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COST ANALYSIS OF CONSOLIDATED FEDERALLY PROVIDED HEALTH CARE

June 2017

By: **Joshua R. Harding**
Carlos R. Munoz Aguirre

Advisors: **Amilcar Menichini**
Uday Apte
Spencer Brien

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13. ABSTRACT (maximum 200 words)

This study explores specialization of health care as a solution to increase efficiency to the Department of Defense and Veterans Affairs health care. Health care for veterans and eligible beneficiaries continues to pose a significant budgetary constraint to the Departments of Defense and Veterans Affairs. Without modification to the current services provided at the Departments of Defense and Veterans Affairs, health care service will either decline or increase expense to the federal government and/or beneficiaries.

Using data from the Naval Medical Center San Diego and Veterans Affairs Medical Center San Diego as examples to specialization, five additional locations were identified as similar to the medical facilities in San Diego. The six total locations represent approximately 24% and 6% of the total health care budget for the Departments of Defense and Veterans Affairs, respectively. Using research on specialization of hospitals, an estimated cost reduction to the Departments of Defense and Veterans Affairs represents a potential median savings of $0.5–1.2 billion annually for the Departments of Defense and Veterans Affairs, respectively.

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COST ANALYSIS OF CONSOLIDATED FEDERALLY PROVIDED HEALTH CARE

Joshua R. Harding, Lieutenant Commander, United States Navy
Carlos R. Munoz Aguirre, Captain, United States Army

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Approved by: Amilcar Menichini

Uday Apte

Spencer Brien

Aruna Apte
Academic Associate
Graduate School of Business and Public Policy

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LIST OF ACRONYMS AND ABBREVIATIONS

3P	production preparation process
5S	sort, simplify, sweep, standardize, and self discipline
DHA	Department Health Agency
DHP	Defense Health Program
DOD	Department of Defense
FV	future value
FY	fiscal year
GAO	Government Accountability Office
JIT	just-in time
KPO	Kaizen promotion offices
LT	lead time
MHS	Military Health System
MRI	magnetic resonance imaging
NCR	National Capital Region
NMCSD	Naval Medical Center San Diego
O&M	operations and maintenance
OH	on hand
OMB	Office of Management and Budget
PSA	patient safety alert system
PTSD	post-traumatic stress disorder
PV	present value
RPIW	rapid process improvement workshop
SKU	stock keeping unit
TPS	Toyota Production System
VA	Veterans Affairs
VAMCSD	Veterans Affairs Medical Center San Diego
VMMC	Virginia Mason Medical Center
VMPS	Virginia Mason Production System

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I. INTRODUCTION

A. BACKGROUND

The current military health-care system in the United States is operated by the Department Health Agency (DHA), an entity of the Department of Defense (DOD). DOD has optimized health care through the creation of DHA by pooling individual military services under one health care organization. The beneficiaries of pooling are service members, retirees, and veterans, and their family members. Additionally, the U.S. government has a commitment to provide quality health care to veterans through the Department of Veterans Affairs (VA). This thesis examines how hospital specialization and resource pooling between the DOD and VA can gain efficiencies for the U.S. government.

According to National Defense Budget Estimates and Office of Management and Budget (OMB) Historical Tables 3.2 and 4.1, the U.S. government annually spends approximately $76.4 billion on health care, with the following breakdown: the DOD spends an annual average of $28.2 billion, while the VA spends an annual average of $48.1 billion yearly on health care. The figures represent an average of 5% of the Defense budget, while the VA spends an average of 43% of its yearly budget on health care for their beneficiaries, as shown in the Appendix, from fiscal years 1998–2017.

The DOD health-care system faces a growing challenge to provide top-tier health care to eligible recipients in a resource constrained environment. It is hypothesized that the government may be spending more than necessary by creating a redundancy of services for their employees. The U.S. government can simplify health care by combining services and resources instead of having multiple services that create higher overheads. The current system consists of the following: Tricare for active members, retirees, and family members and the VA health care system for veterans and retirees. The Tricare program provides health care to all eligible beneficiaries either at DOD hospitals or civilian institutions depending on geographic location. The VA health system provides health care based on service connected disability to veterans only. It is possible for an

individual to be eligible for treatment at both the DOD and VA locations, but the individual must be retired from the military and have a service connected disability. The key distinction is that the VA only treats those who are no longer in the military with a service connected disability, and the DOD treats both current and retired military with the inclusion of eligible family members. In essence, the current system treats these two populations as separate pools vice viewing as a sole pool of federally eligible beneficiaries. Of note, there are joint sharing agreements between the DOD and VA, which allow a blending of this population when excess treatment capacity exists, such as the agreement between the NMCSD and the VAMCSD.

In 2011, DOD consolidated medical services for all branches of service (Army, Navy and Air Force) under the Department of Health Agency (DHA). According to DHA, the goal of combining health services is to provide high-quality care by ensuring service members are medically deployable for wartime and peacetime missions; additionally, provide top-tier medical care under the Military Health System (MHS), administrated by the DHA, by integrating clinical and business processes. Our theory is that the U.S. government can adopt the DHA model concept by implementing hospital specialization to optimize medical services provided by the DOD and VA; thereby, reducing unnecessary redundant services offered by pooling to create economies of scale.

The current health care system provides benefits for active members, retirees, veterans, and family members under two separate budgets. The DOD provides benefits for active members, retirees, and family members, while the VA provides benefits for veterans who have been found to have a service-related injury or post-traumatic stress disorder (PTSD). One problem with the current system is the backlog created by the surplus of applicants for veteran benefits. If a service member were injured while performing his or her job on active duty, he would be taken care of while he is under contract with the government. DOD-provided health care covers all hospital bills or fees, medical equipment, and prescription medications. Upon exiting from the military, this same veteran has to reapply through the VA system if he is in need of future care, medications, and medical equipment.

The DOD and the VA both provide health care services for the same member at two different time periods. If regulatory policy were to change to create a unified system, the U.S. government may save money by reducing the administrative and operating costs of two separate entities. An additional benefit of creating a unified system is that all current infrastructures would be optimized by servicing all DOD and VA customers. Additionally, a service member who is either retiring or separating from the military would already be part of the medical system and no longer have to reapply for medical benefits under the VA system. A combined system would review health care beneficiaries, and if a veteran qualified for benefits, all service related injuries, mental problems, and PTSD cases would be under coverage at all times benefiting the government and patients by reducing claims and reentry into the health care system.

According to research from the Heritage Foundation, health care spending continues to increase and without changes, it is at the brink of collapse:

> The Military Health system alone increased 14 percent in three years from $43 billion in 2007 to $47.9 billion in 2010 taking approximately 10% of the DOD budget. The current system is projected that military medical spending will grow by more than 80 percent in real terms by 2024. (Spring, 2011, p. 4)

The Heritage Foundations study of 2011 analyzed the years of 2007–2010 demonstrating that although the average over a longer period of time is a lower proportion of the DOD budget it is disproportionally higher in more recent years then previous historic costs. Hospital specialization and pooling of resources will allow the government to maximize all medical services. This thesis will examine how merging the DOD and VA health care programs may provide efficiencies for the administration of the military health care systems.

B. PURPOSE

The purpose of this thesis is to study, dissect and analyze how the Department of Defense and Veteran Affairs health care systems can gain efficiencies through hospital specialization, economies of scale and inventory pooling. The objective is to reduce expenses within the operations and maintenance portion of expending through pooling

assets and resources along with consolidating, eliminating, and reducing redundant overhead expenses.

C. RESEARCH QUESTIONS

1. Primary Question

- What is the potential magnitude of savings for the U.S. government by adopting hospital specialization?

2. Secondary Questions

- What are the financial implications of adopting specialization?
- What are the potential savings to the U.S. government by pooling resources?
- What are the geographical areas suitable for hospital implementation?
- What are the disadvantages to hospital specialization?
- What are roadblocks or limitations that will prevent implementation?

D. SCOPE AND LIMITATIONS

The San Diego region was chosen as the proof of concept for federally provided health care specialization. Focus on a regional area presents a feasible opportunity for specialization given the geographic limitations due to the size of the U.S. prohibiting a national level of specialization. San Diego's close geographical proximity to the Naval Postgraduate School met the criteria of one regional area containing a near co-located DOD and VA hospital. Budgetary data for the Defense Health Program limited the scope of this study. The Department of Defense Comptroller lacked operations and maintenance data from 2000–2002. Additionally, data before fiscal year 2012 was unavailable from either the Naval Medical Center San Diego or the Veterans Affairs Medical Center San Diego; fiscal year 2017 data was unavailable from the Veterans Affairs Medical Center San Diego at the time of this study. This study does not research the cost of implementation for hospital specialization or the steps necessary for government officials to adopt the recommended courses of action.

E. METHODOLOGY

The methodology for this research is to calculate and analyze the historical yearly appropriation the U.S. government allocates to the DOD and VA health services for operation and maintenance. The value of funding was computed utilizing the formula: $FV = PV * (1 + r)^n$ to adjust all amounts into 2017 dollars. OMB Circular A-94, appendix C provides the discount rates for government analysis on lease, purchase, and other analysis.

F. ORGANIZATION OF THE RESEARCH

Chapter II addresses how hospital specialization and pooling of resources can be beneficial to the U.S. government. Additionally, it discusses potential disadvantages to hospital specialization and the pooling of resources.

Chapter III addresses how the data collected was analyzed, and what assumptions were applied to construct the data tables. The data provides the reader a glimpse of the funds appropriated by the U.S. Congress to the DOD and VA health care programs. The National Defense Budget used for the study focuses from fiscal years 1998–2017.

Chapter IV addresses the analysis of data collected and manipulated based on studies to determine potential cost savings for the DOD and VA. This analysis provides the reader the overall potential benefits from specialization by the DOD and VA health care systems.

Chapter V makes conclusions and recommendations based on the results and analyzed data.

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II. REVIEW OF LITERATURE

This literature review studies medical and supply chain management publications as well as the following case studies: Shouldice Hospital Limited, Virginia Mason Medical Center (Abridged), and West Coast University Student Health Services Primary Care Clinic. A complete analysis of these documents and studies recommends that the United States government can gain efficiencies within the Department of Defense (DOD) and Veteran Affairs (VA) Health care systems through hospital specialization and economies of scale.

Hospital specialization will require changing the current organization of hospital services. Hospitals today currently operate in the job shop process, but to gain economies of scope, the process needs to change to a flow production. Job shops produce items just once making production or a service more expensive. Shouldice Hospital presents flow production, comparable to car assembly lines in the sense that each factory specializes in a specific vehicle. Merging the services provided by local DOD and VA general hospitals will change the process from a job shop to a flow shop and can increase patient capacity, by servicing a higher number of patients in bulk and providing services through specialization.

According to Hopp and Lovejoy (2013), health care needs to radically transform just like the car and tax preparation industries.

> The net result will be a progressive deskilling, of the health care industry (in those processes that migrate into empirical medicine) like that which has occurred regularly in other industries. For example, auto assembly once required highly skilled mechanics; it now requires narrowly trained line workers. Tax preparation once required skilled accountants; we can now do it ourselves using software. (pp. 485–486)

Hospitals of today are currently set up like Figure 1. The figure displays how current hospitals operate and how a patient can enter the hospital through various points. The exhibit illustrates how patients are sent to multiple providers and departments in order to get treated. Additionally, this hospital setup causes inefficiencies because patients get bounced from unit to unit and such change makes it difficult for caregivers to work in

partnership since departments have separate, uncoordinated workloads. According to Hopp and Lovejoy (2013), “Units treat a variety of patient types, they operate as job shops and cannot offer flow shop efficiency to patients with predictable needs.” (p. 489) If the Department of Defense and VA hospitals set up their general hospitals to operate as flow shops, they would mutually benefit from mass production.

