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Healthcare Group Purchasing Organizations: Who's Really Saving? An Empirical Investigation
of Hospital Characteristics That Influence Supply Expense for Healthcare GPO Members

by

Kenneth K. Stinson

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree

Of

Executive Doctorate in Business

In the Robinson College of Business

Of

Georgia State University

GEORGIA STATE UNIVERSITY

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2019

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ACCEPTANCE

This dissertation was prepared under the direction of the *KENNETH K. STINSON* Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Business Administration in the J. Mack Robinson College of Business of Georgia State University.

Richard Phillips, Dean

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DEDICATION

This work is dedicated to my wife Crystal and my children Kenneth the 2nd and Kensington Pearl without whom this work could have been completed. With love and appreciation, I also dedicate this work to my mother, Yolanda and in the spirit of reverence and remembrance, the two Dorothys, my late grandmothers and Joe S. Davis, my stepfather, who would be most proud!

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LIST OF ABBREVIATION

CAH: Critical Access Hospitals
DNVHC: Det Norske Veritas Healthcare
EST: Economies of Scale Theory
HCO: Health Care Organization
HGPO - Healthcare Group Purchasing Organizations
HRR: Hospital Referral Region
HSC: Healthcare Supply Chain
HSCCO: Healthcare Supply Chain Consulting Organizations
ISM: Institute for Supply Management
JCAHO: Joint Commission on Accreditation of Healthcare Organizations
MDH: Medicare-Dependent Hospital
RRC: Rural Referral Center
SCH: Sole Community Hospital,
SER%: Supply Expense as a Percentage to Total Expense
U.S.: United States
VA: Veteran Affairs

ABSTRACT

Healthcare Group Purchasing Organizations: Who's Really Saving? An Empirical Investigation
of Hospital Characteristics That Influence Supply Expense for Healthcare HGPO Members

by

Kenneth K. Stinson

August 2019

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Major Academic Executive Doctorate in Business

Healthcare Group Purchasing Organizations (HGPOs) can aggregate purchasing volume and leverage this power to influence supply and service expenses for its members. However, all HGPO members do not realize corresponding value across the board, which could be due to hospital characteristics that impact organizational structure positioning some members to better leverage the resources of the HGPO.

This empirical investigation is a quantitative study that examines healthcare provider characteristics associated with influencing supply expense ratio (SER%) for HGPO members that employs the Economies of Scale Theory (EST) as a conceptual framework. EST suggests that increased size and output of the HGPO, decreases the operating cost per purchase venture thereby decreasing the purchase spend for the HGPO member. Utilization of HGPO contracts is a prime example of the EST and is expected to influence supply expense for its members, legitimizing the need to investigate other factors driving SER% and the differentiation seen amongst members. Prior research has shown that certain hospital characteristics can positively or negatively influence the operations and organizational structure of the hospital warranting the focus on this factor (Armansingham et al, 2008). Using two years of supply expense data for

2162 healthcare providers in the U.S, this study investigated whether specific HGPO member characteristics such as (demographic, descriptive, utilization and service-type designation.) can influence the members SER%. This model not only adds pragmatic findings concerning influencers of hospital expense for HGPO members, it also presents a reliable and replicable model for healthcare supply chain researchers and practitioners to further determine how the effective use of HGPOs can be maximized. The strategic design and implementation of this study will provide healthcare supply chain executives, healthcare policy and reform researchers and hospital administrators with new leads of research areas aimed at decreasing the problem of rising healthcare expenditures in the U.S.

INDEX WORDS: Healthcare, Group Purchasing Organizations, Supply Expense, Hospital Characteristics

I INTRODUCTION

I.1 Problem: The Rise of Healthcare Cost and Expenditures in the U.S

Healthcare supply chain has gained the interest of scholars, researchers, hospitals, government officials and healthcare providers as a mechanism to manage rising healthcare cost and enhance quality in chorus (Elmuti, et al., 2013). In 2008, Pricewaterhouse Health Research Institute reported over \$1.2 trillion of \$2.2 trillion the United States spends on healthcare each year is wasteful spending (Kavilanz, 2009). Inefficient use of inventory management has a direct impact on the operating costs in the healthcare industry, which data suggests is 38% of the total expense, while this number attributes to only 5% in the retail industry (Johnson, 2015; Wang et al, 2015). There is cause for concern and delving into supply chain implementation, as improvement mechanisms could curtail rising healthcare costs: Which account for 17% of the U.S. 2009 GDP and is projected to increase to 19% by 2019 (Smith et al, 2012). At almost 4.6 trillion, the highest of any developed country, the exploration of industry influences of healthcare supply expense is warranted. On average, each U.S. hospitals spent \$3.8 million on supply expenses in 2013, with a \$9.1 million median (Singleton, 2018). Whilst also being expensive, healthcare supply chain is equally as complex and challenging as it has a direct effect on the health of the patient population and requires accurate and consistent inventory to provide care to the patient populations (Little and Coughlan, 2008, Wernz et al, 2015).

Rees, 2003 posited in an issue of Modern Healthcare that HCOs throughout the country are pulling themselves out of financial pitfalls, which is partially attributed to the decline in Medicare and Medicaid reimbursements, increasing expenses and bad debt from patient. While there is limited ability to reduce staff and definitely not a good idea to minimize the quality of care delivered, HCOs have the ability to strategically manage their supply cost, which generally

accounts for 30% of an HCOs purchases that are channeled through a HGPO portfolio (Rees, 2003).

I.2 Healthcare Group Purchasing Organizations

As the past projections of increased healthcare spending in the United States are realized, the influence on supply expenses by healthcare group purchasing organizations (HGPOs) is a key component in healthcare providers' strategy. The Centers for Medicare and Medicaid - Office of the Actuary projected healthcare spending to average annual growth rate of 5.8% between 2015 and 2025. This growth will vary by healthcare spending category, which enables HGPOs to deliver value. The Healthcare Supply Chain Association (HSCA) represents the United States leading HGPOs, which serve as supply chain partners to virtually all 7,700 hospitals within the U.S. This includes more than 68,000 long-term care facilities, surgery centers, clinics, and many other healthcare providers. HGPOs members of HSCA are projected to save the healthcare system between \$329B to \$864B during the time period of 2013 to 2022 (HSCA 2017 Annual Report). While the prominent value add from HGPO to healthcare providers is supply and purchased service cost reductions, a 2014 study found that HGPOs can also provide approximately \$2B in human resource cost savings (Raskin et al, 2016). The human resource cost savings in this study was achieved by HGPOs carrying out the supply chain administrative rolls of strategic sourcing and contracting across a variety of spend categories for the healthcare providers. While the premise of this study was human capital, other studies have explored alternative uses of HGPOs that can influence supply expense.

Several studies have performed empirical investigations that produced findings suggesting HGPOs bring value to its members' in a variety of forms (Doucette & William, 1997; Schneller, 2000; Burns, 2008). In addition, there are many researchers that oppose the use of

HGPOs and believe they cost more than save for its members' (Scanlon, 2002; Singer, 2006; Sethi, 2006). Although, there appears to be adequate literature coverage within the research field on the topic of healthcare HGPOs, an in-depth literature review revealed a significant absence of a vital area of focus. In fact, this gap in the literature is relative to the most prominent claim of HGPO to its members', which is an HGPOs ability to have a significant influence on the members' supply expense. The field currently lacks an empirical investigation that examines what influence do specific hospital characteristics of HGPO members' have on their supply expense? While this area of focus may appear to be tautological, it is vital to fill this gap in research with an empirical investigation that specifically examines a foundational value proposition of HGPOs.

I.3 Hospital Characteristics

Hospital characteristics have long been appreciated primary variables of interest as they relate to outcomes measures in the hospital setting for patient outcomes and overall performance (AbuDagga and Weech-Maldonado, 2016; Engineer et al, 2016; Amarasingham et al, 2008). The HGPO may demand a specific environment to flourish and produce financial value for the member, and this environment could be related to explicit hospital characteristics.

Hospitals that differ demographically, will care for different socioeconomic classes of patient populations and could have disparities in the financial resources available to them (Amarasingham et al, 2008). Hospitals with financial strength and adequate human resource support could have environmental advantages when compared to others. Some examples of demographic hospital characteristics in this study include hospital region, core based statistical area type, Center for Medicare and Medicaid designations. Hospitals utilization, which is the number of patients served by hospitals is an important characteristic to investigate as increased

utilization should be directly proportional to the supply expense. Total admissions are also included it will correlate to the number of patients served. Service-Type hospital characteristics are of interest as well, as the primary hospital types of the services provided at a hospital will cause variances in the supply expense and demands.

I.4 Purpose of the Study

The purpose of this study was to test the Economies of Scale theory by relating hospital characteristics to overall supply expense for HGPO member hospitals.

I.5 Research Perspective and Approach

In effort to produce a thorough investigation, this study will descend on this area of research in the lens of hospital characteristics (demographic, descriptive, utilization and service-type designation) and their influence on annual supply expenses for HGPO members. While the literature base lacks empirical studies comparing members of HGPOs to non-members by examining their annual supply expenses, hospital characteristics that differ between these member hospitals could cause one hospital the ability to better leverage an HGPOs resources and skew the findings of using this type of research model. Initiating this exploration at member characteristic-level instead of comparing the supply expense of HGPO members to non-HGPO members to analyze the annual impact on supply expense is a more impactful model to the field. The aforementioned study would not be a reliable or replicable comparison of HGPO members to non-members as 96% of the data set used in this study was HGPO members, presenting population bias. Furthermore, identifying predictors of HGPO influences on supply expense will contribute targeted data to the existing field of research, with a model that can be used to investigate additional factors that predicts the success of HGPO utilization. In this quantitative study, healthcare spending data from the largest annual survey of hospitals in the U.S will be

analyzed to determine what hospital characteristics, if any, have an influence healthcare supply expense for HGPO members in effort to provide added evidenced-based value, and recommendations for healthcare organizations (HCOs). Hospital comparisons studies, especially those that influence healthcare delivery need to be driven by reliable research that investigates these characteristics and their impact on supply expense for HGPO members.

I.6 Summary

Chapter 2: Literature Review

This review of literature will organize and analyze the current field of evidence and study of HGPOs and validate the need for pursuing this research. We will provide an in-depth background concerning healthcare supply chain through a detailed review of its components and goals. With this background, the challenges and differences in healthcare supply chain that must be appreciated to understand the role of the HGPO will be evident. We will examine the development of HGPOs with emphasis on field literature that demonstrates the strengths, weaknesses and value adding impact of these purchasing organizations and address any gaps in the knowledge base of the field. Hospital characteristics and their considerations in the literature as it pertains to the hospital environment, operations and healthcare spending will be reviewed. This section will also examine the current literature concerning the Economies of Scale Theory and its use within the hospital industry. The section seeks to validate the use of this theory for assessing HGPO supply expense as well as the use of this parameter in healthcare supply chain.

Chapter 4: Research Design and Methodology

The design and implementation of this research will be explicated in this section. It will endorse the choice of the cross-sectional, quantitative approach chosen to answer the primary research question, validate the chosen data set, and provide detailed account of the approach and

methodology in this study. Each of the 5 hypotheses to be tested will be outlined in this chapter. This chapter will also cover the collection of data, data cleansing and transformations, formal data and statistical analysis plan, as well as an explanation of the research model.

