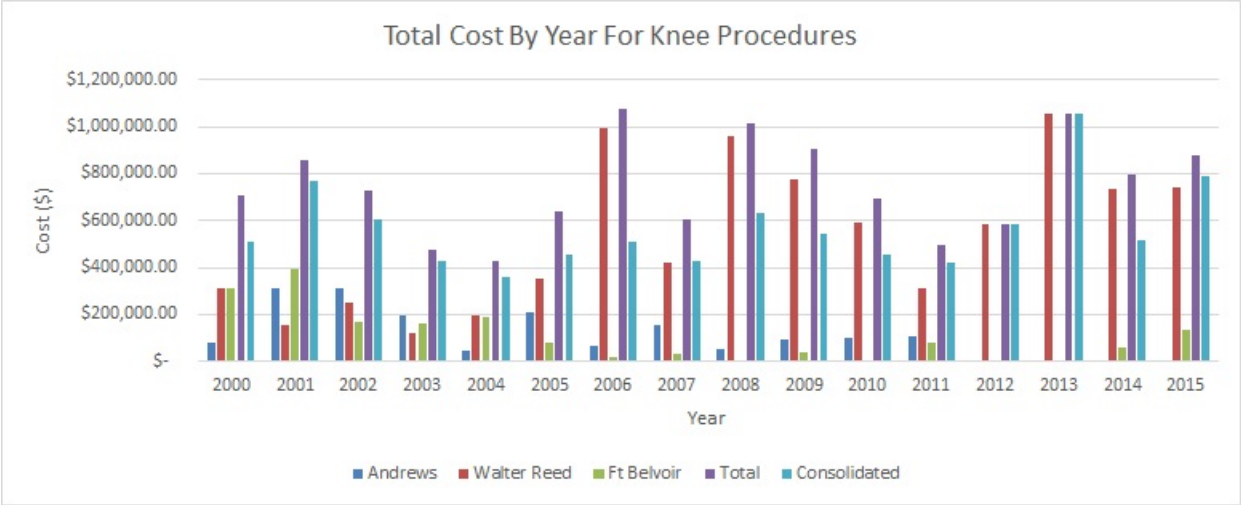

Figure 5. Total costs of each MTF with sum costs of all three MTFs and consolidated solution

Appendix C

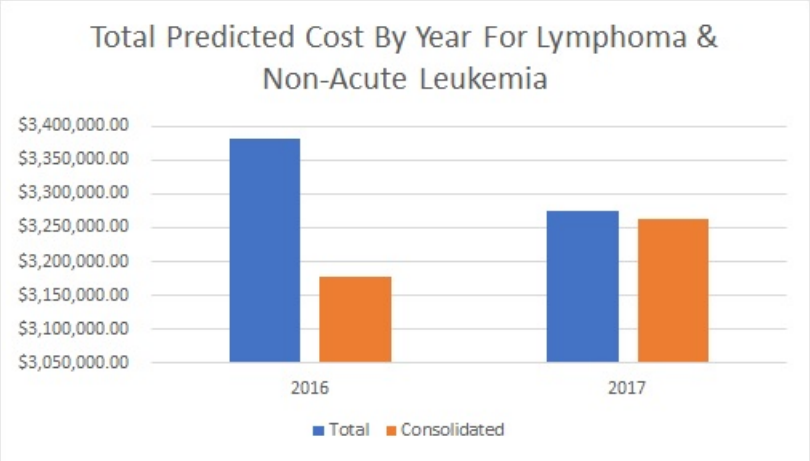

Figure 6. Total predicted costs of each MTF with sum costs of all three MTFs and consolidated solution

Figure 7. Total predicted costs of each MTF with sum costs of all three MTFs and consolidated solution

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14. ABSTRACT

The increase in competition locally and globally has forced companies to become more efficient. One way for companies to gain efficiency is by regionalizing their facilities by either consolidating or collocating to a particular location. A comprehensive literature review addressed the advantages and disadvantages organizations have used in the past when regionalizing. This insight was used on a case study looking at military hospitals in the National Capital Region. The case study was used to find potential cost savings for three surgical procedures by consolidating each procedure to the lowest cost hospital. Future years were then forecasted to find cost savings for these hospitals to look at for future reference.

15. SUBJECT TERMS

Regionalization, consolidation

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