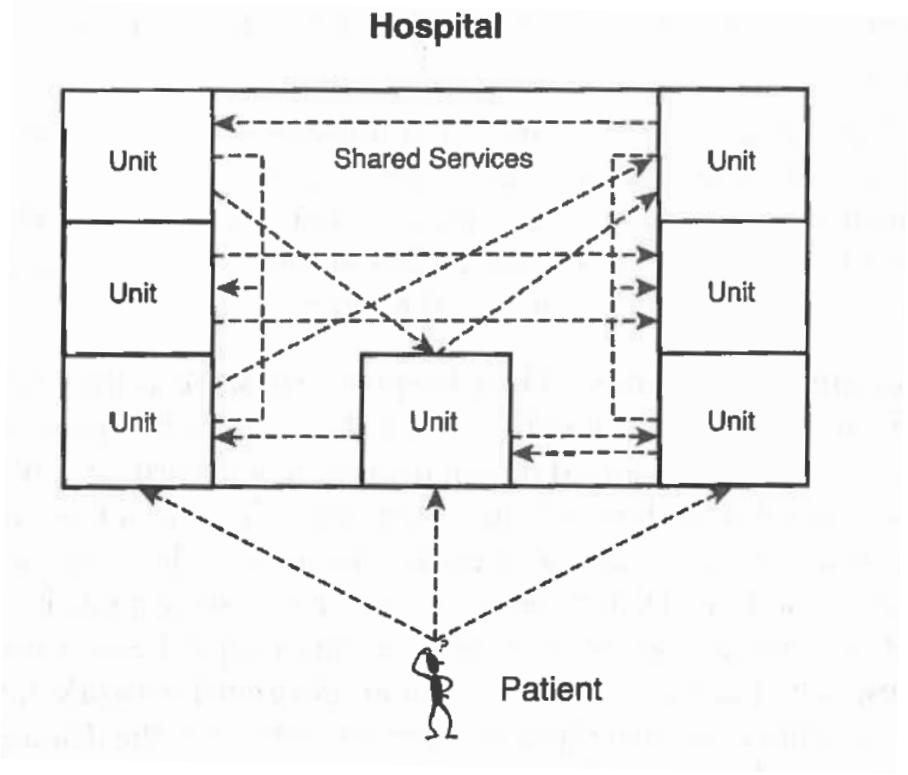


Figure 1. General Hospital of Today. Source: Hopp and Lovejoy (2013).

The flow shop process would replicate the Toyota Production System (TPS) to health care. According to Harvard case study 9–610-055, Virginia Mason Medical Center (VMMC) adopted a version of TPS as its philosophy to operations management in 2002; the adopted changes turned VMMC around economically (Bohmer, 2010). In 2002, Virginia Mason executives visited Toyota and after their visit, VMMC adopted a modified version of TPS. Hospital executives called the new system Virginia Mason Production System (VMPS), applied the adopted principles to the medical centers and found them financially beneficial to VMMC. Additionally, the new practices turned

VMMC around from a situation of not being profitable for two continuous years (1998, 1999) losing millions of dollars.

The principles and tools of TPS, as described by Bohmer (2010), are as follows:

- **Just-in-time (JIT) production:** produce only what is needed, and only when needed.
- **Jidoka:** detect abnormalities in the production process and immediately halt work to respond to them. Jidoka integrated quality control into the production process.
- **Standard work:** streamline processes to eliminate nonvalue-added activities and to make abnormalities glaringly obvious.
- **Innovation:** emphasize innovation by frontline workers to solve production problems (pp. 3–4).

The TPS principles that resulted in VMPS and new terms were personalized to fit the health care model. According to the case study, VMMC used the following principles to improve their organization: Value-stream mapping, Rapid Process Improvement Workshop (RPIW), 5S—Sort, Simplify, Sweep, Standardize and Self Discipline, 3P—Production, Preparation and Process, Everyday lean, Patient safety alert system (PSA) and VMPS infrastructure. The adoption of these new principles to health care improved VMMC systems by improving distance travel within the medical center, inventory, lead time and productivity. Bohmer's 2010 case study reveals the advances of VMMC as

> a total of 275 RPIWs from 2002 to 2004 reduced staff walking distances by 38% and travel distance by 77%, inventory was cut in half, lead time decreased by 53% and a gain in 44% rise of productivity--equivalent to 77 full time employees redeployed within the center. (p. 9)

A. RECOMMENDED REORGANIZATION TO HOSPITALS

The hospital of the future is illustrated in Figure 2 also known as a specialty hospital. According to Hopp and Lovejoy (2013), "specialty hospitals, which integrate testing, diagnosis, treatment and education of a specific type of patient, have already emerged (for example, for cardiac, cancer, and patients) and are likely to become more common in the future" (p. 487). As shown in Figure 2, the design reconfiguration allows

hospitals to operate as flow shops and gain all of the efficiencies mentioned by the TPS model adopted by the VMMC.

> According to Hopp and Lovejoy: "Exhibit B provides a schematic of patient flow in an integration hub hospital. Patients are guided into the hospital by a gatekeeper, who directs them to the appropriate treatment option. If patients are in need of empirical/precision medicine, they are sent to a supported self-care network, and external clinic offering minimal care, or an internal unit set up as a flow shop. (Hopp and Lovejoy, 2013, p. 490)

The recommended reorganizations to DOD and VA hospitals would focus on departments and or procedures that each hospital performs to each demographic population with an agreement to share specialty services.

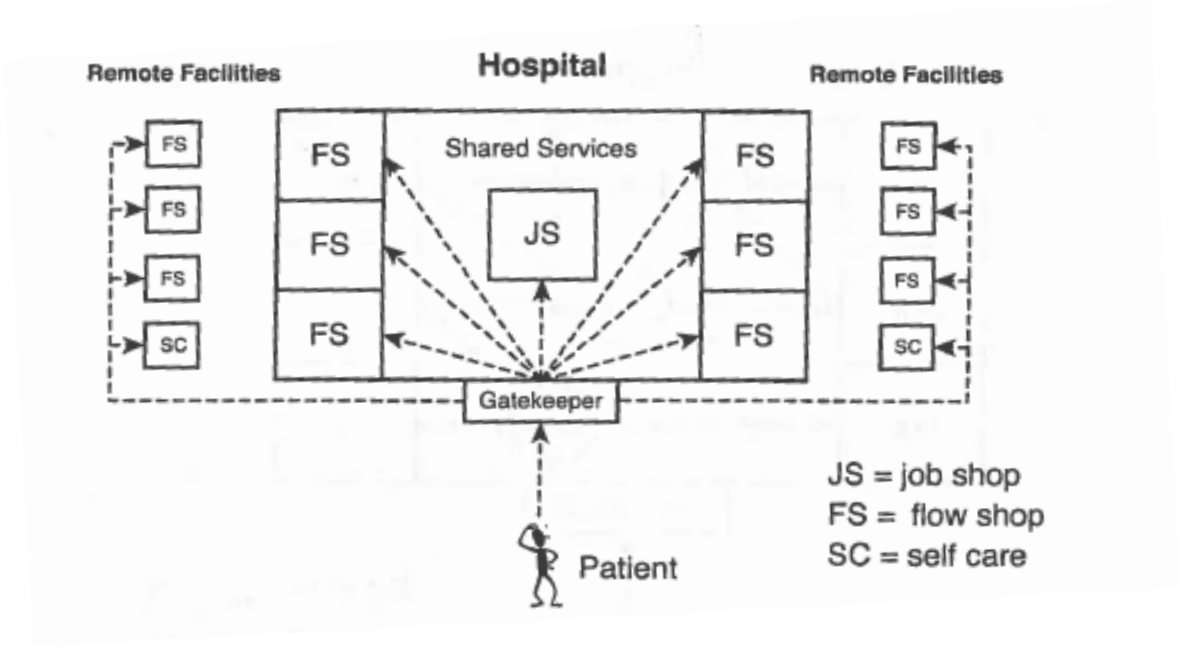


Figure 2. Hospital of the Future (Flow Shop Model).
Source: Hopp and Lovejoy (2013).

Figure 3 is a representation of a hospital that works in teams. A hospital or clinic team concept allows patients to be seen by any medical provider assigned to that team. The pooling of medical professionals reduces patient waiting times and ultimately improves the level of service.

Figure 3 illustrates patient flow in a custom care hospital. Instead of a gatekeeper, who guides patients to units, a custom care hospital uses a team formation process, which assigns caregivers to an individualized care team for each patient. This team formation process is not an exogenous judgment made prior to starting care, but rather a collaborative effort among caregivers to flexibly evolve the right combination of expertise. Once in the hospital, patients are diagnosed and treated in team fashion by a set of caregivers, whose makeup may evolve according to the needs of the patient. Consequently, the essence of a custom care hospital is a culture of adaptability (Hopp and Lovejoy, 2013, p. 491).

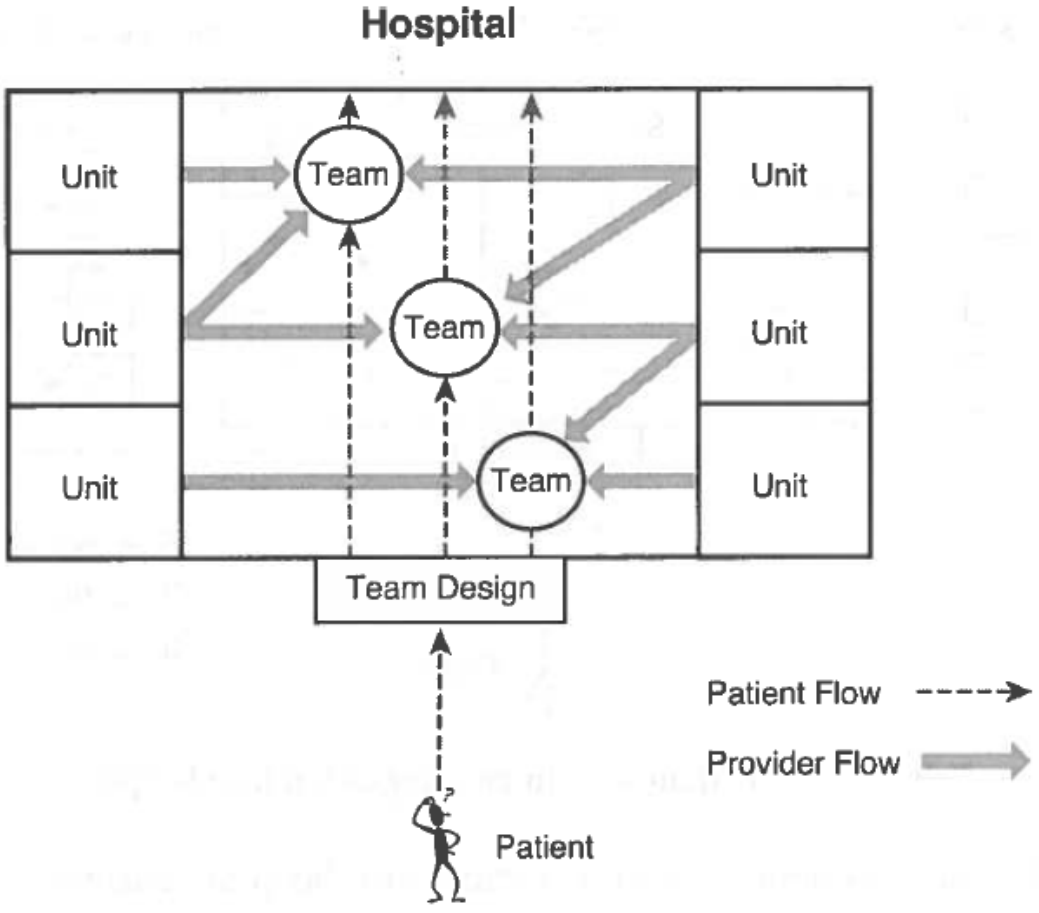


Figure 3. Hospital of the Future (Team Model).
Source: Hopp and Lovejoy (2013).

Economies of scale can be gained by hospital specialization as seen at Shouldice Hospital in Ontario, Canada. Shouldice Hospital specializes in abdominal hernia repairs resulting in high-quality patient care with a high success rate. The high utilization rates of hospital specialization enables hospitals lower operations costs that can trickle down to the consumer; this potential cost reduction creates savings for to the U.S. government. The focus of hospital specialization would simplify health care for a military community. Efficiencies gained will benefit all eligible beneficiaries by reducing waiting times as in a service line concept.