Chapter 5: Results

This chapter will present the results of this study beginning with the interpretation of the descriptive statistics of the sample. The regression analysis used to explore our independent variable, hospital characteristics, and the dependent variable which is supply expense ratio (SER%) will be outlined. The results of this study validate our model and interest in hospital characteristics as a factor to investigate as the statistical methods employed indicate an association between these hospital characteristics and SER% for HGPO members.

Chapter 6: Discussion

This chapter examines the results from the study and includes possible justifications and explanations for the findings in the literature. Unexpected results and unintentional finding are also included in this section. The results are clarified and presented in the lens of practical application. The statistical findings are interpreted and discussed in lay terms.

Chapter 7: Contributions, Limitations, Conclusion and Future Research

This study has several contributions to healthcare supply chain, healthcare reform and policy implementation, and for HGPOs that are seeking to further understand how to maximize their value for member hospitals. The theoretical contribution of the HGPO being an effective use the Economies of Scale theory has not been elucidated in the literature. The statistical model used here, while it is the first time this model has been used to interpret the relationship between supply expense and hospital characteristics for HGPO members, it presents a new method for supplementary investigation and new research. Lastly the findings have imperative implications

for future research by health policy researchers. The use and subsidy of HGPOs for public, rural hospitals may present an opportunity for these hospitals to leverage Economies of Scale to reduce supply expenditures and provide financial vitality.

II LITERATURE REVIEW

II.1 Supply Chain

Supply chain has been defined as a virtual network that enables the flow of goods from the point of production, through distribution, to the point of end-user consumption (McFadden, and Leahy, 2000). The supply chain consists of management techniques that add value, in the form of integration and coordination, to business processes and strategy alignment throughout the production chain to first satisfy the customer, while also reducing costs (Mentzer et. al 2001).

The Institute for Supply Management (ISM) has developed and periodically revises a future-orientated definition of supply chain management. To date, ISM defines supply chain management as the identification, acquisition, access, positioning, management of resources and related capabilities an organization requires or potentially requires in the pursuit of its strategic initiatives.

Identification is the role of supply professionals that identify opportunities and needs in terms of company services, processes and performance. Understanding and interacting with customers and company stakeholders to minimize risks and improve efficiency are the overarching goals.

Acquisition and Access refers to how organizations acquire and utilize services and products, including outsourcing. Access reflects how the acquired assets are used by others. Access also embodies the creation of close external relationships with suppliers, while leveraging their innovative resources and energies for the organizations overall advantage.

Positioning: Positioning is the posing of the organization or company in such a way that acquiring and accessing the best possible services, goods, and assets from their suppliers are ensured. Becoming a valued customer ensures superior services and efficient quality and flow.

With good positioning the organization can influence the behaviors and the actions of their suppliers to benefit the organization and its business processes

Management of Resources: Management of resources occurs internally as supply chain primes how the organization provides services and goods for its constituents. External spectrums include how supply chain leaders work in partnership with suppliers and influence how products are manufactured, packaged and delivered. The goal is to have effective process management that ensures that this process has optimal efficiency and ensuring the lowest overall cost. Some leading companies share their supply chain, IT and logistics with other experts to help suppliers use the innovative processes to improve supply costs. Though this transparency may seem risky, it produces overall value to the organization and end users.

Related Capabilities: This facet includes a variety of organizational mechanisms that determine how effectively supply chain professionals can evaluate and respond to markets and gain advantages to maximize organizational performance. This includes the organizations ability to identify personal strengths and competencies, combine tasks, and determine when collaboration is beneficial. Some classic examples noted by ISM include (a) strategic sourcing, (b) total costs, including total cost of ownership, (c) life-cycle costs, (d) scenario planning, and more recently (e) category and risk management and leadership. One very important ability is to determine the appropriate of primary buying power versus collaborative efforts. A proficient supply chain professional is financially conscience and aspires to achieve improved performance outcomes through several avenues such as lower pricing, working capital, total cost, reduced asset bases, and faster cash-to-cash cycles.

Following an ISM field investigation, findings from separate study suggested the scope of supply chain management to be an integration of fourteen components: *investment recovery*,

distribution, inventory control, logistics, manufacturing supervision, materials management, packaging, procurement, product and service development, quality, receiving, strategic sourcing, shipping, and warehousing (ISM; Cavinato, 2009).

Investment Recovery is also referred to as surplus asset management and is the process of obtaining the highest value of an asset that is surplus, obsolete or the product has now changed (i.e. outdated medical imaging equipment). This can be accomplished by reassigning the asset to another department within the organization to avoid the cost of purchasing a new unit, marketing it for sell, scrapping it to avoid high warehouse parking costs, or considering it for donation. When there is no disposition that provides a return on an asset no longer needed for company operations, disposal through a waste management company ensuring prevention of negative environmental impacts is usually more cost effective than storage. A study from the Center for Advanced Purchasing Studies of Arizona University in 2013 revealed that for every \$1 spent in the investment recovery process produces a \$20 return to the bottom line, in the form of cost avoidance and reduction, employee productivity and sales revenue.

Distribution refers to the buying of products from manufacturers in bulk and reselling these products to a customer base in various quantities. Manufacturers sell in larger wholesale quantities, while distributors sell in smaller quantities with immediate delivery options and provide services such as return and warranty that manufacturers will not provide. Distribution also encompasses the entire process by which commodities move to final customers which includes activities such as storing, transacting, packaging and shipping. The overall objective is to achieve efficiency in the delivery of raw materials and partially finished components to the right place and time, and in operational condition.

Inventory control is the management of inventory items. Expertise is required for the management of inventories and decisions on which items to stock at each location, how much and how often items are bought. Managing a shortage or back order is also under inventory control as well as controlling pilferage and damage. A key function of inventory management is to keep a detailed record of new or returned product at that enters or leaves the warehouse or point of sale.

Logistics involves the processes of planning, implementing and controlling a cost-effective flow and storage of raw materials, in-process inventory, as well as finished goods from its point of origin to the point of consumption for the purpose of adapting to customer needs. Logistics management deal with several elements, such as; selecting component vendors that possess the ability to offer transportation facilities, choosing the most effective routes for efficient transportation, identifying the most efficient delivery methods, and utilizing software and IT capabilities to address related processes.

Manufacturing refers to the planning, management, and performance of the processes involved with developing a product from its raw material stage into an intermediate or finished product, which is usually produced in large quantities.

Materials management is a managerial approach for inventory that is primarily used to integrate supply management functions into the organization's operations. Specifically, materials management focuses on the planning, acquisition, flow and distribution of production materials from the stage of raw material to finished products. Activities within this process include, but are not limited to, procurement, inventory management, receiving, stores and warehousing, in-plant materials handling, production planning and control, traffic, and surplus and salvage. While

they share slightly different meaning, materials management is often used interchangeably with supply management.

Packaging refers to the container, wrapper or shipping mechanism the finish product is placed inside. Packaging offers several value-adds to the finish product, such as, containment, protection, apportionment, unitization, convenience and communication. Although healthcare supply-chain management does not participate in this component of supply chain. When choosing a vendor for commodities there is heavy consideration of this component.

Procurement is an organizational function that is responsible for purchasing the required and requested products and equipment for end-users. This involves several functions, such as, development of specifications, value analysis, market research, price negotiations, contract administration, warehouse receiving, and inventory control.

Product and service development involves a series integrated processes in the new product development chronicling, which is from the idea conception stage through commercialization.

Quality has been defined in numerous ways over the years, and in some instances has become synonymous with the term innate excellence. Nevertheless, quality refers to the management of expectations for all inputs to a supply chain. In this function, supply chain owners assess the level of quality for all suppliers and all other partners who have the ability to influence the end-customer.

Receiving is the department generally responsible for verifying order accuracy for all products shipped from vendors. This involves validating the correct products were shipped, as well as the correct quantities.

Strategic sourcing is the process of strategically collecting and comparing information for a specific product or service, which is used as leverage and market knowledge to ensure the buying organization obtains the best value within the marketplace.

Transportation, traffic and shipping are terms that describe the movement of materials and products from point of origin to destination. Traffic is a materials management term that refers to activities that control the buying, scheduling, auditing and billing of carriers.

Warehousing or physical distribution refers to a range of materials management activities that involves taking care of shipping, receiving, internal movement, and storage of raw materials and finished goods.

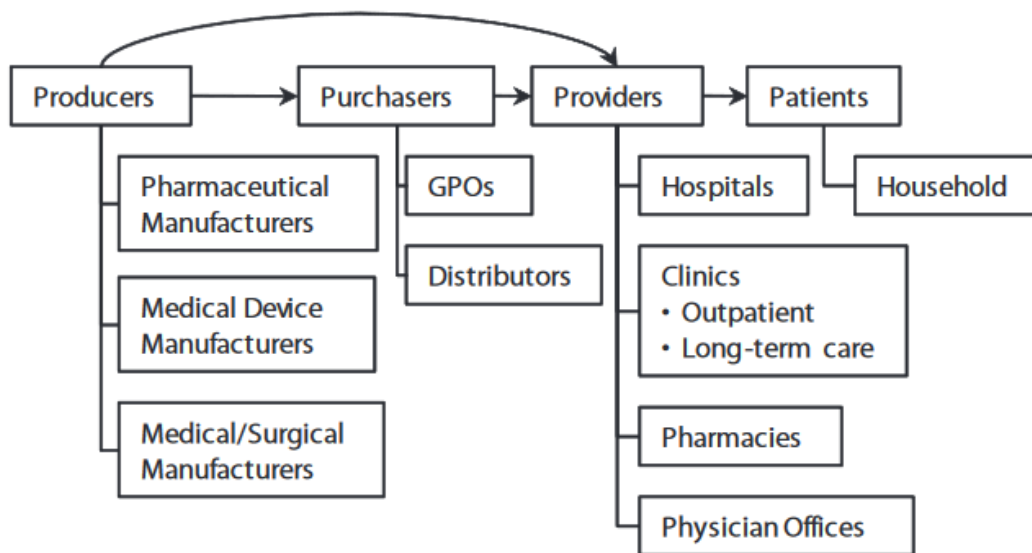
In his book, Cavinato (2009) defines procurement as an operating division of organizations that is responsible for acquiring materials, services, and equipment requested by internal stakeholders. As the business environment continues to evolve, so does the complexity of demands for products and services organizations' need for operation. This evolution of environmental climate and demands across various industries was one of the key contributors to the development of the strategic procurement processes (Anderson & Katz, 1998). Although the definitions discussed for supply chain management, and procurement are not tailored to a specific industry, the terms produce generalizable outcomes regardless of the industry they are implemented within. It is important to understand the basic components of supply chain to understand how healthcare supply chain evolved from these components and ultimately how HGPOs can intervene at certain points in the supply chain to maximize organizational and business outcomes.