B. EFFICIENCY GAINS FROM THE FOCUSED FACTORY MODEL

The assumption is that government hospitals operating independently in a geographical region perform assigned services for a specific community incurring higher fixed costs than those hospitals with a resource sharing agreement where fixed costs can be spread over multiple facilities. A resource sharing and hospital specialization agreement between a local DOD and a VA hospital may allow each hospital to become a focused factory. If DOD and VA hospitals created a partnership, then each hospital could specialize and focus on specific services in a geographic region. Example: an independent hospital that provides twenty different services would benefit from a partnership. A joint venture between a DOD and a VA hospital to service a community would split scope of services between both hospitals enabling each hospital to focus and specialize in just ten scopes of services. According to Skinner (1974),

> a factory that focuses on a narrow product mix for a particular market niche will outperform the conventional plant, which attempts a broader mission. Because its equipment, supporting systems, and procedures can concentrate on a limited task for one set of customers, its costs and especially its overhead are likely to be lower than those of the conventional plant. (p. 114)

Shouldice Hospital is set up to operate as a focused factory and only offers one type of service. Providing one service allows Shouldice Hospital to specialize resulting in high volume and quality by maximizing capacity and learning by repetition. The Shouldice Hospital is an example of hospital specialization where only one scope of service is provided. For the DOD and VA, the requirement to provide more than one

scope of service exists and the level of specialization demonstrated by Shouldice Hospital would not be achievable, but that does not mean specialization through reducing unnecessary redundant service scopes could not be eliminated. Doing so would require some administrative reorganization and budgetary transfers across agencies, which may make those transfers less onerous.

C. ECONOMIES OF POOLING

The DOD and VA health care systems will gain efficiencies by treating more patients with the same resources, known as Economies of Pooling. The gains are noticed in "fixed-cost amortization, statistical economies of scale and learning effects" (Freeman, Savva, & Scholtes, 2016, p. 7). Our research will explain how hospital specialization can improve hospital productivity by adopting a policy of service lines similar to car manufacturing.

1. Fixed Cost Amortization

Hospitals are large organizations that require investments in high-end, expensive medical devices. According to Dranove (1998), "a hospital that is only large enough for one MRI unit may need to hold it idle much of the time to permit emergency testing; whereas, a hospital large enough to support two units may need to schedule less idle time as a percentage of idle time" (p.71). Additionally, Freeman et al. (2016) argued the following:

> Hospitals that treat more patients will be able to spread their fixed costs across a wider activity base, thereby reducing the average cost per patient. In fact, not only are assets better utilized in higher-volume organizations but the better returns on investment make it more likely that productivity-improving assets will be economical in the first place; such assets are therefore more likely to be found in larger hospitals. For example, studies consistently find that larger hospitals are more likely to adopt innovative health information technology than smaller hospitals. (p. 7)

The studies validate hospital specialization reduce the fixed cost of medical assets and reduce duplication of services in a military community by consolidating high end medical assets. With specialization, the demand for a specific service will be higher; therefore, the specialized hospital will see more patients within a community with less

equipment. A hospital seeing more patients will realize cost reductions by spreading the fixed cost of hospital equipment and services with higher utilization rates, resulting in reduced idle time.

For example, Navy Medical Center San Diego and San Diego VA hospital both provide outpatient pharmaceutical services. Duplication and redundancy of operating two separate outpatient pharmacy services requires duplication of equipment (e.g., pharmacy automation equipment) that is used in daily treatment services. Any idle time of equipment is lost capacity, but reducing equipment redundancy does not equal fewer services in a community, it reflects a higher utilization rate of high-end equipment. For example, if the yearly operating cost of one pharmaceutical machine is $100,000 per year, the fixed cost will be lower because the same machine is being used to serve the DOD and VA communities. Additionally, eliminating one pharmacy will mean lower overhead.

Another example of fixed cost amortization would be the consolidation of medical records. As medical records become digital in today's hospitals, duplication costs of computers and software can be reduced with the consolidation of medical records into one database, thereby eliminating the costs of redundancy. Medical record consolidation would allow active duty members to transition into the VA health system smoothly. Veterans who need to process a medical claim through the VA will benefit from medical record consolidation into one database. Accessibility of a consolidated medical records system will benefit the government through cost reductions, but it will also benefit all beneficiaries upon retiring or transitioning from the military.

2. Statistical Economies of Scale

Consolidation of redundant services between a DOD and a VA hospital would result in statistical economies of pooling. Hopp and Lovejoy stated that "pooling of separate services made up of homogenous customers in a single service line staffed by the same servers can reduce average waiting times" (Hopp and Lovejoy, 2013, p. 513). Redundant services can be merged so that all equipment and personnel are servicing one line. An example of pooling is the following: if a DOD hospital lab is overwhelmed by

current demand by working at maximum capacity, and the local VA hospital lab has resources not being used to its maximum potential. The consolidation of common resources or merger between the DOD and VA hospitals is a term known as “pooling”; the high demand of one hospital will average out the demand of the low volume hospital. The benefits of merging services are the following: reduced treatment time, increased capacity, bottleneck reduction (the resource or process that is being used to maximum capacity and can be a constraint in production), and higher overall utilization rate through batching. Hopp and Lovejoy noted, “the intuition behind this principle is that the busier the system, the less excess capacity it has for catching up from backups that result from fluctuations in the rate of demand or processing” (Hopp and Lovejoy, 2013, p. 502). Batching, as noted by Hopp and Lovejoy, is “an illustration of batching is the process of specimen collection by hospital phlebotomists. Typically, phlebotomists visit several patients to draw blood before delivering the specimens to the laboratory—in a batch” (Hopp and Lovejoy, P. 504).

Pooling of inventories will create savings and gain efficiencies to the U.S. government by consolidating inventories through pooling the variance associated with independent inventories. DOD and VA hospitals can save money by reducing inventory and stock consolidation. An example of stock consolidation is the online retailer Amazon. Hopp and Lovejoy noted, “First, online retailing (primarily by Amazon) replaced the job/flow shop mix of retail outlets with flow/self-service activities involved in e-tailing and mail delivery. This model also took advantage of pooled inventories to reduce costs and improve product availability” (Hopp and Lovejoy, p. 469). Centralized stock consolidation used by Amazon fulfills customer orders nationwide. Amazon can reach any customer nationwide with Internet access through e-commerce. E-commerce allows Amazon to place their warehouses strategically and pool their inventory. An advantage of pooling an inventory is that it allows Amazon to have a smaller inventory but it also allows Amazon to stock a wider range of products. A government hospital can benefit by using the same logic. The proceeding example will be described in further detail in chapter III.

3. Learning Effects

Consolidation of services would lead to a constant flow of patients, which would give hospital staff an opportunity to acquire experience by constantly repeating the same procedure or task. A good example of learning effects by repetition is demonstrated by Shouldice Hospital in Toronto Canada. According to Harvard Business Case Study 9–683—068(2003), Shouldice Hospital specializes in only abdominal area hernia surgery. Hernia surgery is a simple procedure, but it can be difficult surgery to perform if a surgeon does not perform this procedure daily. Shouldice is an assembly line type of Hospital and averages between 30–36 surgeries daily. The constant flow of hernia repair surgeries results in each surgeon performing this type of surgery three to four times a day. According to Dr. Shouldice,

> At Shouldice Hospital, a surgeon learns the Shouldice technique over a period of several months. He learns when he can go fast and when he must go slow. He develops a pace and a touch. If he encounters something unusual, he is encouraged to consult immediately with other surgeons. We teach each other and try to encourage a group effort. And he learns not to take risks to achieve absolute perfection. Excellence is the enemy of good. (Heskett, 2003, p. 6)

Learning effects would result in higher proficiency of staff at all levels and a lower rate of patients of suffering a hernia repair recurrence according to data tracked by Shouldice Hospital for over 30 years. A doctor who repeats the same procedure increases productivity and in return reduces costs by making fewer mistakes and perfecting his skills through constant repetition.

D. DISADVANTAGES TO PROPOSED SPECIALIZATION

Hospital specialization has disadvantages and these come at the infancy stage prior to implementation. The two significant disadvantages of specialization would be the initial capital investment and implementation.

The capital investment would be used to improve hospital infrastructure, train and educate personnel, and to build teams that would oversee the implementation. Bohmer noted on his study that VMMC had to create the infrastructure to implement VMPS within their organization. According to Bohmer (2010), “To support the massive

undertaking of VMPS implementation, the medical center created an infrastructure designed around VMPS operations and Kaizen Promotion Offices (KPOs)" (p. 8). Hospitals of today are currently postured as previously illustrated in figure 1. To gain efficiencies, hospitals would have to remodel and rearrange their current hospital layout to better serve their customers. VMMC invested in its staff to properly train and educate them. VMMC used its operations managers as VMPS specialists. According to Bohmer, "operations managers oversaw the training and education of all 5,000 VMMC employees" (p. 8). The teams that VMMC created were called KPOs and were responsible for the planning and implementation of VMPS procedures. According to Bohmer, "The financial commitment to VMPS was large, but administrators thought that financial gains through improved efficiency outweighed the added labor costs" (p. 8). The teams that VMMC created were a big initial investment that paid off. VMMC turned around and within two years, the efficiencies adopted by implementing the VMPS tools had a positive return on their initial investment. The success at VMMC may not produce the same outcome within the DOD and VA just by following the same pattern. Multiple variables determined the success at VMMC, and slight differences in results may produce an unfavorable outcome.

Implementation of new procedures is hard to adopt; most humans are comfortable and happy with the status quo. Initially, hospital staff at VMMC felt that every patient is unique and standardization of heath care should not be adopted. VMMC funded trips to Toyota's factory to train and implement lessons learned from their lean production principles. According to Bohmer's case study, a VMMC surgeon was reluctant to participate in the biannual trips and finally the surgeon changed his mind once he heard the trips were value added time. The VMMC sponsored trips allowed hospital staff to observe a vehicle production line and encouraged them to find the waste within the assembly line. The surgeon learned his lesson once he was asked to "get the measurements of their workers." According to Bohmer (2010), "the surgeon said, 'I can't get any measurements. I can't clock it.' I asked, 'Why not?' And he answered, 'Because the operator does it differently every single time. There is no standard work!' And there was the teaching point" (p. 8). Many hospital staff saw the implementation of a new

system as another management imposed idea that would threaten the way they treated patients. The implementation of VMPS was seen as negative and felt that they were no longer treating patients and were now being turned into production line workers. Bohmer quoted hospital staff saying, “we don’t make cars, we treat patients” (p. 9). Organizations will often have employees who will have a hard time grasping new concepts, cultures and or ideas. VMMC had faced the same struggles when it implemented the VMPS ideas within its organization. The VMMC case study states the following: “Nevertheless, 10 physicians and some staff personnel left the medical center. ‘They knew they wouldn’t fit into the new culture, or they weren’t comfortable with VMPS, or they just didn’t like the change’, explained a KPO specialist” (Bohmer, 2010, p. 9). Organizations that go through major changes and or overhauls usually experience a pushback from employees who are comfortable with the status quo. Leaders need to understand that adopting new procedures to improve an organization comes at a cost that may or may not be easily attributable to an exact dollar figure. The loss of experienced personnel has both easily traceable costs (e.g., recruitment, hiring, and training costs), as well as, harder to trace costs (e.g., opportunity costs associated with replacement of less experienced personnel, loss of acquired knowledge costs).

E. DISADVANTAGES OF POOLING INVENTORY

Inventory management has many different approaches bringing advantages, but at the same time, some methods have disadvantages. The approach adopted to inventory management depends on the product and/or service provided. A supply chain manager can adopt a periodic, continuous, or hybrid inventory management system. A supply manager will adopt a management system that will mitigate uncertainty caused by variability and poor demand information. A periodic review system will be at a set interval to review the inventory, weekly, monthly, quarterly, etc.; this method is less time consuming, but a supply manager could potentially run out of stock of a product. In comparison to the continuous review system, the periodic system will have a longer on-hand inventory. A continuous review system will inventory on a daily basis; this method is more time consuming, but the supply manager will know what product is prone to a stock out.

The main disadvantage of inventory pooling is the increased transportation and infrastructure cost associated with the construction of a consolidated warehouse and or distribution center. Additional, costs of delivering supplies to multiple locations can be incurred, and if the location is not geographically located near the hospital facility, it creates an unneeded distance between the inventory and the demand location. Additionally, to successfully pool items, the demand for items must be uncorrelated to be effective and to reduce the uncertainty from demand, as displayed in the left image of Figure 4. If the demands are perfectly correlated, as show in the right image of Figure 4, there will not be a reduction in standard deviation of pooled demand. Consequently, there will be no reduction in total on-hand inventory. The approach to inventory pooling is similar to Harry Markowitz's portfolio theory of diversification to minimize risk. Ideally, the demand signal from the two facilities would look similar to the uncorrelated example below, and not like the example of almost perfect positive correlation shown in the image.

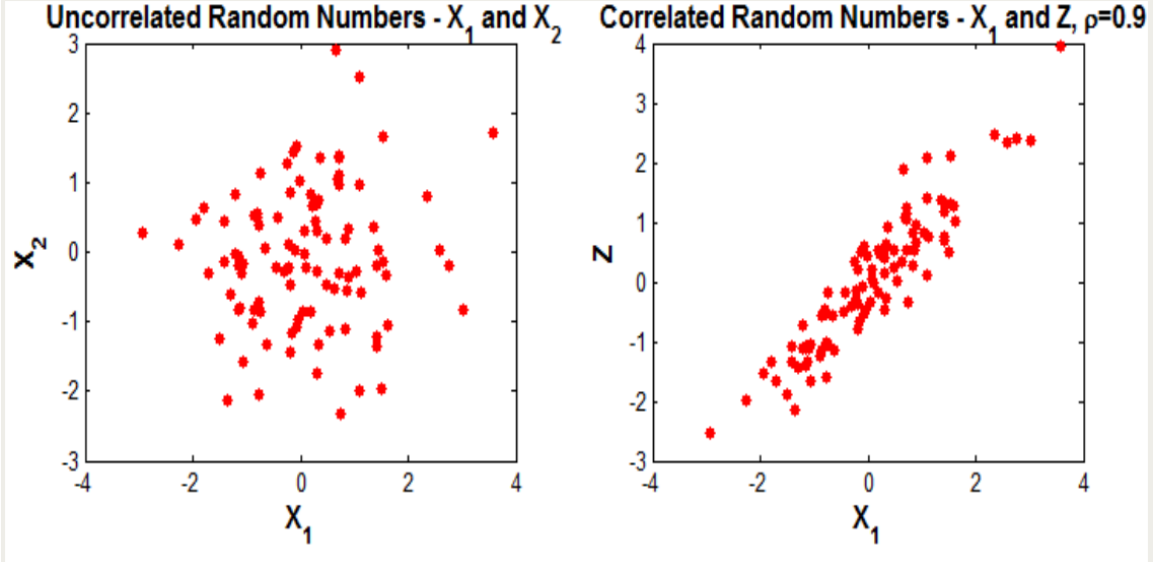


Figure 4. Comparison Chart of Correlation. Source: Mathuranathan (2014).

A unique limitation or disadvantage to hospital specialization is that our scope is limited to six geographical locations, but not applicable to the entire network of hospitals within the DOD or VA health care systems; therefore, numerous facilities would

necessarily function as independent facilities while only a very select few would operate as a specialized partnership health care system. Additionally, the study only focuses on maximizing the locations with the highest concentrations of active duty military and VA beneficiaries. The results of this study can be adopted by only the communities identified, and federal legislation would need to align with the proposed way DOD and VA provides services to its beneficiaries.

III. METHODOLOGY AND DATA

This chapter will focus on the current resources of federally funded health care by the Defense Health Program and the Veteran's Affairs Administration. The purpose is to identify current outlay's for federally provided health care and identify actual costs in today's dollar for comparison. The proceeding sections will detail how specialization could be implemented and/or applied, if all necessary data applicable for implementation is available. Additionally, this study will present the data used for this study from historical budgetary government sources, including NMCSD and VAMCSD specific budgetary data, with further analysis in subsequent chapters. It is recommended that specific data regarding costs of implementation and specific demand data analysis are future focus areas for research.

A. METHODOLOGY FOR SPECIALIZATION

To assess applicability of specialization within the DOD and VA health care systems, this study focuses on San Diego area as the proof of concept for specialization. Data regarding specific service duplication, number of specific service treatment occurrences at both DOD and VA facilities (e.g., types of procedures performed, medications administered, etc.), minimum operating scale, and budgetary data. The more duplication of services by DOD and VA will result in a higher justification for specialization, provided that there is low degree of correlation between the two facilities located in San Diego. The primary goal of this study is to determine if the federal government will benefit from specialization financially. This study is not meant to identify any service terminations or service reductions offered by either DOD or VA, merely attempts to financially determine if the currently provided services by the DOD or VA facility would be efficiently conducted within a specialized hospital. The goal of specialization would be to take available services and distribute according to the largest demand between the DOD and VA within a specified region. Demand-based distribution would be used to ensure that only one of the two facilities offers the service, but all previously available services would continue to be available within that region (i.e.,

treating the hospitals as one entity with two co-located facilities). The calculations regarding specific costs of implementation and full determination of what services the NMCSD and VAMCSD should specialized are recommended topics for future research.

1. Service Duplication

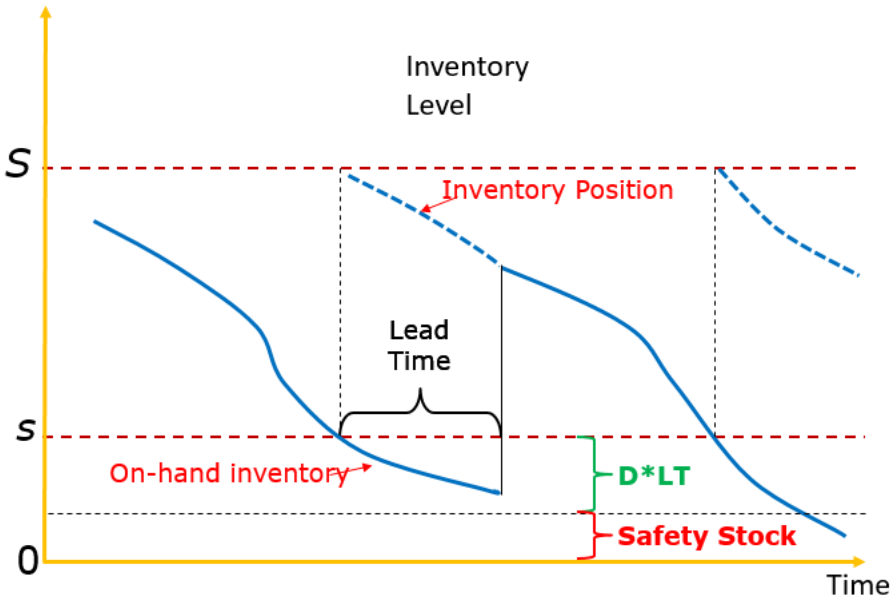
The following example is provided to explain the result of duplication of services and provide the formulas necessary to analyze potential data regarding inventory pooling. If the local DOD San Diego hospital and San Diego VA have a policy of 97% service level on all hospital supplies. The San Diego DOD hospital stocks an average 91 boxes of gloves in stock while the San Diego VA Hospital keeps an average of 88 boxes of gloves in stock at the current service level. If both hospitals kept a decentralized network of gloves, they would have to keep an average of 179 boxes combined. If the two hospitals merged and adopted the policy of a centralized inventory network, the consolidation would reduce glove inventory to 132 boxes. The reduction of 47 boxes of gloves would result in 26.3% reduction of the inventory of gloves. Adoption of new inventory practices would result in the reduction of the numerous Stock Keeping Units (SKU) that a hospital keeps in stock. The potential savings would be enormous. Additionally, a centralized inventory would save the government by purchasing in bigger lots and ordering sufficient supplies for hospital operations.

a. The Following is the Result and Comparison of Decentralized and Centralized Inventories.

(1) Decentralized Inventory

- Economic Order Quantity for Naval Medical Center San Diego Hospital

The following optimal order or economic order equation is used to calculate this example. The service level for this example is 97% and the lead time (LT) of 1 week, K = ordering cost of $60, H = holding costs of $0.27 and D = 39.3 for Naval Medical Center San Diego Hospital. Lead time is the period of time needed to order and receive replenishment of a part/product to use in providing a service/product as described in the inventory level image below.



Source: G. Ferrer, personal communication, November 4, 2016.

Figure 5. Lead Time Example.

$$Q = \sqrt{\frac{2 * D * K}{H}}$$

where:
D = Item annual demand
K = Order cost
H = Holding cost
Q = Optimal Quantity

The optimal order for this example, using the figures and equation above equals to Q = 132.1 boxes. The Q = 132.1 boxes represent the optimal order for Naval Medical Center San Diego, and would need to be rounded to meet order requirements/restrictions (i.e., if minimum order quantity is a multiple of 20 boxes then 140 boxes would be the optimal order quantity based on external restrictions).

- Safety Stock at Naval Medical Center San Diego Hospital

The safety stock equation is used to calculate this example. The service level (SL) for Naval Medical Center San Diego in the example is 97% or a Z-score of 1.88 and the (σ)= Standard Deviation of 13.2.

$$SS = \text{SL or } (\text{Z} - \text{score}) * (\sigma)$$

where:
SS = Safety Stock
SL = Service Level
σ= Standard Deviation

The product or (SS) of the SL and the Standard Deviation equals to 24.8 boxes. The SS of 24.8 boxes in this example represents the measurement in boxes of gloves that Naval Medical Center San Diego would have to keep as extra stock to mitigate the risk of stockout in order processing or delivery times.

- Average On Hand Inventory at Naval Medical Center San Diego Hospital

The average OH inventory is used to calculate this example. The Safety Stock (SS) for Naval Medical Center San Diego in the example is 24.8 and the Q = Optimal Quantity of 132.1.

$$Average\ OH\ inventory = SS + \frac{Q}{2}$$

where:
SS = Safety Stock
Q = Optimal Order Quantity

- The average OH Inventory will equal to 90.8 boxes, rounded up to 91 boxes. The average on hand inventory means how many days of inventory a manager would keep in stock. If Naval Medical Center San Diego used an average of 9.1 boxes of gloves per day, this would mean that the Medical Center maintains on average 10 days' worth of inventory.

- Economic Order Quantity for San Diego VA

The following optimal order or economic order equation is used to calculate this example. The service level for this example is 97% and the LT lead time of 1 week, K = ordering cost of $60, H = holding costs of $0.27 and D = 38.6 for San Diego VA.

The optimal order for this example, using the figures and equation above equals to Q = 131. The Q = 131 represents the optimal order for San Diego VA, and would need to be rounded to meet order requirements/restrictions. Following the limitations of a

minimum order quantity being a multiple of 20 boxes, 140 boxes would be the optimal order quantity for this example, based on external restrictions.

- Safety Stock San Diego VA

The safety stock equation is used to calculate this example. The service level (SL) for San Diego VA in the example is 97% or a Z-score of 1.88 and the (σ)= Standard Deviation of 12.05.

The product or (SS) of the SL and the Standard Deviation equals to 22.7. The SS of 22.7 boxes in this example represents the measurement in boxes of gloves that San Diego VA would have to keep as extra stock to mitigate the risk of variability in order processing or delivery times.

- Average On Hand Inventory San Diego VA

The average OH inventory is used to calculate this example. The Safety Stock (SS) for Naval Medical Center San Diego in the example is 22.7 and the Q = Optimal Quantity of 131.

The average OH Inventory would be equal to 88.2 rounded down to 88. The average on hand inventory means how many days of inventory a manager would keep in stock. If Naval Medical Center San Diego used an average of 8.8 boxes of gloves per day, this would mean that the San Diego VA keeps on average 10 days' worth of inventory.