II.2 Healthcare Supply Chain

The healthcare supply chain management's (SCM) value chain consists of four main components; suppliers (manufacturers, service providers, and distributors), sourcing and procurement resources (internal and external), healthcare providers, and patients (Burns, 2002). It is essentially the flow of medical products and equipment from manufacturer to provider-patient. Spann, 2015 stated in an interview that "supply chain is the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole". He went on to say, "the challenge for hospitals is to align the supply chain to the care delivery model".

This is of importance as patients are beginning to align healthcare costs to overall customer satisfaction and quality of care. Womack, 2005 stated that healthcare organizations have been slow to identify who the true customer or end user is, yielding the internal customers (doctors, hospitals, payers) as the end user while it should be the patients that they serve (Womack, 2005). Simplistically, healthcare supply chain is how commodities such as nitrile gloves make it from the manufacturer to the end user (doctor, nurse, etc.) and management of this process deals with how to make that chain as seamless and inexpensive as possible. As simplistic as this sounds, it is not so simple to execute as the products offered in healthcare organizations are complex involving high-skill knowledge, and the inputs used in their production are become more sophisticated, in conjunction with the rising cost (Jahre et al., 2012). Supply chain operations account for approximately 25% of pharmaceutical costs and over 40% of the cost for medical devices (Ebel et al, 2013). The annual spending is so massive—about \$325 billion on pharmaceuticals and \$122 billion on medical devices (Ebel et al, 2013). Any gain in efficiency and supply expense reduction in this process will yield exponential increases in revenue for the HCO.

As mentioned, there are several stakeholders to complete the process from manufacturer to end-user. This includes the hospitals, providers, regulatory agencies and payers. The introduction of the HGPO in this process aims to create sizeable cost-reducing opportunities as reimbursements and operating budgets continue to decrease. HGPOs are represented in this value chain as an external resource within the sourcing and procurement link. At the end of the value chain, healthcare providers utilize the supplies and service acquired from suppliers in their daily effort of delivering healthcare to patients (Smith et al, 2011).



(Smith, Nachtmann, and Pohl, 2012)

Figure 1: The Healthcare Supply Chain

Let's revisit the healthcare supply chain, their stakeholders and their roles. The healthcare supply chain begins with the product manufacturer, where items are developed and delivered to a distribution partner. Hospitals can then purchase the item directly from the manufacturer or from the distributor. The purchase can also be made through an HGPO that has a purchasing contract with the manufacturer and if the hospital pays for HGPO membership they are privy to the

negotiated price, which is generally lower than what contract negotiators within the HCO could obtain independently.

The purchased medical products are then sent to the HCO (hospitals, pharmacies, clinics, etc.) The supplies are received in shipping and stocked in inventory. This portion of the healthcare supply chain is complex and fragmented. As the organization attempts to ensure that providers have access to all essential medical products and life-saving materials, there is a lack of emphasis on inventory control. One study found that healthcare providers possess a weak understanding of the products they require, and as a result expensive inventory is ordered in excess (Talluri et al., 2013). Visibility and collaboration are just a couple of ways to reduce cost and ensure more products are consumed prior to expiration. Zepeda, 2016 suggested there are some very common supply chain costs that most hospital is challenged with (i.e. unnecessary product stockpiling, drug diversion, upgrades and repairs, clinician hoarding, and nonstandard ordering methods). Therefore, focusing on product price reductions is not enough to overcome challenges in rising healthcare costs. One supply chain researcher stated, “It is also about the people who buy, move, and use products. The human supply chain links — such as physicians, providers, manufacturers, and distributors — are failing to communicate cohesively and productively”. This is another component of supply chain that can be improved, streamlined and made cohesive when using a HGPO. Being an HGPO member can provide a dedicated resource to your hospital to analyze your supply chain flow and improve inventory control, leverage the value of the HGPO contracts in purchasing supplies and services and improve organizational positioning to ensure unsurpassed supplier and manufacturer relationships. A challenge that HGPOs are now facing with maximizing healthcare spend savings through use of manufacturer and distributor contracts is the issue of physician preference items, which account for approximately 60% of the total spend. This allows

for physicians and providers to become involved with the buying process that have very strong preference for items and will not yield to comparable, contracted items, which ultimately increase supply spending (Nyaga and Schneller, 2015). HGPOs have challenges with this but are more apt to deal with physician negotiations than hospital administration as mediators. For example, when Premier, North Carolina Based HGPO, implemented the development of a device selection algorithm for cardiac implants, it included the physicians input as well as best patient outcomes in the processes to address the physicians' perceptions of HGPOs dictating their purchases and treatment (Sweesy et al, 2004). HCOs that purchases products and services through large purchasing agreements are positioned to achieve significant supply expense savings. Generally, these organizations receive a rebate each quarter, which is share-back based on their volume of purchases for that quarter. Care must be taken with how much control is put on physician preference items as decreasing clinical input in product selection processes can shift the primary goal of purchasing to obtaining the best price rather than the most effective product (Mallach, 2001). HGPOs normal practices includes collaborative efforts with internal and HCO based clinical experts.

The aspect of healthcare supply chain management that makes it more perplexing than any other organizational supply chain is the participation of regulatory agencies such as the Federal Drug Administration, which decides if medical products are approved for use on patients and have specific guidelines, rules and regulations for medical products to abide by as standards of care for patients. This must be considered when purchasing medical supplies and products. This is also one area that HGPO membership can exert its advantages as HGPO supply chain professionals are often on a team of former medical providers that continue to be well-versed in regulations and

standard of care. This could divert a great deal of stress and responsibilities from hospital contracts and purchasing departments to the HGPO professionals.

Healthcare payers such as Medicare and private health insurance companies are also a unique aspect of healthcare supply chain adding further complexity. Healthcare payers decide what providers will be reimbursed and are particularly interested in reducing healthcare costs to reduce reimbursement costs on their part.

Healthcare supply chain management could benefit from exploring tools available in commercial and retail industries to improve and maximize business processes (Kwon et al, 2016). Utilizing HGPOs who are savvy supply chain professionals, with experience in traditional supply chain, but specialized in the healthcare sector is a simple, readily available avenue for HOCs to pursue for performance benefits.

Some would argue that supply chain concepts and principles are identical whether it is applied to commercial or healthcare industries (Kwon et al, 2016). Although commercial aspects of supply chain can be applied to healthcare supply chain, the retail industry is not responsible for providing goods or services in which human life and survival depend on (Wernz et al, 2014). Although one may be dying to buy a new pair of shoes that is sold out everywhere, it is inherently different from a loss of life due to lack of lifesaving treatment, medication, or vaccines. This factor of human life will forever make healthcare supply chain unlike any commercial or retail supply chain. Organizations providing healthcare services are obviously a vital component their surrounding the community and managing these organizations can present unique instances. While it is undoubted that managing the supply chain across other industries will present challenges, managing the supply chain for healthcare presents a completely different level of complication due to the risk to patients' health (Schneller and Smeltzer, 2006).

II.3 Healthcare Group Purchasing Organizations

The Hospital Bureau of New York established the first HGPO in 1910, and now approximately 96% of hospitals within the U.S. channel their purchases through HGPO contracts (Singleton, 2018). Regional HGPOs consolidated into prominent national groups in the 1980s and 1990s based on the premise that healthcare providers have the ability to leverage the groups buying powers, as opposed to an individual HCO, to contract more favorable terms with national suppliers (Rhea, 2009). Recent statistics suggest that over 70% of healthcare spends is managed by HGPOs (Government Accountability Office, 2012; Definitive Healthcare, 2016). National HGPOs (e.g. Vizient, Premier, and Health Trust) serve a supply chain resource to healthcare providers' that offer a robust catalogue of operational improvement service resources. Among these service offerings, the contract portfolio of supplies and services is undoubtedly the most utilized resource of HGPO membership. Surprisingly, this also includes doctor services and hospital care (Starr, 1993). To be clear, healthcare providers opt-in to become members of HGPOs, and these providers collectively represent the group that is leveraged to obtain long-term fixed pricing with suppliers. The Healthcare Supply Chain Association (HSCA) explains how healthcare supply chain consulting organizations (HSCCOs) formulate HGPOs in effort to procure and contract for supplies and services on behalf of its members at a national level. HSCA defines HGPOs as an entity of the HSCCOs that healthcare providers join as members to obtain assistance with identifying opportunities for cost savings and avoidance, as well as operational supply chain improvements. HGPOs can be a valuable resource to healthcare providers who participate, as they provide financial assistance by combining the purchasing volume of the entire membership and using that as leverage to negotiate discounted pricing with national suppliers. This value is

achieved through short, and long-term contracts, which are developed and managed by HSCCOs (Healthcare Supply Chain Association, 2011).

The procurement process and decisions of healthcare providers can affect operational efficiency and the quality of care delivered to patients (Kumar, et al, 2009). From a sourcing and procurement perspective, healthcare providers are faced with the make-or-buy decision, as they must decide whether to procure supplies and services with their internal supply chain resources or outsource these functions to be carried out through the HGPO (Smith et al., 2011). Existing literature has expressed the importance of sourcing and procurement in healthcare. Kumar et al., (2008) states that the procurement function of HCOs is comprised of the activities necessary to purchase products or services from suppliers, and provides opportunity for HCOs to reduce inventory, lower operational cost, and increase revenue during the process. In addition, failure by the procurement process to safeguard the availability of necessary supplies and services could disrupt HCOs delivery of care to patients, which is the most pertinent objective (Kumar, et al, 2008). HGPOs are tasked with helping HCOs identify and secure savings and efficiencies by aggregating purchasing volumes, which forces fair pricing and discounts from manufacturers, distributors and vendors.

There is over 600 GPOs across a variety of industries, but healthcare is dominated by a handful of HGPOs. A study by The Government Accountability Office found that in 2012, the five largest HGPOs contracted for similar products reported a total purchasing volume of \$130.7 billion, and received administrative fees totaling about \$2.3 billion (Government Accountability Office, 2014). Later information suggest they were MedAssets (acquired by Vizient, Inc.), Premier, Inc., and Vizient (formerly Novation), HealthTrust, and Intalere. Premier, Inc. is one of the healthcare industry's largest HGPO with more than 1,500-member hospital and more than 200

of the nation's leading hospital systems with facilities in 50 states and \$25 billion in purchasing volume, provides an array of resources supporting health care services including group purchasing, supply chain improvement, comparative data, and insurance (Sweesy et al, 2006). Novation ranked highest in purchasing volume among the healthcare HGPOs with \$36 billion in contracted healthcare supplies and services in 2009, with 2533 participating hospitals (Rhea, 2009). The five HGPOs reported that the typical supplier administrative fee is 3% of all contracted purchases, and that this fee accounted for 92% of the HGPOs revenue (Government Accountability Office, 2014). HGPOs also reported that 70% (1.6 billion) of the fees were passed on to the HCOs as share-backs and rebates. Other revenue was comprised of outside investments, vendor exhibit fees and HCO membership fees and supplier licensing fees--which are also based on a percentage of the purchase price of products--to market their products using the HGPO's brand name (Government Accountability Office, 2014).