The following table summarizes the results of a Decentralized Inventory for Naval Medical Center San Diego and San Diego VA. In summary, Naval Medical San Diego would have to keep 91 boxes of gloves on hand while the San Diego VA would keep 88 boxes of gloves on hand. A Decentralized inventory would mean that these government entities would keep a combined average of 179 boxes of gloves on hand at any given time.

Table 1. Decentralized Inventory.

Economic Order Quantity	Naval Medical Center San Diego Inventory	San Diego VA	**Total**
	Q*= SQRT (2*D*K/H)	Q*= SQRT (2*D*K/H)	
	Q*= SQRT (2*39.3*60/.27)	Q*= SQRT (2*38.6*60/.27)	
	Q*= 132.1	Q*= 131	
Safety Stock	Safety stock = (σ) * SL or Z-score (13.2*1.88) = 24.8	Safety stock = (σ) * SL or Z-score (12.05*1.88) = 22.7	
	SS = 24.8	SS = 22.7	
Average OH inventory	Q*/2+SS (132.1/2+24.8) = 90.8 round up to 91	Q*/2+SS (131/2+22.7) = 88.2 round down to 88	**179**

(2) Centralized Inventory

- Economic Order Quantity Centralized

The following optimal order or economic order equation is used to calculate this example. The service level for this example is 97% and the LT lead time of 1 week, K = ordering cost of $60, H = holding costs of $0.27 and D = 77.9 (39.3 Naval Medical Center San Diego + 38.6 San Diego VA).

The optimal order for this example, using the figures and equation above, Q = 186 boxes. The Q = 186 boxes represent the optimal order for boxes of gloves, after centralizing inventories for Naval Medical Center San Diego and the San Diego VA.

- Safety Stock Centralized

The safety stock equation is used to calculate this example. The service level (SL) for a centralized inventory in the example is 97% or a Z-score of 1.88 and the (σ)= Standard Deviation of 20.7. The standard deviation of two independent demands equations will be used for the standard deviation.

$$\sigma_1 + \sigma_2 + \ldots \sigma_n = \sqrt{\sigma_1^2 + \sigma_2^2 + \ldots \sigma_n^2}$$

$$SS = \text{SL or } (\text{Z} - \text{score}) * (\sigma)$$

where:

SS = Safety Stock
SL = Service Level
σ_1 = Standard Deviation of demand at demand location 1

The product or (SS) of the SL and the Standard Deviation equals 38.92 boxes. The SS of 38.92 boxes in this example represents the measurement in boxes once inventories are centralized for Naval Medical Center San Diego and San Diego VA. The quantity of 38.92 boxes represents what one centralized facility would have to keep as extra stock to mitigate the risk of variability in order processing or delivery times.

- Average On Hand Inventory Centralized

The average OH inventory is used to calculate this example. The Safety Stock (SS) for Naval Medical Center San Diego in the example is 38.92 and the Q = Optimal Quantity of 186 boxes.

The average OH Inventory will be equal to 131.92, rounded up to 132 boxes. The average on hand inventory means how many days of inventory a manager would keep in stock. If Naval Medical Center San Diego and San Diego VA used a combined average of 17.9 boxes of gloves per day, this would mean that Naval Medical Center San Diego and San Diego VA pooled inventory would maintain on average 7.4 days' worth of inventory.

Table 2 presents a summary of the results of a Centralized Inventory for Naval Medical Center San Diego and San Diego VA. A Centralized Inventory between Naval Medical San Diego and the San Diego VA would keep 132 boxes of gloves on hand. A Centralized Inventory would mean that government entities would save by reducing the quantity of stocks on hand at any time. This is a cost savings measure for the government by reducing an unnecessary expense of keeping excess inventory and invested capital.

Table 2. Centralized Inventory.

Consolidated Inventory
Q*= SQRT (2*D*K/H)
Q*= SQRT (2*77.9*60/.27)
Q*= 186
Safety stock = (σ) * SL or Z-score (20.7*1.88) = 38.92
SS = 38.92
Q*/2+SS (186/2+38.92) = 131.92 round up to 132

The table below represents the differences of a Decentralized Inventory and Centralized Inventory and the reduction of 47 boxes or 26% of on hand inventory upon consolidation of inventories. The potential savings can be enormous since there are many supplies, medicine and items that can be consolidated and purchased in bulk for a locality.

Table 3. Decentralized and Centralized Comparison.

	Warehouse	Product	Demand (D)	Standard Deviation (σ)	Coefficient of Variation= σ÷D	Average Inventory	Inventory reduction
Decentralized Inventory	Naval Medical Center San Diego Hospital (DOD)	Gloves	39.3	13.2	.34	91	
	San Diego VA	Gloves	38.6	12.0	.31	88	
Centralized Inventory	Consolidated Warehouse	Gloves	77.9	20.7	.27	132	26%

2. Disease Treatment and Medicine Administration

Detailed data concerning each and every treatment service received at both the DOD and VA location will provide data necessary to determine the applicability of specialization within the DOD and VA hospitals in San Diego. This data should include disease treatments (i.e., demand) and medicines administered (i.e., inventory pool). Assessing the overall demand patterns for each location will determine whether there is correlation in demand, and if a minimum operating scale, justifies specialization. Specific data regarding diseases treated and medications prescribed were not available by the time of this study.

According to NMCSD and VAMCSD webpages, there are 14 duplicate services offered by both locations. The duplication of services occurs in the following areas: cardiology, dental, dermatology, gastroenterology, emergency, mental health, nephrology, occupational therapy, orthopedics, physical therapy, pulmonology, radiology, and urology represent a possible focus area to assess for specialization between the DOD and VA in San Diego. In the Department of Health and Human Services statistical brief #165 (Most Frequent Procedures Performed in U.S. Hospitals, 2011), the data regarding procedures performed during hospitalizations across the U.S. was broken down to age ranges. The data revealed the following: "Among adults 18–44 years, four of the top five procedures were related to pregnancy and child birth." (Pfuntner, Wier, & Stocks, 2013). Predominate procedures for those over 45 years were cardiac, pulmonology, or gastroenterology related treatments (Pfuntner, et. al, 2013). The information provided by the Department of Health and Human Services suggest a starting point for specialization would be using demand specific data to validate or refute the San Diego VA specializing in the older age range (i.e., over 45 years) treatment services (e.g., cardiology, pulmonology, and gastroenterology).

3. Minimum Operating Scale

To assess applicability, the costs associated with specialization will need to be determined and balanced against the expected benefits. This will include both tangible and intangible figures. For example, the costs of construction and/or remodeling may

exceed the expected benefit of specialization making the investment ill advised. Once determination is made that specialization is applicable by data supporting that claim, full and thorough analysis is needed to assign costs to all areas impacted by specialization. A cost benefit analysis can then be conducted to overall determine the impacts of specialization and provide recommendations whether to pursue or not. The primary data driver for or against specialization will be demand. Sufficient demand is necessary and also must not be perfectly correlated demand between the DOD and VA hospitals in San Diego.

B. ANALYSIS OF AVAILABLE DATA

Utilizing data available at the time of this study, the proceeding information was compiled from the following data sources: DOD, OMB, NMCSD, and VAMCSD. The data sets provide a fiscal outlay for base level funding of operations. Data gathered represents the budget for each respective service for the past 20 fiscal years over a 20-year period (1998–2017) being expressed in nominal terms, additionally, the data was adjusted for today's dollar. The data sets validate the continued cost growth of health care consistent with the aforementioned published research by the Heritage Foundation.

Data collected from the historical Department of Defense Comptroller provides a record of overall federal level funding for Operations and Maintenance; Research, Development, Testing, and Evaluation; and Procurement. Table 4 represents the fiscal year budgets from 1998 to 2017. The data in Table 4 provides an overall federal level of funding that the Defense Health Program received for each fiscal year. Overseas Contingency Operations funding was not included within the Table 4 data. The Overseas Contingency Operations funding provides additional discretionary funding above the base budget, but is not provided on a consistent or predictable basis; therefore, it was removed from determining the base level funding requirements. Fiscal Years 2016 and 2017 data were provided as estimate or proposed amounts, and may differ from actual amount of funding provided.

Table 4. Defense Health Program Funding in Nominal Dollars from 1998–2017.

Discount Rate		2.5%
Fiscal Year	Nominal Value	Present Value
FY 98	$9,930,812,000.00	$15,875,894,447.45
FY 99	$10,525,100,000.00	$16,415,563,969.73
FY 00	$12,305,451,000.00	$18,724,198,953.62
FY 01	$13,580,291,000.00	$20,160,018,319.71
FY 02	$17,623,037,000.00	$25,523,412,175.23
FY 03	$15,404,879,000.00	$21,766,690,742.27
FY 04	$17,769,464,000.00	$24,495,402,385.11
FY 05	$18,388,481,000.00	$24,730,462,591.77
FY 06	$21,219,575,000.00	$27,841,921,241.71
FY 07	$24,095,596,000.00	$30,844,400,022.80
FY 08	$25,365,755,000.00	$31,678,352,124.26
FY 09	$28,078,037,000.00	$34,210,361,637.19
FY 10	$29,102,846,000.00	$34,594,138,431.40
FY 11	$30,311,988,000.00	$35,152,612,976.55
FY 12	$31,125,704,000.00	$35,215,877,137.60
FY 13	$29,649,076,000.00	$32,727,032,283.92
FY 14	$31,919,805,000.00	$34,374,138,756.33
FY 15	$32,262,109,000.00	$33,895,378,268.13
FY 16	$32,273,869,000.00	$33,080,715,725.00
FY 17	$33,467,516,000.00	$33,467,516,000.00

*Data used to create this table was retrieved from National Defense Budget Estimates series years 1998–2017.

Similarly, budgetary data for the Veteran's Affairs Administration was compiled from the historical tables maintained by the Office of Management and Budget (OMB) into Table 5. For fiscal years 1998 through 2003, the amount of funding includes the total medical care expenses plus medical administration and miscellaneous expenses. Subsequent years funding only includes the outlays for total medical care. Similar to Table 4, fiscal years funding for 2016 and 2017 are proposed or estimated amounts, and may differ from actual funding provided.

Table 5. Veteran's Affairs Administration Medical Funding in Nominal Dollars.

	Discount Rate	2.5%
Fiscal Year	**Nominal Value***	**Present Value**
FY 98	$18,055,835,000	$28,864,963,974.80
FY 99	$18,197,356,000	$28,381,664,924.61
FY 00	$19,842,894,000	$30,193,309,865.00
FY 01	$21,361,905,000	$31,711,868,040.52
FY 02	$23,026,621,000	$33,349,412,974.95
FY 03	$25,835,650,000	$36,505,097,097.84
FY 04	$28,168,915,000	$38,831,160,449.01
FY 05	$30,783,558,000	$41,400,463,124.74
FY 06	$31,369,789,000	$41,159,881,604.94
FY 07	$36,526,823,000	$46,757,421,570.90
FY 08	$39,205,707,000	$48,962,555,682.92
FY 09	$44,490,921,000	$54,207,867,059.28
FY 10	$47,965,065,000	$57,015,389,439.27
FY 11	$51,488,236,000	$59,710,568,404.59
FY 12	$54,212,908,000	$61,336,929,355.88
FY 13	$56,130,555,000	$61,957,630,166.94
FY 14	$58,176,428,000	$62,649,649,909.19
FY 15	$59,875,879,000	$62,907,095,374.38
FY 16	$65,218,823,460	$66,849,294,046.50
FY 17	$69,640,367,400	$69,640,367,400.00

* Data used to create this table was retrieved from OMB Historical Table 3–2 series years 1998–2017.

Within the Defense Health Program, it was assumed that both research, development, testing, and evaluation and procurement expenses are efficiently conducted and insignificant marginal value could be added by further improvements within these categories. Only the operations and maintenance portion of the funding would provide the cost reduction from further efficiency improvements. Table 6 was created using the data from Table 4 by only listing the Operations and Maintenance portion of the fiscal year budget. Fiscal years 2000 through 2002 budget data did not provide separate categorization of funding categories. To determine the operations and maintenance

funding during the fiscal year 2000 to 2002 time-period, the average level of operations and maintenance funding from all other years was calculated and used to approximate the funding during this period. As previously stated, the data provided for fiscal years 2016 and 2017 are proposed or estimated amounts and may differ from actual funding provided.

Table 6. Defense Health Program Operations and Maintenance Funding in Nominal Dollars.

	Discount Rate	**2.5%**
Fiscal Year	**O&M Nominal Value***	**O&M Present Value**
FY 98	$9,538,402,000.00	$15,248,568,128.10
FY 99	$10,083,700,000.00	$15,727,130,611.74
FY 00	$11,646,886,462.91	$19,290,283,192.70
FY 01	$12,853,499,429.66	$13,921,254,425.21
FY 02	$16,679,885,285.85	$24,157,447,276.89
FY 03	$14,663,931,000.00	$20,719,750,615.57
FY 04	$16,978,868,000.00	$23,405,557,067.09
FY 05	$17,497,102,000.00	$23,531,656,936.50
FY 06	$20,266,071,000.00	$26,590,841,365.15
FY 07	$22,825,984,000.00	$29,219,189,324.47
FY 08	$23,951,089,000.00	$29,911,628,142.02
FY 09	$26,622,754,000.00	$32,437,240,613.29
FY 10	$27,134,479,000.00	$32,254,368,620.51
FY 11	$28,559,538,000.00	$33,120,308,245.80
FY 12	$29,220,749,000.00	$33,060,595,405.42
FY 13	$28,294,511,000.00	$31,231,845,975.73
FY 14	$29,503,757,000.00	$31,772,319,315.58
FY 15	$30,324,881,000.00	$31,860,078,100.63
FY 16	$29,787,027,000.00	$30,531,702,675.00
FY 17	$32,231,390,000.00	$32,231,390,000.00

* Data used to create this table was retrieved from National Defense Budget Estimates series years 1998–2017.

Table 7 was created to adjust the Veteran's Affairs funding to match the limitations imposed on Defense health care program funding in Table 6 with the same underlying assumption that only the operations and maintenance piece is a source for significant cost reduction from further efficiency improvements. To create Table 7, the total medical care programs authority was combined with the medical administration and miscellaneous operating expenses authority.

Table 7. Veteran's Affairs Administration Medical Operations and Maintenance in Nominal Dollars.

	Discount Rate	**2.5%**
Fiscal Year	**O&M Nominal Value***	**O&M Present Value**
FY 98	$17,783,835,000	$28,430,131,124.30
FY 99	$17,881,704,000	$27,889,355,531.05
FY 00	$19,521,894,000	$29,704,870,403.16
FY 01	$21,011,677,000	$31,191,952,606.00
FY 02	$22,658,914,000	$32,816,863,601.04
FY 03	$25,443,250,000	$35,950,646,170.49
FY 04	$27,733,322,000	$38,230,690,687.45
FY 05	$30,351,210,000	$40,819,003,131.35
FY 06	$30,927,789,000	$40,579,939,302.19
FY 07	$35,740,343,000	$45,750,660,678.58
FY 08	$38,635,707,000	$48,250,703,790.05
FY 09	$43,946,921,000	$53,545,055,883.04
FY 10	$47,329,065,000	$56,259,385,299.94
FY 11	$50,674,394,000	$58,766,761,193.73
FY 12	$53,126,150,000	$60,107,362,429.26
FY 13	$55,140,494,000	$60,864,788,072.63
FY 14	$57,177,015,000	$61,573,391,418.98
FY 15	$58,873,660,000	$61,854,139,037.50
FY 16	$63,940,023,000	$65,538,523,575.00
FY 17	$68,274,870,000	$68,274,870,000.00

* Data used to create this table was retrieved from OMB Historical Table 3.2 series years 1998–2017.

For Tables 4, 5, 6, and 7, the present value of funding was computed utilizing the formula: $FV = PV * (1 + r)^n$ to adjust all amounts into 2017 dollars.

where:

FV = Future Value
PV = Present Value
r = discount rate
n = the number of periods between year listed and 2017.

The discount rate of 2.5% was chosen based on guidance within OMB Circular A-94, Appendix C for a 20-year program expressed in nominal dollars. (OMB, 2016).

Naval Medical Center San Diego and Veterans Affairs Medical Center San Diego were identified as one of six potential sites for specialization. The budgetary data provided by each location was analyzed in a similar method to the federal level of funding (i.e., only the budget amounts for operations and maintenance are listed). Table 8 provides the funding information for Naval Medical Center San Diego, and Table 9 provides the funding information for Veterans Affairs Medical Center San Diego. The same discount rate was utilized to determine the budgetary data expressed in 2017 dollars. Data prior to fiscal year 2012 was unavailable from either the Naval Medical Center San Diego or the Veterans Affairs Medical Center San Diego; fiscal year 2017 data was unavailable from the Veterans Affairs Medical Center San Diego at the time of this study. In Table 8, the value obtained for fiscal year 2017 from Naval Medical Center San Diego was only one quarter of the budget ($401,374,458.48). The value provided was multiplied by four to approximate the anticipated amount of a full year of funding.

Table 8. Naval Medical Center San Diego Budget.

	Discount Rate	2.5%	
Fiscal Year	**Nominal Value***	**Present Value**	**% NMCSD of DHP**
FY 12	$1,160,689,906.40	$1,313,214,092.72	4%
FY 13	$1,203,174,976.18	$1,328,080,048.38	4%
FY 14	$1,177,925,507.72	$1,268,496,936.21	4%
FY 15	$1,072,818,585.98	$1,127,130,026.90	4%
FY 16	$1,053,261,366.96	$1,079,592,901.13	4%
FY 17	$1,605,497,833.92	$1,605,497,833.92	5%

* Data used to create this table was retrieved from T. Piner, personal communication, January, 11, 2017.

Table 9. Veteran's Affairs Medical Center San Diego Budget.

	Discount Rate	2.5%	
Fiscal Year	**Nominal Value***	**Present Value**	**% VAMCSD of VA**
FY 12	$458,795,238	$519,084,699.84	0.86%
FY 13	$483,217,561	$533,381,773.16	0.88%
FY 14	$516,560,058	$556,278,683.49	0.90%
FY 15	$632,303,028	$664,313,368.46	1.07%
FY 16	$602,431,096	$617,491,873.02	0.94%

* Data used to create this table was retrieved from E. Atienza, personal communication, January, 18, 2017.

Naval Center San Diego funding represents approximately four percent of the federal level of Operations and maintenance funding per year from fiscal years 2012 through 2016, and an estimated five percent for fiscal year 2017. Comparatively, the Veteran's Affairs Medical Center San Diego represents approximately one percent of the Veteran's Affairs Medical funding for fiscal years 2012 through 2016.

IV. ANALYSIS AND RESULTS

This chapter will focus on the analysis of federally funded healthcare by the Defense Health Program and the Veteran's Affairs Administration. The purpose is to identify potential locations for specialization and savings estimates if hospital specialization is adopted at the areas identified as possible locations for specialization of VA & DOD Hospitals.

A. LOCATIONS FOR SPECIALIZATION

The table and image below assisted in the analysis and evaluation of which DOD hospitals would be suitable and were good candidates for hospital specialization. The DOD hospitals considered are operated by the Army, Navy, Air Force and National Capital Region (NCR) within the United States. The criteria used to determine eligibility for specialization was local population size, capacity and capabilities. According to the Government Accountability Office (GAO) (2016) report, the DOD currently has 41 hospitals that are operated by the DOD. The hospital data analyzed included the 41 DOD hospitals and it broke down hospital into total bed size categories represented in the table below.

Table 1: Number of Domestic Military Hospitals by Number of Inpatient Beds, Reported by Each Military Service and the National Capital Region, as of July 2015

Military service	0-25 beds	26-50 beds	51-100 beds	101+ beds	Total
Army	8	4	3	5	**20**
Navy	6	2	1	2	**11**
Air Force	2	1	4	1	**8**
National Capital Region (NCR)[a]	0	0	0	2	**2**
Total	**16**	**7**	**8**	**10**	**41**

Source: Army, Navy, Air Force, and NCR. | GAO-16-596

Figure 6. Domestic DOD Military Hospitals. Source: GAO (2016).

To simplify the table above of four respective categories we created a new table with five categories of DOD hospitals resulting in reduction of 34 hospitals that did not meet the criteria described in the following sentences. The new categories were classified in the table below according to bed size. During the study, our analysis only focused on hospitals that fell into categories “A” and “B” because these hospitals are co-located near similar size VA operated hospitals. Categories “A” and “B” are DOD hospitals with a total bed size 126 beds and higher. The Air Force does not have a hospital that met the criteria of either “A” or “B,” as previously stated, and was excluded for consideration of specialization.

Table 10. Department of Defense Hospitals Category Classification. Adapted from GAO (2016).

DOD category	Total bed size	Army	Navy	National Capital Region	Total
A	251-400	1	1	1	3
B	126-250	3	1	0	4
C	51-125				
D	11-50				
E	0-10				
Total		4	2	1	7

The image below depicts the locations of four Army operated hospitals that fell into categories “A” and “B”. The locations identified were the following:

- Madigan Army Medical Center (Tacoma WA)
- Tripler Army Medical Center (Honolulu, HI)
- Brooke Army Medical Center (San Antonio, TX)
- Darnall Army Medical Center (Killeen, TX)

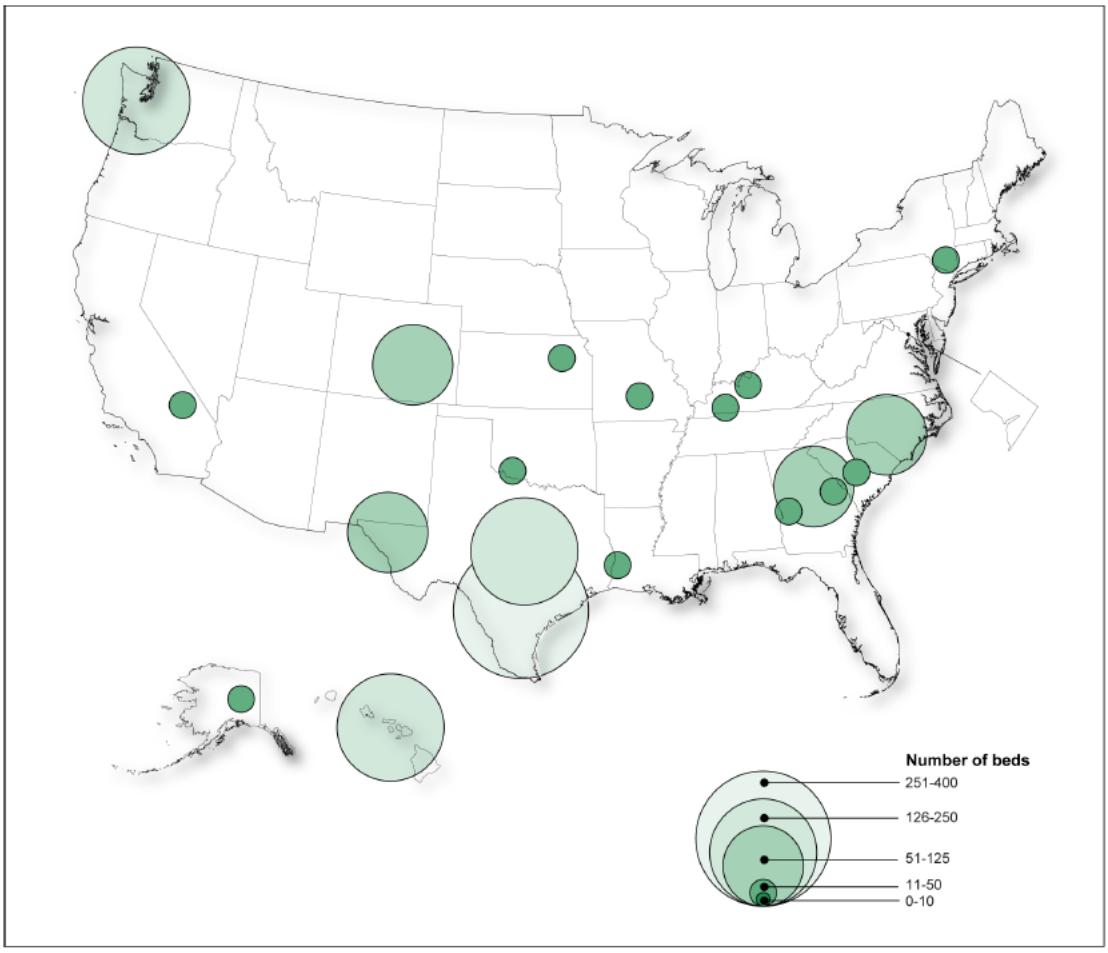


Figure 7. Army Operated Hospitals. Source: GAO (2016).