Some healthcare providers, despite subscribing to a HGPO membership elect to explore the market independently to source, procure, and contract supplies and services directly from suppliers. In some cases, the complexity of the supplies or services being procured will have influence on the healthcare providers' decision of whether to utilize the HGPO contract portfolio (Jayaraman et al, 2014; Saha et al, 2011). Existing research has offered warnings for healthcare providers' that decide to explore the market independently and expressed potential detriments that may arise from this method of procurement. Saha et al., 2011, argues internal procurement processes can be a complex and highly fragmented with overlap in the requirements for products, equipment, and services being acquired. Jayaraman et al., 2014, complimented the previous argument in their study and suggested that product portfolios' (i.e. contracts and procurement documentation) generated from these internally managed procurement processes are generally

extensive, imposing unnecessary expenses, making it a challenge to effectively cultivate valuable supplier relationship and contracts. Bearing in mind the complex requirements of HCOs demands, fluctuating operational expenses, along with the need for committed resources to strategically procure goods and services, the utilization of an HGPO contract portfolio has gained high regards among HCOs. A core offering of HGPOs is to provide an opportunity for purchasing that reduces supply costs and increase supply standardization. This in turn enhances quality and reduces human error all whilst providing hospitals with the best equipment for their money. The partnership between HCOs and HGPOs requires detailed information to be shared between both parties, however, HCOs should rest assure that this information is in safe hands as HGPOs are governed by regulation and principles that support fair business practices.

HGPOs business practices are regulated, and have an ethical responsibility to its hospital members, government and the supplier community.

The Healthcare Group Purchasing Industry Initiative Principles

Require each participant to:

- (1) Have and adhere to a written code of business conduct. The code establishes the high ethical values expected for all within the signatory's organization.*
- (2) Train all within the organization as to their personal responsibilities under the code.*
- (3) Work toward the twin goals of high-quality healthcare and cost effectiveness.*
- (4) Work toward an open and competitive purchasing process free of conflicts of interest and any undue influences.*
- (5) Have the responsibility to each other to share their best practices in implementing the principles; each signatory shall participate in an annual best practices forum.*
- (6) Be accountable to the public.*

Each year HGPOs must answer an accountability questionnaire that is synthesized into a public accountability report available to government officials and can be used by hospitals and HCOs to aid in selection of HGPO memberships. The report is reviewed in depth at the annual best practice's forum of HGPO representatives which includes some members outside of healthcare supply chain. The initiative was voluntary and a combined effort by HGPOs to gain trust with key stakeholders (Health and Medicine Week, 2002).

HGPOs are making transparency into their practices and improving oversight a priority. The Healthcare Group Purchasing Industry Initiative, a HGPO-formed organization concentrating on ethics and best practices, launched an independent arbitration process for supplier contracting grievances. With this an ethics board comprised of business ethics specialist outside of the healthcare industry was formed (Modern Healthcare, 2010).

Other conflict of interest policies exists to ensure fair business practices. No HGPO employee can influence contracting decision by accepting any gifts over \$50 per instance or more than \$100 per year. Nonemployees, such as hospital workers who participate in any part of the contracting process, are required to annually disclose any gifts and must recuse themselves from any decision-making panel that involve the vendor (Becker, 2002). HGPO employees who are in a position to have any level of influence on the contracting decisions cannot may not stock or any financial interest in participating suppliers. While nonemployees can, they are required to annually disclose all financial interest and will be excluded from future negotiations involving the vendor (Becker 2002).

HGPOs understand that they prosper when their members are prosperous. Executives at small and large HGPOs are seeking to improve business models to help their members transform their care delivery systems to succeed amidst healthcare reform. HGPOs are implementing changes

in focus and services to help hospitals lower cost and improve quality outside of just buying power. Access to expanded services from staffing and workflow analytics to evaluating the clinical effectiveness and cost impact of medical products that are being provided to members. HGPOs are participating in benchmarking quality of care and managing hospitals' outsourced supply chain services (Rhea, 2010). While HGPOs are transforming and extending into other healthcare supply chain areas, procurement and purchasing are still baseline functions of HGPOs. Simply stated by Anderson and Katz, they function to Buy Less, Buy Better and Use Better. It goes far beyond purchase price and delves into consolidation of volumes, standardization of products, increased service at decreased prices, and eliminations in redundancies in the buying practices (Nollet et. al 2003).

HGPOs are determining the unique challenges of healthcare supply chain and engaging their professionals to find solutions. The current barrier to standardization that impedes adequate ordering and tracking of medical products and streamlining is of top concern. Engineering management-based data are well-suited for supporting healthcare commodity data standard system adoption. HGPOs are imploring professionals like Tolk and Aaron (2010) to develop easily employed inventory tracking systems to reduce costs for their member HCOs. Sure, the GS1 labeling system widely used in the retail industry to track inventory would produce advantageous data for HGPOs but most importantly its adoption would be well-suited to help HCOs standardize as an industry, manage recalls and build momentum towards improving safety and quality of care. HGPOs are politicking for HCOs and suppliers to adopt universal standards for identification and tracking of medical products throughout the supply chain. Amerinet and Premier, Inc. have goals of having all providers and suppliers utilizing the GS1 system. HGPOs are also investing resources to not only help HCOs understand the GS1 alphabet but are also offering resources to help with

implementing the system. HCOs can now rely on HGPOs to develop these types of resources. For example, Vizient, Inc. developed an e-commerce platform where multiple members could streamline purchasing activities without making investments toward redundant services with incompetent vendors.

HGPOs have a strong set of rivals that do not believe they are a true asset to HCOs and believe they contribute to the rising costs of healthcare. Prakash Sethi, president of Baruch College's International Center for Corporate Accountability, conducted an investigation on healthcare HGPOs and suggested that HGPOs administrative fees are excessive and drive up healthcare supply prices by \$5-\$6 billion per year. Another survey research study reported that HCOs were not complying with their HGPO contracts and were only used for a fraction of the promised potential volume of sales (Becker, 2003). Rees, 2003 advocated that administrative fees are a normal business practice that manufacturers are using to attempt to create a negative stigma of HGPOs, but that disregards the fact that typically purchasing cooperatives and groups across other industries are also funded by the same administrative fees. Rees stated, "The lesson from these examples is that the healthcare HGPO business model is definitely not unusual. We would also argue that current financial realities would preclude hospitals from funding group purchasing activities on their own, so the current HGPO fee model is still the most viable solution" (Rees, 2003).

A clinical engineer who participated in capital medical equipment purchasing with Premier, Inc. for more than 40 years believes that the life cycle cost of medical equipment and the utilization of multi-year service agreements by manufacturers reverse any cost-savings earned during HGPO bidding and multiple buys (Lynch, 2017). This notion assumes that if HCOs contract with the manufacturer outside of the HGPO contract portfolio that they will not include service

agreements in the purchase terms and still discount the price to nearly 50 percent from list price. A manufacturer's service agreement can be as expensive as 20% to 28% per year for diagnostic imaging equipment. This amounts to millions of dollars each year and to think that manufacturers will forgo these fees when they contract directly with HCOs is wishful thinking to say the least. What will likely happen is manufacturers will barely discount the item and include the service contract and leave HCOs with a bill they cannot refuse literally and figuratively. Refusal means they do not have the means to provide care for the patients they serve. It is not implausible to assume that manufacturers will try to negotiate directly with the HCO without HGPO knowledge to avoid administrative fees and will likely provide a substantial discount at time of purchase to avoid paying HGPO administrative fees. This model of savings only works due to the presence of the HGPO, without their influence on pricing, HCOs would be vulnerable to the capitalist nature of healthcare supply manufacturers (Rees, 2003).

Other critiques propose that HGPO domination within the procurement and contract management realm of healthcare provides minimal opportunity for suppliers and members to develop genuine relationships, which many with the suppliers believe is a critical management philosophy for optimizing supply chain processes (Kwon et al, 2016). Senator Herb Kohl (D-WI) stated "Group purchasing organizations are at the nerve center of our healthcare system. Because they determine what products are in our hospitals, they directly affect patient health and safety. Because they control more than \$34 billion in healthcare purchases, they impact the cost we all pay for our health system. Because they represent more than 75% of the nation's hospital beds, they are a powerful gatekeeper who can cut off competition and squeeze out innovation,"

HGPOs are continuously criticized for "locking out" smaller products suppliers and limiting innovation. HGPO leaders have responded to this by ensuring to include small business

and products in their portfolios and have even found an advantage in seeking partnership with local suppliers shortening and streamlining the overall purchasing, shipping and receiving process. Some critics still harp on rumored HGPO executive conflicts of interest stating that HGPOs determine suppliers' contracts based on personal gain from stock ownership. Although the adopted code of ethics prohibits this practice, many suppliers and manufactures do not believe there is truly anyone who can enforce this rule.

Small suppliers are not alone in the bundle of disgruntled suppliers who frown upon administrative fees and the HGPOs ability to drive pricing (Becker, 2003). Bigger manufacturers are upset because they claim HGPOs are hampering the introduction of their innovative products or because they cannot price gouge HCOs for goods and services that are essential to their life saving practices. Patients have no clue there are middlemen standing between them and their hospital beds, linen, scrubs, pulse oximeters, bandages, etc.-in short everything a hospital purchases to operate their massive and complex operation. On the other hand, the vendors are acutely aware of it, and they do not like it (Modern Healthcare, 2006). In a recent industry survey, suppliers were asked to rank HGPO priorities. Reinforcing the complaints of the small device manufacturers, they said they thought the HGPOs are most concerned with bringing low prices to members and, secondly, with recruiting and retaining hospital members. The suppliers said the HGPOs were least concerned with seeking out new products that provide better care or clinical effectiveness (Becker, 2003). Through HGPOs, locally owned hospitals have ability to achieve more favorable pricing with national manufacturers. Second, many HGPOs utilize clinical decision councils, which is comprised of representatives that currently work within member hospitals, to evaluate products. Christopher O'Connor, executive vice president of GNYHA Ventures, a Premier, Inc. affiliated regional HGPO that serves members of the Greater New York Hospital

Association stated his “ hospitals are able to realize even greater supply expense reductions by aggregating their contract purchases and buying at high volume tiers that providers could not be reached as an individual hospitals or systems”. "What we do is work with all of our members to get them to that top tier," O'Connor says. "We can say, 'All our hospitals will commit to buying from a particular supplier.' That way, the supplier views all of us as one entity, and our small hospitals will be put into the system" at top-tier pricing. Administrative fees are passed off to the manufacturer in hopes to reduce the burden on smaller or struggling HCOs that could not afford the membership. Administrative fees are typically based on a percentage of the costs of the products that HGPO customers purchase through HGPO-negotiated contracts (Government Accountability Office, 2012)

While some may view the extensive resources that HGPOs devote to development of clinical quality programs, labor-management and revenue cycle management as “crisis identity” (Rhea, 2010). HGPOs are revamping and extending what they can offer to members to distinguish themselves from the pack. While Rhea, and HGPO critics may see this as not knowing their true identity and role in healthcare supply chain, members are excited to have more value from the HGPO membership. Others argue that extended roles of HGPOs make it challenging for policymakers and legislators to “get their arms around” the actual role of HGPOs in the healthcare supply expense arena (Rhea, 2010). Although they may claim to be perplexed about HGPO roles, Government and private insurance company payer can trigger changes in the use of HGPOs. When payers’ put emphasis on savings, more HCOs increase use of HGPO contracts. They can also have direct influences by presenting the roles of HGPOs to their HCOs and request attention to how they can reduce healthcare spending (Doucette, 1997).