Figure 8 depicts the locations of two Navy operated hospitals that fell into categories “A” and “B”. The locations identified were the following:

- Balboa Navy Medical Center (San Diego, CA)
- Naval Medical Center Portsmouth (Portsmouth, VA)

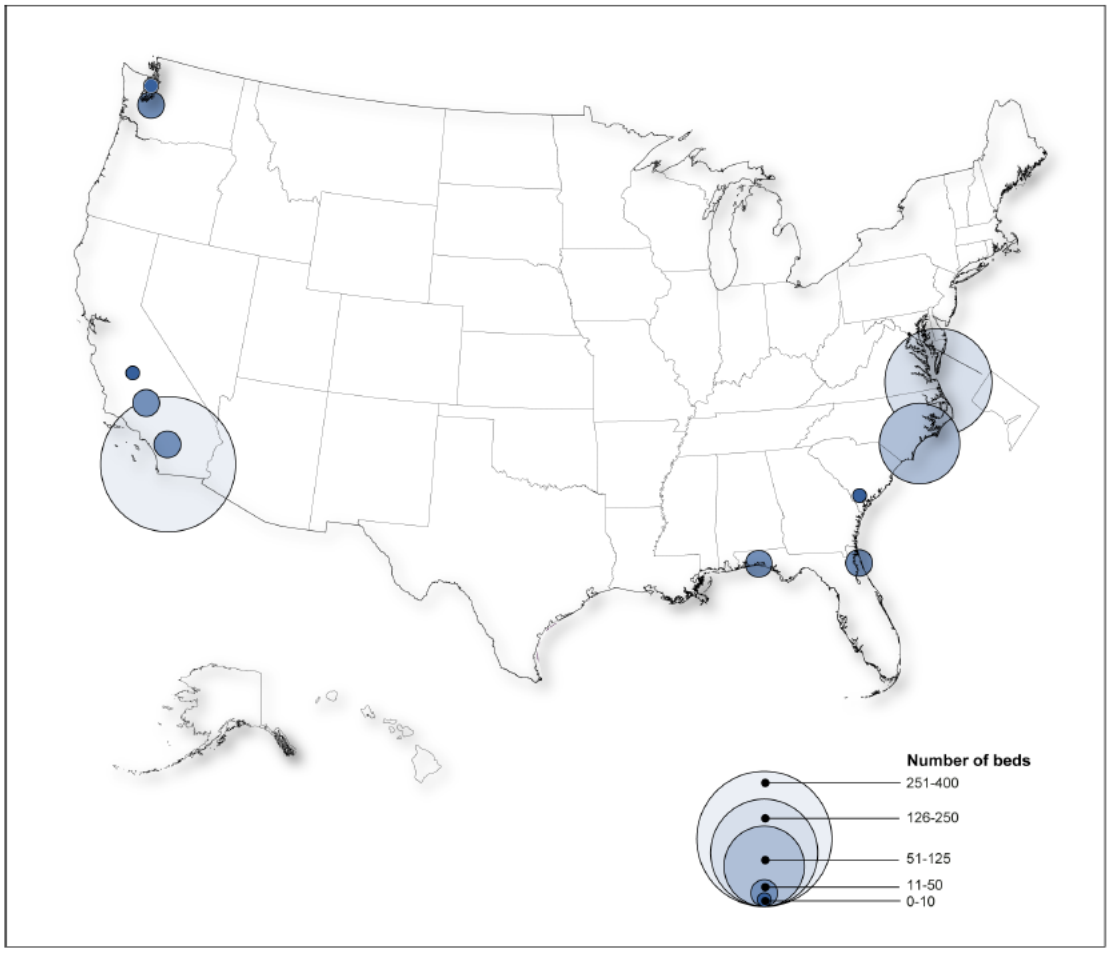


Figure 8. Navy Operated Hospitals. Source: GAO (2016).

Figure 9 below depicts the location of National Capital Region (NCR) operated hospital that fell into categories “A” and “B”. The locations identified were the following:

- Walter Reed National Military Medical Center (Washington, DC)

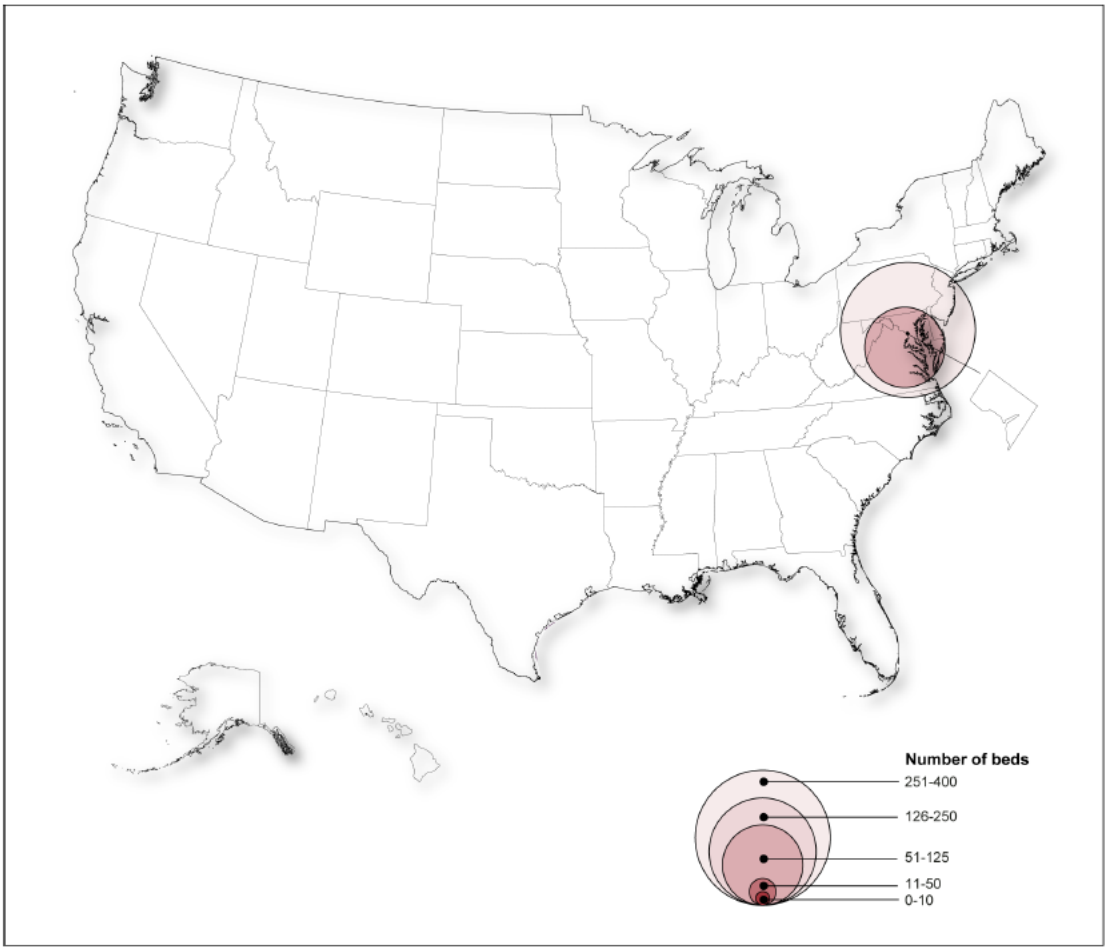


Figure 9. National Military Hospitals. Source: GAO (2016).

The analysis identified seven potential locations that fell into categories “A” and “B” for the DOD. Darnall Army Medical Center in Killeen, Texas was eliminated due to a distance factor. The closest VA operated hospital is located approximately 30 miles in Temple Texas.

The locations of Honolulu, HI, San Antonio, TX, Tacoma, WA, Portsmouth, VA, and Washington, DC, were identified as additional potential locations similar to the San Diego DOD and VA healthcare systems in terms of size, capacity, and capability. Although there are geographical differences of location that would result in budgetary differences, the combination of these areas is assumed to be similar to the budget of San Diego Naval Medical Center and Veterans Administration Medical Center. The federal wage scale for employees at each of these locations will provide a similar manpower cost of operations for individuals performing similar functions, (e.g., a cardiologist employed at the San Diego Naval Medical Center will be compensated nearly identically to an otherwise equal cardiologist employed at the Brooke Army Medical Center in San Antonio, TX), and although there may be slight geographical specific cost differences on a large budgetary scale the differences would not amount to substantial financial impacts. As previously identified, the San Diego Naval Medical Center represents approximately 4% of DOD related annual healthcare costs and the Veteran's Affairs Medical Center San Diego represents a comparative 1% of VA funded annual healthcare costs. The combined costs of these six locations identified represent a 24% and 6% annual budget pool that would be impacted by specialization assuming full adoption at each location between the DOD and VA.

The six areas identified for specialization may not be the only areas that could benefit from the specialization model. It is possible in other areas that either the DOD or VA may benefit from specialization depending on the healthcare networks available in the surrounding community. This study focused on the potential cost savings from specialization to both the DOD and VA, not the individual benefit only one entity could achieve. Further analysis and determination is needed to assess the applicability of specialization in other areas within the United States.

B. TOTAL COSTS AND ESTIMATED SAVINGS

Over the past six fiscal years (i.e., fiscal years 2012–2017), the cost of federally provided healthcare at Naval Medical Center San Diego was an average annual cost of $1.3 billion using an average present value data contained in Table 8 expressed in 2017

dollars. Similarly, the cost of federally provided healthcare at the Veterans Administration Medical Center San Diego was an average annual cost of $578 million using the present value data provided in Table 9 expressed in 2017 dollars. Freeman et al. working paper identifies a potential savings of 5.7% to 15.3% for hospitals that have specialized (Freeman et al., 2016, pp. 3-4). Freeman et al.'s research may be overly optimistic at the upper range of savings potential. In Charles Kenney's "Transforming Health Care," he noted that VMMC reduced operating margin by 3.6 percent during first year of implementation (2008) and 5.9 percent in the following year (2009) (Kenney, 2011, pp. xix-xx). The operating margin improvements found by VMMC in Seattle, WA presents a more likely expected savings from specialization based on U.S. operating costs, but are consistent with the lower potential savings found by Freeman et al. The similarity identified between the San Diego DOD and VA hospitals and those studied by Freeman et al. were that in both cases the hospitals provide service line oriented hospital services evolving from technological or educational related advancements that focus around specific body parts, disease, or metabolic diseases (Freeman et al., 2016, p. 2). Additionally, Freeman et al. found the following:

> Further counterfactual analysis shows that if pairs of hospitals in the London area worked together and redistributed elective service lines so that only one of two hospitals provided any particular service, then the cost of elective treatments could be 4.2% lower without a substantial change in the hospitals' total admission volumes (Freeman et al., p. 4).

Focus on the pairs of hospitals by Freeman et al. identifies a further benefit to pairing services offered by either the DOD or VA hospital within the San Diego region. If future research data reveals that specialization is applicable to the San Diego area DOD hospital and VA hospital, the potential annual savings could be approximately $73 million to $197 million for the DOD and $33 million to $88 million for the VA due to fixed cost amortization and economies of scale. Tables 11 and 12 were created to provide the potential costs with minimum, maximum, and median specialization savings.

Table 11. NMCSD Cost of Operations and Estimated Savings.

		Discount Rate 2.5%		
Fiscal Year	**Present Value**	**Estimated Cost with 5.7% Savings**	**Estimated Median Cost**	**Estimated Cost with 15.3% Savings**
FY 12	$1,313,214,092.72	$1,238,360,889.44	$1,175,326,612.98	$1,112,292,336.53
FY 13	$1,328,080,048.38	$1,252,379,485.63	$1,188,631,643.30	$1,124,883,800.98
FY 14	$1,268,496,936.21	$1,196,192,610.85	$1,135,304,757.91	$1,074,416,904.97
FY 15	$1,127,130,026.90	$1,062,883,615.36	$1,008,781,374.07	$954,679,132.78
FY 16	$1,079,592,901.13	$1,018,056,105.77	$966,235,646.51	$914,415,187.26
FY 17	$1,605,497,833.92	$1,513,984,457.39	$1,436,920,561.36	$1,359,856,665.33
Annualized	$1,287,001,973.21	$1,213,642,860.74	$1,151,866,766.02	$1,090,090,671.31

* Data used to create this table was retrieved from T. Piner, personal communication, January, 11, 2017.

Table 12. VAMCSD Cost of Operations and Estimated Savings.

		Discount Rate 2.5%		
Fiscal Year	**Present Value**	**Estimated Cost with 5.7% Savings**	**Estimated Median Cost**	**Estimated Cost with 15.3% Savings**
FY 12	$519,084,699.84	$489,496,871.95	$464,580,806.36	$439,664,740.77
FY 13	$533,381,773.16	$502,979,012.09	$477,376,686.98	$451,774,361.87
FY 14	$556,278,683.49	$524,570,798.54	$497,869,421.73	$471,168,044.92
FY 15	$664,313,368.46	$626,447,506.45	$594,560,464.77	$562,673,423.08
FY 16	$617,491,873.02	$582,294,836.26	$552,655,226.35	$523,015,616.45
Annualized	$578,110,079.60	$545,157,805.06	$517,408,521.24	$489,659,237.42

* Data used to create this table was retrieved from E. Atienza, personal communication, January 18, 2017.

To operate the six DOD and VA locations annually represents an estimated budget outlay of approximately $7.7 billion and $3.5 billion respectively. The potential federal savings over the same time period if all hospitals specialized would represent an approximate savings of $440 million to $1.2 billion for the DOD and $197 million to $531 million for the VA, utilizing the findings from Freeman et al. Table 13 shows the estimated cost of operations for six DOD and VA hospitals and the combined potential minimum, maximum, and median cost savings.

Table 13. DOD and VA Estimated Cost of Operations and Potential Savings Using Freeman et al. Research.

	Total Cost	Estimated Cost with 5.7% Savings	Estimated Median Cost	Estimated Cost with 15.3% Savings
DOD Locations	$7,722,011,839.27	$7,281,857,164.43	$6,911,200,596.14	$6,540,544,027.86
	DOD Savings	**$440,154,674.84**	**$810,811,243.12**	**$1,181,467,811.41**
VA Locations	$3,468,660,477.57	$3,270,946,830.35	$3,104,451,127.43	$2,937,955,424.50
	VA Savings	**$197,713,647.22**	**$364,209,350.15**	**$530,705,053.07**

Conversely, if the Freeman et al. figures do overestimate the potential savings at the upper range, the potential savings would represent an approximate savings of $228 million to $456 million for the DOD and $125 million to $205 million for the VA utilizing the actual savings figures realized by VMMC as detailed in Table 14.

Table 14. DOD and VA Estimated Cost of Operations and Potential Savings Using Actual Savings Figures from VMMC.

	Total Cost	Estimated Cost with 3.6% Savings	Estimated Median Cost	Estimated Cost with 5.9% Savings
DOD Locations	$7,722,011,839.27	$7,444,019,413.05	$7,355,216,276.90	$7,266,413,140.75
	DOD Savings	**$277,992,426.21**	**$366,795,562.37**	**$455,598,698.52**
VA Locations	$3,468,660,477.57	$3,343,788,700.38	$3,303,899,104.89	$3,264,009,509.40
	VA Savings	**$124,871,777.19**	**$164,761,372.68**	**$204,650,968.18**

There are several assumptions built into these calculations, such as instantaneous specialization is possible and the full year cost savings from specialization would occur immediately following specialization implementation. Additionally, there is no inclusion of costs to specialize that would likely result in the first year or first few years' cost savings being significantly less than future years' potential savings. Although the assumptions built in to streamline calculations are not fully achievable within real world constraints, there are longer term approximations that can be generated using the

calculations with more reliability than a five-year cost savings data used for calculation offers. Further data is needed to fully assess the long-term cost of operations within these six locations to yield a more specific and reliable calculation.

V. SUMMARY, CONCLUSION, AND RECOMMENDATIONS

A. SUMMARY

This study identified potential cost savings to the Federal Government if the DOD and VA healthcare adopts a specialization model noted in the research. However, there are significant hurdles that may neutralize the cost savings that may result from implementing specialization. Specifically, this study identified six locations out of the numerous federally operated healthcare network within the United States where within the region both the DOD and VA facilities are currently producing similar services that would be ideally suited for the specialization model discussed in the research. Adoption of specialization by these six locations identified where the savings are most likely to occur. A harder to assess challenge to adoption of health care specialization is the political and regulatory requirements that would need to be addressed and/or changed to adopt specialization. The unique population pool to federally provided health care subdivides and limits the overall size of the population that could provide an economies of scale approach to savings, as there may not be enough demand to financially justify specialization.

B. CONCLUSION

Specialization is a strategy to gain efficiency and increase utility of scarce resources. Shouldice Hospital proves the concept behind specialization within health care. The DOD and VA have collaboration levels that range from no shared services to fully integrated hospitals. Specifically, the locations of William Beaumont Army Medical Center and El PASO VA have co-occupancy sharing agreement and the North Chicago Federal Health Facility is a fully DOD and VA integrated hospital further demonstrate a possibility of specialization within the federally provided health care system (Barberena, n.d.). According to *U.S. Medicine*, "the Defense Health Agency is projected to save $2 billion by 2019" (Boyle, 2014). The efforts of the DHA have led to savings within just the DOD; however, there remains a significant impact from economies of scale and fixed amortization if the efficiency improvements were extended to other federally provided

healthcare locations beyond just those under DOD control. As shown in Tables 13 and 14, the median savings represent a calculated $367–810 million and $165–364 million of potential resources saved for the DOD and VA respectively from just six locations adopting specialization. The combined median cost reduction represents a value of $0.5–1.2 billion to the federal government.

C. RECOMMENDATIONS

Although there are substantial challenges to specialization within the federal health care network, consideration and further analysis should be conducted, as the potential savings would allow reallocation of scarce resources within the federal government. As health care costs continue to increase, necessary adaptation to provide quality service for the most efficient costs becomes paramount. By adherence to DOD instruction 6010.23 (2013) for DOD and VA resource sharing program the six previously identified locations should form an expanded joint venture agreement that focus on demand data at each location. Adoption of these expanded joint ventures may prove that specialization is the optimal solution to reach optimized efficiency provided the data supports adoption of specialization. Review of all available historical records within the San Diego area to provide disease treatment and medications prescribed will provide additional information that will ultimately determine the feasibility of specialization within the DOD and VA. Future research is recommend to fully validate specialization within the DOD and VA as a solution to reduce expenses while providing the necessary federally funded health care to eligible beneficiaries.

APPENDIX. BUDGET OUTLAYS

	DOD	*2.5%* Discount Rate		
	Nominal Value*	**Present Value**	**DHP Present Value^**	**% DHP of Total**
FY 98	$255,793,000,000.00	$408,923,526,937.76	$15,875,894,447.45	4%
FY 99	$261,196,000,000.00	$407,376,618,430.07	$16,415,563,969.73	4%
FY 00	$281,028,000,000.00	$427,617,336,702.07	$18,724,198,953.62	4%
FY 01	$290,185,000,000.00	$430,781,263,531.39	$20,160,018,319.71	5%
FY 02	$331,845,000,000.00	$480,610,505,061.57	$25,523,412,175.23	5%
FY 03	$388,686,000,000.00	$549,203,142,579.01	$21,766,690,742.27	4%
FY 04	$437,034,000,000.00	$602,456,195,976.05	$24,495,402,385.11	4%
FY 05	$474,354,000,000.00	$637,953,393,336.53	$24,730,462,591.77	4%
FY 06	$499,344,000,000.00	$655,182,600,053.12	$27,841,921,241.71	4%
FY 07	$528,578,000,000.00	$676,624,528,202.22	$30,844,400,022.80	5%
FY 08	$594,662,000,000.00	$742,651,351,435.02	$31,678,352,124.26	4%
FY 09	$636,775,000,000.00	$775,848,505,061.88	$34,210,361,637.19	4%
FY 10	$666,715,000,000.00	$792,514,622,256.90	$34,594,138,431.40	4%
FY 11	$678,074,000,000.00	$786,357,954,861.29	$35,152,612,976.55	4%
FY 12	$650,867,000,000.00	$736,396,269,299.48	$35,215,877,137.60	5%
FY 13	$607,800,000,000.00	$670,897,474,921.88	$32,727,032,283.92	5%
FY 14	$577,898,000,000.00	$622,332,938,406.25	$34,374,138,756.33	6%
FY 15	$562,499,000,000.00	$590,975,511,875.00	$33,895,378,268.13	6%
FY 16	$576,328,000,000.00	$590,736,200,000.00	$33,080,715,725.00	6%
FY 17	$586,834,000,000.00	$586,834,000,000.00	$33,467,516,000.00	6%
			Average % of Total	5%

* Data used to create this table was retrieved from OMB Historical Table 4.1

^ Data used to create this table was retrieved from National Defense Budget estimates series years 1998–2017.

	VA	*2.5%* Discount Rate		
	Nominal Value*	**Present Value**	**VAMC Present Value^**	**% VAMC of Total**
FY 98	$41,724,000,000.00	$66,702,080,346.03	$28,864,963,974.80	43%
FY 99	$43,125,000,000.00	$67,260,282,201.09	$28,381,664,924.61	42%
FY 00	$47,044,000,000.00	$71,583,009,478.81	$30,193,309,865.00	42%
FY 01	$45,012,000,000.00	$66,820,566,997.17	$31,711,868,040.52	47%
FY 02	$50,868,000,000.00	$73,672,031,133.43	$33,349,412,974.95	45%
FY 03	$56,921,000,000.00	$80,427,882,863.65	$36,505,097,097.84	45%
FY 04	$59,554,000,000.00	$82,095,846,765.14	$38,831,160,449.01	47%
FY 05	$69,815,000,000.00	$93,893,413,264.76	$41,400,463,124.74	44%
FY 06	$69,777,000,000.00	$91,553,470,721.40	$41,159,881,604.94	45%
FY 07	$72,792,000,000.00	$93,179,914,141.14	$46,757,421,570.90	50%
FY 08	$84,749,000,000.00	$105,839,887,840.10	$48,962,555,682.92	46%
FY 09	$95,457,000,000.00	$116,305,085,387.60	$54,207,867,059.28	47%
FY 10	$108,274,000,000.00	$128,703,761,292.67	$57,015,389,439.27	44%
FY 11	$126,918,000,000.00	$147,185,969,252.74	$59,710,568,404.59	41%
FY 12	$124,124,000,000.00	$140,434,913,016.84	$61,336,929,355.88	44%
FY 13	$138,464,000,000.00	$152,838,348,087.50	$61,957,630,166.94	41%
FY 14	$149,074,000,000.00	$160,536,393,031.25	$62,649,649,909.19	39%
FY 15	$159,216,000,000.00	$167,276,310,000.00	$62,907,095,374.38	38%
FY 16	$177,612,000,000.00	$182,052,300,000.00	$66,849,294,046.50	37%
FY 17	$180,220,000,000.00	$180,220,000,000.00	$69,640,367,400.00	39%
			Average % of Total	43%

* Data used to create this table was retrieved from OMB Historical Tables 4.1

^ Data used to create this table was retrieved from OMB Historical Tables 3.2

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