While the HGPO opponents exist, the true professionals that can attest to the value and impact of HGPOs are the hospital chief executives that have intimate knowledge and understanding of what HGPOs bring to the table. It appears that no one comprehends how HGPOs protect HCOs in many ways from the predatory pricing strategies from manufacturers. Ultimately, suppliers would have the discretion to inflate pricing for HCOs in the event HGPOs disappeared or were weakened through legislation (Rees, 2003).

Lawton Burn, professor and director at the University of Pennsylvania's Wharton Center for Health Management and Economics, conducted a survey that suggests HCOs are satisfied with their HGPO contracts and believe that HGPOs save them money. The survey results indicated that 80% of HCO executives that reviewed the HGPO code of conduct approve it and find it to be a strong ethics code. The survey excluded hospitals that are not HGPO members to prevent bias or skewing of the results (Burns, 2006).

HGPOs can only work for HCOs who leverage the advantages completely and properly. Dula also cautions HCOs to evaluate savings promised from a competitor HGPO. Jumping from HGPO to HGPO due to presented upfront savings can be tempting but determining the HGPO that is right for the HCO (Dula, 2004). Some of this burden of maximizing potential is placed on the HGPO, as they must be capable of fostering and sustaining their member's commitment. Doucette, 1997 hypothesized four key variables to have a positive influence on member commitment: (1) satisfaction with the HGPO; (2) the perceived commitment of other HGPO members; (3) the degree of information exchange between member and HGPO; and (4) trust in the HGPO (Doucette, 1997).

Overall, the opposers of HGPOs neglect to see the potential of the relationship between HCOs and HGPOs as a positive and realize how increased utilization could improve management

of supply expenses and supply chain operations. With this relationship representing a significant portion of the HCOs overall operating budget, it is vital for it to be managed effectively (Kaldor, 2003). This study could add to the field a body of quantitative evidence that evaluates the actual influence HCOs have on the outcome of HGPO utilization.

Survey research that investigates whether HCOs believe their HGPOs as a valuable resourced was a beneficial contribution to the field, however, a study that analyzes actual healthcare supply expense data could draw some definitive conclusions on the value HGPOs lends to its members. These findings could then be replicated to other HGPOs or future researchers to continue developing this area of focus. It is also important for those not convinced of the HGPOs benefits to understand characteristics about their specific hospital environment that could be contributing to how the HGPO is performing, or not.

II.4 Hospital Characteristics

Hospital characteristics (demographic, utilization and service related) impact the organization construct of hospitals and have been shown in the research to impact patient care outcomes, quality of care, operational failures and beyond (Zhao, 2011). Healthcare services researchers have already identified hospital characteristics that contribute to increases in hospital costs of care: geographical area, population density, complexity of illnesses and specialty designation (Eagar, 2010). This research domain would benefit from a deeper understanding and identification of specific hospital characteristics that have been found to be associated with higher value and efficiency. This would not only impact this literature stream, it would also have vital implications for patients, payers, and policy makers (Desai, 2018). The American Hospital Association (AHA) has categorized the hospital characteristics in their annual AHA survey as Demographic and Descriptive, Utilization and Service Related but further explanation concerning

each of these variables is warranted. Demographic and Descriptive hospital characteristics relate to where the hospital is located and the populations they serve.

II.5 Region and Region Division (Demographic and Descriptive)

While AHA has its own hospital regions, hospitals are also categorized by the U.S. Census Regions and Division in the U.S., which is depicted in the figures below.

Figure 2: United States Regions

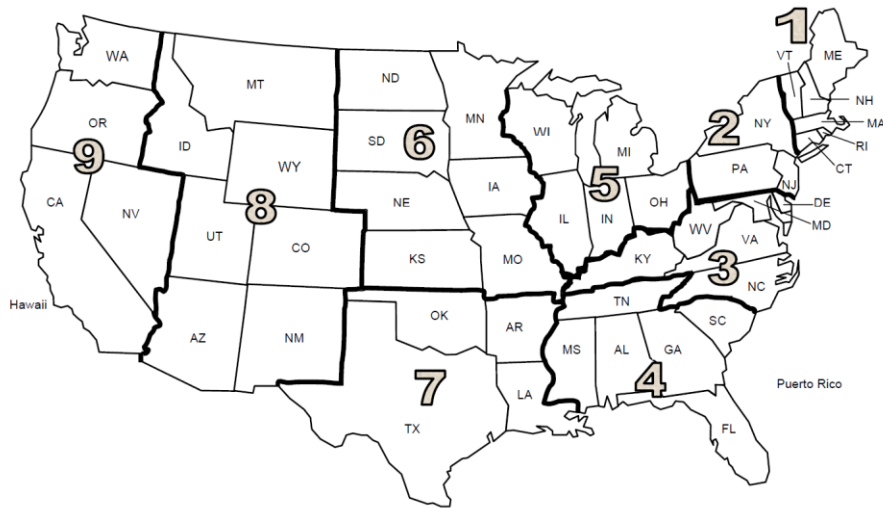
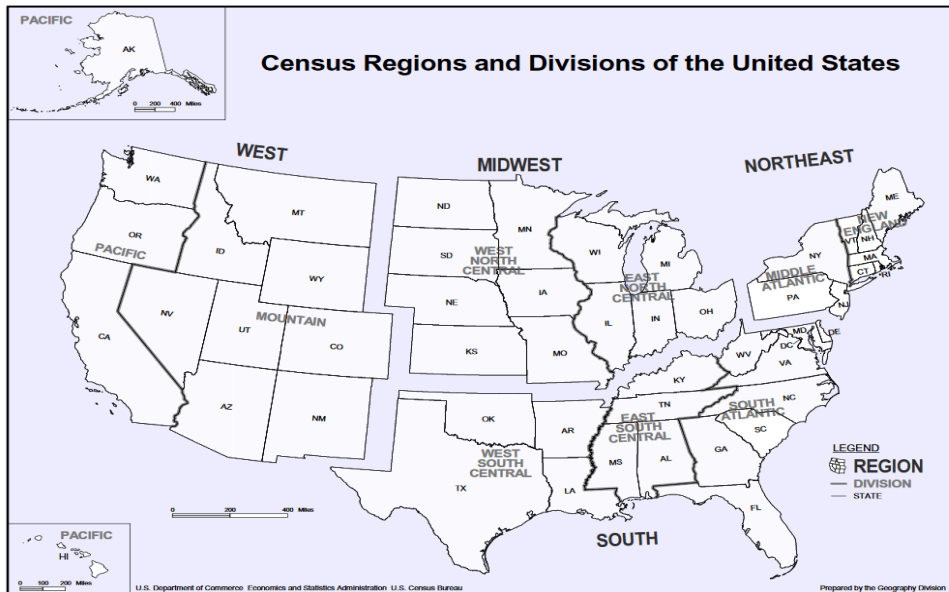


Figure 3: United States Region Divisions



The region whether as designated by AHA or the U.S. Census will display diversity in terms of cost of living, culture, innovation, industry and topography. The West North Central region boasts low unemployment rate and abundance of affordable housing. The East North Central Region is the most inexpensive of the regions to live while the New England area is the most expensive in terms of cost of living (US Census Data). The Census regions also organize ethnic groups and population characteristics, housing, education, health, income and businesses for each individual region. Even minor differences between the regions could impact the individual hospitals that serve these regions.

The Core Based Statistical Area (CBSA) is a U.S. geographic region defined by the Office of Management and Budget and based on the U.S. Census designated counties that are anchored by an urban center of at least 10,000 people in addition to the adjacent counties that are connected to the urban center by commuting (US Census Bureau Census Summary File, 2010). The classifications are metropolitan (population >50,000), micropolitan (population < 50,000 but >10,000) and are based on counties. The AHA includes the rural designated hospitals in the CBSA categories, but the urban vs rural areas designation is a separate hierarchy of the Census geographic entities which is defined as populations and territories outside of cities and towns with greater than 2,500 people (Ratliff, 2016). Urbanized areas with greater than 50,000 form the urban cores of metro areas and urbanized areas with less than 50,000 but greater than 10,000 form the urban cores of micro areas and the cores can be classified as urban or rural (Ratliff, 2016). Rural hospitals with special Medicare payment provisions include: Critical Access Hospitals (CAH), Sole Community Hospital, Medicare-Dependent Hospital and Rural Referral Center (RRC) as seen in Appendix A (Holmes et. al 2010). 62% of rural hospitals are CAHs, 17% are SCHs and 7%, are MDHs (Critical Access Hospitals Payment System, 2016). The

Centers for Medicare and Medicaid Services designates CAH to *rural* hospitals with 25 or less acute beds and 35 miles from another hospital (HRSA, 2015). Congress created the CAH designations through the Balanced Budget Act of 1997 to reduce the financial vulnerability of CAH and stop a pattern of closures seen in the early 1990s (Casey, 2015). CAHs received benefits, financial assistance and cost-based reimbursements for Medicare services, which increased their viability and sustainability. CAHs in rural areas are necessary to provide adequate access to care to these communities with limited resources (Holmes, 2013). SCHs are inpatient facilities that are greater than 35 miles from the closest like hospital facility (excluding CAHs) with a drive time of greater than 45 minutes to the next hospital making them the sole source of hospital services for a rural area. The bed size is greater than 50 and usually are in exclusive Medicare services areas. The MDH designation requires the hospital to be in a rural area, have no more than 100 beds and not be classified as a SCH with at least 60 percent of the inpatient days attributable to Medicare patients (HRSA, 2015). The MDH provides an additional source of care for rural areas and Medicare patients. The RRC is an acute care hospital that treats many complicated cases and has more than 275 beds. These hospitals localize care for rural areas and provide services at lower costs than urban facilities as well as decrease the need for patients to travel to urban areas for care. The system usually has satellite sites with participating outreach clinics to provide primary and emergency care services (Rural Hospital Coalition, 2018).

II.6 Hospital Accreditation

The International Society for Quality in Healthcare refers to the term hospital accreditation as a self-assessment and/or external peer assessment process utilized by HCOs to evaluate its performance levels that are relative to established industry standards for continuous improvement. The following section will address the hospital accreditations analyzed in this

study, as well as any literature to date pertaining to its relationship, if any, with healthcare and supply chain.

II.6.1 *Joint Commission*

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) of Hospitals is not mandatory but many hospitals do not forgo accreditation with the Joint Commission as many major payors (Blue Cross and Federal Medicaid and Medicare) will not pay for care if these hospitals do not possess the accreditation (Linden, 2005). For over 50 years, JCAHO has provided health care facilities the resources to enhance safety and quality of care within their organization through standards, surveys, and consulting services (Franco, 2002). The resources available to JCAHO accredited hospitals enhances the quality of care and operations when compared to non-accredited hospitals (Escott-Stump, 2000). These resources could affect the hospital environment and organizational structure and ultimately how the hospital leverages the HGPO.

II.6.2 *Det Norske Veritas Healthcare Inc*

CMS considers the Det Norske Veritas Healthcare (DNVHC) accreditation as equivalent to the JCAHO as of 2008 (Health Reference Center Academics, 2008). Dissimilarities between the DNVHC and the JCAHO are the cost associated with accreditation and the resources available to the accredited hospitals. The DNVHC costs associated with accreditation are appreciably lower than the JCAHO as the survey process has only one point of contact by one designated staff member that received extensive training from the DNVHC and no other outside consulting services are needed (Ashe, 2012). Also, the DNVHC has not claimed to provide any resources or consulting services affiliated with its accreditation program (DNVHC.com). Lastly,

quality of care and operational outcomes have shown differences in the research based on the certification organization (Man, 2017, Lichtman, 2011).

II.7 Teaching Status

The literature base comparing teaching to non-teaching hospitals suggest that teaching hospitals due to residency training programs and other elements special to these types of hospitals effect the efficiency (Lehner, 1995), cost differentials (Morey, 1995), and patient outcomes (Sandhu, 2013). It is estimated that only 10% of the teaching hospitals are capable of effectively competing with non-teaching hospitals based on the provision of patient services (Grosskopf, 2001). Studies have also shown that rates for invasive medical procedures for patients admitted with common medical conditions is higher in teaching institutions (Zimmerman, 1993), which could undoubtedly affect supply expenditures in these hospitals. The AHA has designated teaching institution as those who have a medical school affiliation reported to the American Medical Association and who have a designation with the Council of Teaching Hospitals with the Association of American Medical Colleges which is a standard parameter for teaching designation (Amarasingham, 2008).

II.8 Hospital Ownership or Controlling Entity

Typical hospital ownership status designates a hospital as public, private/non-profit, and private for profit (Amarasingham, 2008). Public hospitals are owned by the government and typically treat a patient population that is uninsured or underinsured, low income, or covered by Medicaid. In addition, they provide a large amount of unreimbursed care and are usually teaching institutions (Fraze, 2010). Private hospitals which are owned by investors and shareholders and operate as a business concerned with profit margins and profitability (Ko, 2014). Public hospitals are typically larger with 33 million annual patient admissions compared

to private hospitals that have 1-2 million patient admissions (AHA, 2014). Patterns of operation in private vs public, profit vs not-for-profit differ significantly and on average baseline levels of financial performance also differ due to strategic approaches to scale and operational discipline (Reiter, 2014). Public and private not-for-profit hospitals are classified as safety net hospitals who provide care to patients regardless of their ability to pay.

The patient population within the U.S. health care system is rattled with patients that are uninsured or underinsured, which is why safety-net hospitals are a vital component to the access of care for its surrounding community (Zuckerman, 2001). Safety-net hospitals have several attributes that contribute to financial vulnerability such as seeing a high percentage of Medicare and Medicaid patients with a heavy reliance on federal state and local government subsidies, high level of uncompensated care, charity care and unpaid care debt (Song, 2010). Medicaid patients, and Medicaid payment rates are generally less expensive than Medicare and private insurance and with higher patient to physician ratios, longer wait times and not being as technologically advanced as private hospital, attracting insured and able to pay patients is difficult (Institute of Medicine, 2000). The controlling entity of a hospital determines methods of reimbursements, subsidies, procurement and purchasing protocols and overall hospital operations (Cheney, 2017). For this reason, all government, nonfederal hospitals regardless of state, county, city or hospital district have been designated as such. Nongovernment, not-for-profit: hospitals such as those controlled by churches or other charitable organizations are grouped together as research has shown little difference between these two hospital types and the controlling organizations while they can accept federal grant funding, are not subject to government influences in decision-making and lend to community need and service as motivating factors (Wood, 2001). Some may argue that non-profit hospitals are being forced to be concerned with

financial viability and are subject to government intervention due to tax exemptions based on mandated charity care (Kennedy, 2010).

Investor-owned (for-profit) hospitals whether individual, partnership or corporation owned are subject to similar mechanisms of control and decision-making influences legitimizing the grouping of these hospital types for analysis of this hospital characteristic. Government, Federal hospitals, such Veterans Affairs (VA) hospitals are separated from non-federal hospitals as the two sectors differ in internal infrastructure and care delivery, and VA hospitals are commonly located in metropolitan teaching facilities, and experience longer lengths of stay and operational milieus that vary significantly from than nonfederal public hospitals (Rivard, 2010).

II.9 Hospital Utilization

Utilization of a hospital takes into account the volume of hospital utilization, character of individuals utilizing the hospital and efficiency of hospital utilization. Because this study focuses on supply expense and how trends in the volume of hospital utilization can impact supply spending, we will focus on the latter measure of utilization which is measured by volume (Fieldston, 2012). Standard utilization indicators include: bed size, total admissions, occupancy rate, average length of stay, and total inpatient days (Cantor, 2009). The AHA uses the parameters of patient admissions and adjusted patient days to measure utilization. Adjusted patient days or service days are the sum of all inpatient days in the hospital. Bed size of hospital is included in the utilization category as it is an indicator of hospital capacity, which usually mirrors the hospital demand (Fieldston, 2012) While the literature suggests that using annual bed statistics can underestimate hospital utilization measures, because this study focuses on the purchasing standpoint versus the issue of adequate capacity, the use of bed size is justified (DeLia, 2006).

II.10 Service-Type Designations

Most of the hospital characteristics as they relate to the services rendered by the hospitals is explained in service type designation by the AHA (i.e neonatal intensive care hospital, psychiatric care hospital, etc.). Primarily these designations are established by the U.S. Department of Labor and the Occupational Safety and Health Administration (OSHA.gov) which categorizes hospitals as general medical and surgical, psychiatric or specialty. Service-related designations of interest in this investigation are specialty hospitals (obstetric, cardiac intensive care, neonatal intensive care, pediatric intensive care), psychiatric care hospitals and adult and pediatric general medical and surgical hospitals. General medical and surgical hospitals provide standard inpatient diagnostic and medical treatment both surgical and non-surgical. General medical and surgical hospitals usually provide outpatient services, such as diagnostics (radiography, clinical laboratory and pathology) outpatient operating room procedures and pharmacy services. Children general medical and surgical hospitals present with enough variation in patient flow and in-patient demand when measuring utilization that warrants separately categorizes this hospital designation (Lorch, 2008, Hillier, 2009). Depending on the service-type designation the categorical and overall spending will vary based the differences in the operational needs of each hospital, warranting focus on this particular hospital characteristic and investigating how it can influence supply expense for HGPO members.

II.11 The Economies of Scale Theory and Hospital Industries

The EST originally referred to and was developed for single-product outputs in industry, but later assumptions accept multiple product outputs, such as seen in hospitals (Smet, 2002). EST refers to a fall in the average cost of services, as activity volume increases until an optimum efficient level of production is achieved (Smith and Bowens, 2000, Green, 2002, Schneider et. al

2005). Economies of scale in the provision of hospital services can be due to hierarchal, operational and structural changes (i.e. accumulation of knowledge and experience and specialization of healthcare professionals), spreading and sharing of capital investments and the central focus of this study: bulk purchasing of pharmaceuticals, equipment and services at lower price (Baumol and Blinder, 2008). Rural and small hospitals are said to be incapable to reach economies of scale and size efficiency (Zhao, 2011). Because some hospitals fail to operate efficiently due to factors outside of its control, such as cost disadvantages associated with low population density and inability to absorb cost and generate revenues, the use of the HGPO to perform bulk purchasing and how it impacts supply expense is pertinent. Ideally the purchasing aggregation power of an HGPO should allow all hospital types to leverage EST to influence supply expense but inequitable achieved value for HGPO members postulates other factors driving the realization of these influences, in particular hospital characteristics.

III RESEARCH DESIGN AND METHODOLOGY

III.1 Research Design

While HGPOs operate within an array of industries, the healthcare industry was chosen because of its broad impact on the U.S. population. This impact to patients not only involves the delivery of care provided to patients, but also the cost of care that is passes along to patients. Economics suggest that an increase in the cost of operation will likely result into an increase in cost of the product or service being provided, and the healthcare industry is not exempt from this basic principle. With supply expenses accounting for 15%, on average, of a hospital's total expenses, in addition to the unanimous industry focus on combating the rising cost of care, the healthcare industry presented itself as a prime candidate for observation in this study (Abdulsalam and Schneller, 2017).

III.2 Data Collection and Validation

The research design was a cross-sectional time series, quantitative, retrospective analysis which employed the use of raw secondary data. Secondary data was selected, versus primary data, because it provided an avenue to acquire all factor variables from one reliable source. Collecting primary data for an acceptable sample size would require a significant amount of time, as well as require survey respondent to share sensitive information with an unfamiliar outside party. Generally, hospitals cannot share information with outside parties unless it is approved by their legal and compliance department, which would only extend the data collection time period. In addition, each hospital has different information sharing policies, which would have a negative impact on the consistency of data points when comparing hospitals or create a challenge with collecting a sufficient sample size. The dataset used for this research was retrieved from the American Hospital Association (AHA), which is a national organization that represents nearly 5,000 hospitals, healthcare systems, and a list of other providers. Since 1946, AHA has administered an annual survey of hospitals, which over time has produced a comprehensive database that is used for market analysis, benchmarking, and healthcare related research. In this survey, hospitals report information pertaining to their organizational structure, demographics, utilization, finances, service lines, and staffing for the current year (AHA Annual Survey, 2016). The AHA data set is widely used and regarded as a high-quality data source for healthcare supply chain research. In effort to substantiate the use of the AHA data set, Abulsalam and Schneller, 2017 performed analysis and found a 0.985 correlation between the AHA's supply expense data and supply expense data from another study that analyzed 92 independent hospital data sets using the AHA definition for supply expense, which supported a strong predictive relationship. Abulsalam and Schneller study validates the use of the AHA datasets for

this research. The dataset from AHA is a representative sample of the general hospital population reducing the introduction of bias into the study

III.3 Data Sampling Plan

The AHA dataset for fiscal year 2015 and 2016 survey responses was chosen as the most appropriate data source for this research. A primary reason for this decision was the AHA datasets possessed exceptional data coverage, over 85%, for key hospital characteristic variables (i.e. HGPO status, supply expense, total expense) linked to this study.

Financial data reported by hospitals in the AHA annual survey for fiscal years 2015 and 2016 was utilized in this study to develop the dependent variable and measure supply expense for each hospital that reported to be a HGPO member. Supply expense as noted in the AHA survey is “the net cost of all tangible items that are expensed including freight, standard distribution cost and sales, and use tax minus rebates. This does not include labor and labor related expenses and tangible items that are typically part of labor related expenditure” (Abdulsalam and Schneller, 2017). All hospitals included in the sampling are confirmed HGPO members making the sample representative and large enough to ensure precise results. With an understanding that not having a representative sample can introduce bias into the study and that an inappropriate sample size could deem the study results imprecise, the sampling plan consisted key criteria outlined in Table 1.

Table 1: Research Data Sampling Plan

All hospitals are HGPO Members.
All hospitals reported supply expense and total expense.
Number of hospitals examined (N): 2162 out of 6239 hospitals in the data set.
2 years of examination: 2015 and 2016

III.4 Data Cleansing

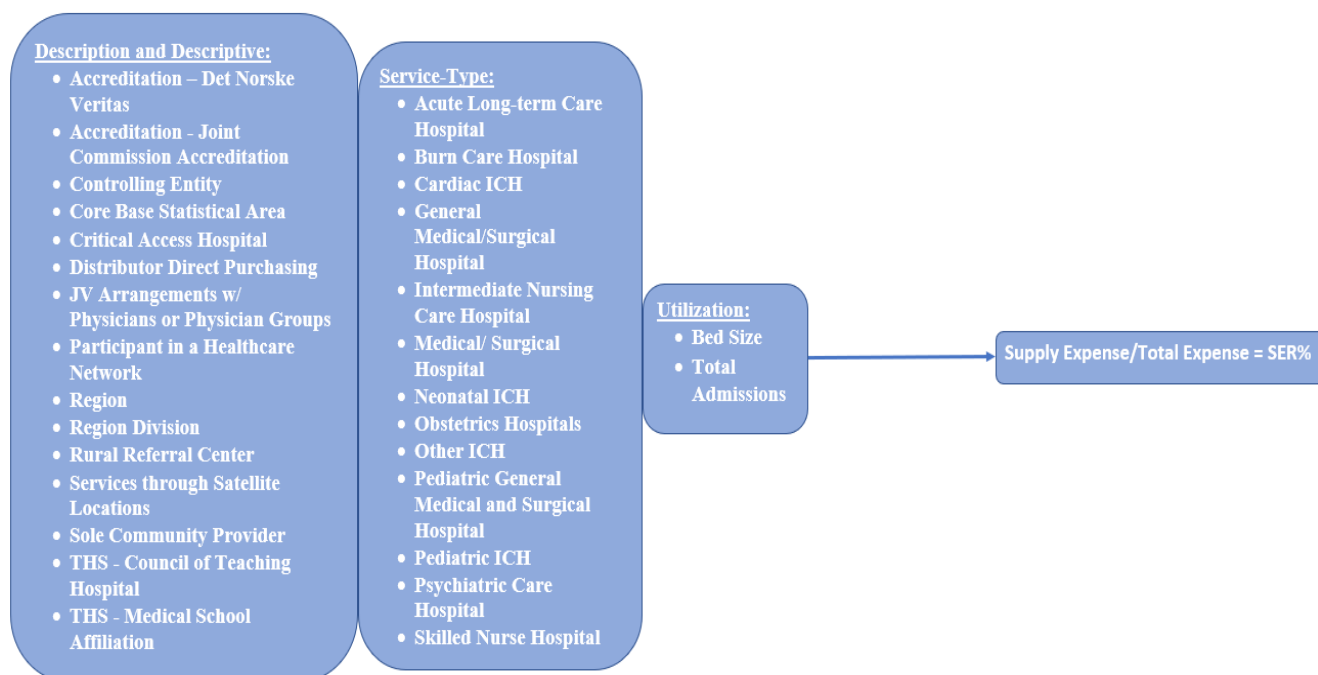
The study employed purposeful sampling using the AHA data set. All hospitals included in the sampling were selected based on a key criterion; confirmed HGPO membership, reported supply expense and total expense for both 2015 and 2016. Hospitals who did not report supply expense or total expense for both years were excluded, as these two measures were critical in developing the dependent variable. Those selected hospitals ($N=2162$) were then stratified based on the independent variables in Table 2 that could impact the association with supply expense.

Table 2: Independent Variable Codes and Description

AHA Acronym	Description
REGION	Hospital Region
REGION DIVISION	Hospital Region Division
TOTADM	Total Admissions
CNTRL	Control Code Description
BSC	Bed Size Code
NETWRK	Participant in a healthcare network
SUPLY	Supplies purchased directly through distributor
CBSATYPE	Core-Based Statistical Area Type ; Metro, Micro, Rural
MAPP1	Joint Commission Accredited
MAPP5	Medical school affiliation reported to the American Medical Association
MAPP8	Teaching Hospital - Association of American Medical Colleges
MAPP 18	Critical Access Hospital
MAPP 19	Rural Referral Center
MAPP20	Sole Community Provider
MAPP21	Det Norske Veritas Accreditation
SNT	Does hospital provide services through one of more satellite locations
JNTPH	Participate in joint venture arrangements with physicians or physician groups
JNTMD	Participate in joint venture arrangements with organizations other than physician groups
EHLTH	Hospital has electronic health record
GENHOS	Adult general medical and surgical hospital
PEDHOS	Pediatric general medical and surgical hospital
OBHOS	Obstetrics hospital
MSCIHOS	Medical/surgical hospital
CICHOS	Cardiac intensive care hospital
NICHOS	Neonatal intensive care hospital
PEDICHOS	Pediatric intensive care hospital
BRNHOS	Burn care hospital
OTHIHOS	Other intensive care hospital
PYSHOS	Psychiatric care hospital
SNHOS	Skilled nurse hospital
ICFHOS	Intermediate nursing care hospital
ACUHOS	Acute long-term care hospital

The survey response dataset was obtained through a secondary licensing agreement with the AHA. The response data was separated into seven files for each year, which was based on the category of survey responses. Three of the seven files were used from each year's survey were used for this study, totaling six file that would be examined. The initial dataset began with responses from each year that consisted of 6,239 hospitals responses, totaling 12,478 for both years (2015 and 2016). With HGPO members as the focal point of this study, the first process of cleansing this data set involved excluding all hospitals that reported not be a HGPO member or did not respond to this question in the survey. There were 3908 (i.e. 7,816 for both years) hospital that confirmed to be a HGPO member. The next step in data cleansing involved excluding all hospitals that did not report supply expense or total expense. There were 1,661 hospitals excluded, which left 2,247 (i.e. 4494 for both years) hospitals remaining. Finally, all hospital located outside of the United States were also excluded, which result into a final sample size of 2,162 for each year, totaling 4,324 for the entire sample.

III.5 Operationalization of Data



III.6 Dependent Variable

The dependent variable utilized in this research was adopted from a study conducted by Abdulsalam and Schneller, 2017, who found that supply expense as percentage of the total hospital expense to be the most common ratio that is used for monitoring and benchmarking trends within healthcare. The purpose of their study was to shed light on the inconsistency of measuring supply expense throughout the healthcare industry. The intent for Abdulsalam and Schneller, 2017 research contribution was to present practitioners and future research with a standardized measure for the supply expense within the healthcare industry. Their measure was strongly supported by an in-depth literature review, which is outlined in Appendix B. This study applies Abdulsalam and Schneller supply expense measure to the data set for both 2015 and 2016. This measure is depicted in the above section as “Supply Expense/Total Expense =

SER%”, with Supply Expense Ratio (SER%) representing the dependent variable measure for each hospital. Prior to calculating SER%, there were two additional calculations performed on the 2016 supply expense variable. First, the sum of 2016 supply expense and pharmacy expense was calculated. 2016 was the first year that AHA separated these two variables. Prior to 2016 these two variables were combined in the dataset and represented as supply expense. The purpose of the second calculation applied to 2016 supply expense was to control for inflation, which was achieved by calculating an inflation correction value that would be applied to the 2016 supply expense value for all hospitals in the sample. The inflation information was obtained from the consumer price index annual report. The annual inflation rate for 2015 and 2016 were 237 and 240, respectively. Therefore, the inflation correction applied to all hospital’s 2016 supply expense was .988 (i.e. $237/240 = .988$). Following the application of these two calculations, supply expense for 2015 and 2016 was then divided by total hospital expense for the respective year to calculate a supply expense as a percentage of total hospital expense, which would serve as the dependent variable for each hospital in the sample.

III.7 Independent Variables

Hospital characteristics related to demographics, utilization, and service lines were hypothesized as independent variables for this study. These characteristics were also obtained from the 2015 and 2016 AHA annual survey for hospitals. The number of survey responses for each characteristic listed in Table 3 were retrieved from the data sets for each hospital in the sample. These hospital characteristics were selected as independent variables based on the support of their influence to hospital performance, which was found in the previous literature. There were two categories of hospital characteristics hypothesized in study; Demographic and

descriptive, and Service-type designation, which were hypothesized to have a positive or negative influence on the SER% of hospitals.

III.8 Statistical Analysis

This study employed a multiple linear regression analysis to test for a correlational relationship between the selected hospital characteristics and their influence on SER%. In effort to add validity to this study, the regression analysis was performed using of SPSS and SAS software, with a three-step process. These three-steps involved performing an initial regression analysis, which was utilized to identify any multicollinearity variables. Variables that possessed variance inflation greater than 10 were gradually excluded, one-by-one, from the model until all variance inflation were less than 10. The next step in this process involved the application of studentized residuals to identify and exclude extreme outliers. The sample size began with a total of 4323, and after excluding multicollinearity variables and extreme outliers the sample size reduced to 4,094.

III.9 Research Question and Hypothesis Testing

III.9.1 Research Question:

Do specific healthcare provider characteristics influence supply expense for HGPO members? If so, how and to what extent?

III.9.2 Hypotheses and Rationale

H1: Metropolitan demographic characteristic will show a negative influence on SER%.

Rationale: Within the United States, rural hospitals are being challenged with funding cutbacks and are receiving lower reimbursements for services. A shortage of physicians' shortages paired with higher uninsured rates are two culprits' rural hospitals are challenged with improving hospital operations and streamlining supply chain practices (Schorr, 2014). Rural

hospitals also struggle internally with shortages of qualified workers and fewer capital resources that would enable them to implement advanced healthcare IT solutions and IT infrastructure, which if they do not already have these internal resources implemented is usually telling that their healthcare supply chain processes are also fragmented (Deville, 2011). Additionally, each healthcare providers environment, will depend on its location (rural, urban) and capability of negotiating lower costs of supplies, devices, and drugs (Lagu, 2013). Based on extant literature, we can infer that healthcare providers located in metropolitan areas possess more resources than peers in non-metro areas, providing metropolitan providers the ability to manage a more strategic supply chain that has a negative influence on supply expense.

H2: Not for Profit controlling entity will show a positive influence on SER%.

Rationale: Microeconomic theory suggests that For-Profit organizations can achieve increased production efficiency in comparison to other forms of ownership structure, as these institutions are incentives for profitability (Ahem and Molari, 2004, Shen, 2005). Accountability for financial performance has a trickle-down effect, from the top of for-profit HCOs, which should encourage the effective leveraging of HGPOs. This is a distinct difference from Not for Profit hospitals which are not at the mercies of stakeholders that demand profitability, which could curtail motivation to negatively impact supply expenses. The literature positions for-profit hospitals to be more finically focused and capable of strategically impacting the institutions spend. This draws the inference that not for-profit institutions do not possess this ability and strategic capabilities, which in turn will have a positive influence on the institution's supply expense.

H3: Joint Commission Accreditation will show a negative influence on SER%.

Rationale: Hospital accreditation has been linked to efficient development of structural, process, and outcome standards as well as improving financial and organizational effects, program evaluation, and measurement of quality (Mohammadkarim, 2017, Shortell, 2004). With this extant literature in mind, I feel this characteristic will impose a negative influence on supply expense for providers that possess Joint Commission Accreditation.

H4: Teaching Status designation will show a positive influence on SER%.

Rationale: Traditionally teaching institutions have indirect costs, not directly educational in nature, associated with clinical research initiatives and specialized service capacity (Pradarelli, 2016). These specific differences are not overcome easily, even while utilizing a HGPO in influencing supply expense. Several prior studies have evaluated costs associated with teaching hospitals and have concluded that teaching hospitals provide more expensive care to its patients (Koenig et al 2003), therefore this characteristic will likely have a positive influence on supply expense.

H5: General Medical/Surgical service type will show a positive influence on SER%.

Rationale: The hospital service type designation and specialty influence spending and is likely linked to the complexity of the care provided (Osborne, 2015). Children's psychiatric and Rehabilitation specialties are at the low end of total supply expense while Surgical and Orthopedic specialties ranked the highest (Abdulsalam, 2017). Supply spend due to these service type designations differs mainly due to likelihood of surgical procedures. General medical and

surgical facility, unlike specialty facilities must be equipped for all common medical occurrences as being the frontline destination before referral to specialty hospitals. This equates to a high-volume of patients and a large product mix of inventory to be on-hand at all time, which is directly associate to having a positive influence on supply expense.

IV RESULTS

IV.1 Descriptive Statistics

The descriptive statistics in this study provide some insight for the dependent variable, as well as one independent variable that was composed of numeric-continuous data. Table 3 shows that the dependent variable (SER%) in this study has a mean of 16.73% and a standard deviation of 7.57%. The independent variable, Total Days of Admissions, has a mean of 9211.4, with a standard deviation of 11460.4. The remaining variable in this study were categorical, and binary.

Table 3: Descriptive Statistics

Variable	Mean	Std. Deviation
Supply Expense/Total Expense = SER%	16.73%	7.57%
Total Admissions	9211.4	11460.4

Table 4 provides insight into the survey respondent population based on each characteristic variable. Hospitals located in the Mid-West (33%) and South (40%) regions of the United States contributed to 73% of responses. While the Western and Northeast regions attributing to 15% and 12%, respectively. From a region division perspective, 21% of hospital respondents were located in the West South-Central division, with 16% being located in both the West North Central and East North Central region division. 14% of hospitals were located in the South Atlantic and 10% located in the Pacific. Hospitals located in all other region division were less than 10% of the sample.

Regarding the core-based statistical area of operation, 70% of hospital respondents were in a Metro area, while hospital located in Micro (15%) and Rural (15%) areas collectively contributed to the remaining 30% of responses.

68% of hospital respondents were controlled by Non-government, Not-For-Profit organization. While those controlled by Government, Non-Federal (16%) and Investor-owned,

For-Profit (16%) made up the remaining 32% of responses. Less than 1% of the hospital respondents were controlled by Government, Federal.

Rural Referral hospital represented 4% of the respondent sample, with Sole Community hospital attributing to 6% of responses. 17% of hospital respondents were Critical Access facilities.

Hospitals that are Joint Commission Accredited represented 74% of the respondent, while DNV accredited hospitals only had a 7% representation. Teaching Status (Medical School) hospitals were represented by 35%, with Teaching Status (Council of Teaching Hospital) only being represented by 9% of the respondent sample.

For hospital services types, there were 90% of hospitals that were Adult General Medical and Surgical, 48% Pediatric General Medical and Surgical, 68% Obstetrics, 74% Medical/Surgical, 33% Cardiac Intensive Care, 29% Neonatal Intensive, 35% Psychiatric Care, 12% Pediatric Intensive Care, 8% Intermediate Nursing Care, 13% Other Intensive Care, 4% Acute Long-term Care, 5% Burn Care, and 20% Skilled Nurse hospitals. 35% of hospital participate in a joint venture arrangement with physician groups, while another 35% participate in joint venture with organizations other than physician groups. Finally, 96% of the respondent population confirmed to have implemented electronic health records.

Table 4: Number of Respondents and Nonparametric Correlations			
<i>Hospital Characteristic</i>	<i>Data Code</i>	<i># Responding</i>	<i>Spearman's Nonparametric Correlation Coefficient</i>
<i>Demographic</i>			
Hospital Region:			
Midwest	<i>REGION_MW</i>	33%	***
Northeast	<i>REGION_NE</i>	12%	***
South	<i>REGION_S</i>	40%	***
West	<i>REGION_W</i>	15%	***
Hospital Region Division:			
East North Central	<i>REGION DIVISION - ENC</i>	16%	***
East South Central	<i>REGION DIVISION - ESC</i>	4%	***
Mid-Atlantic	<i>REGION DIVISION - MA</i>	9%	***
Mountain	<i>REGION DIVISION - M</i>	6%	***
New England	<i>REGION DIVISION - NE</i>	4%	***
Pacific	<i>REGION DIVISION - P</i>	10%	***
South Atlantic	<i>REGION DIVISION - SA</i>	14%	***
West North Central	<i>REGION DIVISION - WNC</i>	16%	***
West East Central	<i>REGION DIVISION - WSC</i>	21%	***
Core Based Statistical Area Type:			
Metro	<i>CBSATYPE_Metro</i>	70%	***
Micro	<i>CBSATYPE_Micro</i>	15%	***
Rural	<i>CBSATYPE_Rural</i>	15%	***
Control Code:			
Controlling Entity (Government, Non-Federal)	<i>CNTRL_1</i>	16%	***
Controlling Entity (Non-government, Not-For-Profit)	<i>CNTRL_2</i>	68%	***
Controlling Entity (Investor-owned, For-Profit)	<i>CNTRL_3</i>	16%	***
Controlling Entity (Government, Federal)	<i>CNTRL_4</i>	<1%	***
Rural Referral Center	<i>MAPP19</i>	4%	.076**
Sole Community Provider	<i>MAPP20</i>	6%	-.122**
Critical Access Hospital	<i>MAPP18</i>	17%	-.570**
<i>Descriptive</i>			
Accreditation (Joint Commission)	<i>MAPP1</i>	74%	.367**
Accreditation (Det Norske Veritas)	<i>MAPP21</i>	7%	.098**
Teaching status (Med school affiliation)	<i>MAPP5</i>	35%	.518**

Teaching status (Council of Teaching Hospital)	<i>MAPP8</i>	9%	.414**
Participant in Healthcare Network	<i>NETWRK</i>	46%	.151**
Provides satellite services	<i>SNT</i>	61%	.374**
Supplies purchased directly through distributor	<i>SUPLY</i>	87%	.191**
<i>Utilization</i>			
Bed Size	<i>BSC</i>	100%	.918**
Total Admissions	<i>TOTADM</i>	100%	1.00
<i>Service Type-Designation</i>			
Adult General Medical and Surgical Hospital	<i>GENHOS</i>	90%	.252**
Pediatric General Medical and Surgical Hospital	<i>PEDHOS</i>	48%	.353**
Obstetrics Hospitals	<i>OBHOS</i>	68%	.510**
Medical/ Surgical Hospital	<i>MSCIHOS</i>	74%	.597**
Cardiac Intensive Care Hospital	<i>CICHOS</i>	33%	.602**
Neonatal Intensive	<i>NICHOS</i>	29%	.632**
Psychiatric Care Hospital	<i>PYSHOS</i>	35%	.204**
Pediatric Intensive Care Hospital	<i>PEDICHOS</i>	12%	.417**
Intermediate Nursing Care Hospital	<i>ICFHOS</i>	8%	.001
Other Intensive Care Hospital	<i>OTHIHOS</i>	13%	.340**
Acute Long-term Care Hospital	<i>ACUHOS</i>	4%	-.118**
Burn Care Hospital	<i>BRNHOS</i>	5%	.247**
Skilled Nurse Hospital	<i>SNHOS</i>	20%	-.068**
Participate in joint venture arrangements with organizations other than physician groups	<i>JNTMD</i>	35%	.369**
Participate in joint venture arrangements with physicians or physician groups	<i>JNTPH</i>	35%	.402**
Hospital has Electronic Health Record	<i>EHLTH</i>	96%	.143**

IV.2 Regression Model Summary

This research model employed an adjusted multivariable to adjust for the inflation of performing multiple regressions for independent variables. The research model summaries below disclose the results from the three-step analysis process that involved ruling for multicollinearity variables and extreme outliers.

1st – Initial model summary including multicollinearity and outliers

Model Summary					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	42	8.28456	0.19725	51.28	<.0001*
Error	4281	16.46691	0.00385		
Corrected Total	4323	24.75146			
Root MSE	0.06202	R-Square	0.3347		
Dependent Mean	0.16729	Adj R-Square	0.3282		
Coeff Var	37.0734				

The initial multiple regression performed generated an r-square of 33.4% and an adjusted r-square of 32.8% and was showed significance.

2nd - Model summary excluding multicollinearity

Model Summary					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	40	8.26831	0.20671	53.71	<.0001*
Error	4283	16.48315	0.00385		
Corrected Total	4323	24.75146			
Root MSE	0.06204	R-Square	0.3341		
Dependent Mean	0.16729	Adj R-Square	0.3278		
Coeff Var	37.083				

After ruling for multicollinearity, we can see that r-square and adjusted r-square remained relatively the same, as well as the model significance at <.0001.

3rd – Final model summary excluding multicollinearity and outliers (Final Model)

Model Summary					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	40	7.0569	0.17642	89.8	<.0001*
Error	4053	7.96287	0.00196		
Corrected Total	4093	15.01977			
Root MSE	0.04432	R-Square	0.4698		
Dependent Mean	0.15898	Adj R-Square	0.4646		
Coeff Var	27.8815				

The *final model* summary revealed a statistically significant and predictive relationship between model's hospital characteristics and their influence on supply expense (SER%). Our regression output indicates that 46.5% (Adjusted R²) of the variance seen in SER% for HGPO members is explained by the hospital characteristics in the research model (Adj R²=0.4646; p<0.001). The results of standardized coefficients for hypothesized hospital characteristics are reported in the proceeding section for ease of understanding. A negative *beta* suggests the dependent variable (SER%) decreases by its value per 1 standard deviation.

IV.3 Hypothesis Findings

H1: Metropolitan demographic characteristic will show a negative influence on SER%.

The standardized coefficient for the metropolitan demographic characteristic was $\beta = 0.0158$ and was significant with a $p < .001$. This indicates that hospitals located in metropolitan areas positively influence SER% by 1.58% per 1 standard deviation. Therefore this hypothesis was rejected. While the literature has suggested that providers located in metropolitan areas possess better capabilities to leverage economies of scale and employ standardization as it relates to supply chain practices (Jensen, 1985; Lagu, 2013), this hypothesis finding suggests different. While health providers located in metropolitan areas are likely have better capabilities to implement supply chain strategy, their diverse case mix and high patient volume can make it challenging task for this group of providers to have negative influence on supply expense.

H2: Not for Profit controlling entity will show a positive influence on SER%.

The standardized coefficient for Not for Profit controlling entity was $\beta = -0.01175$, with a $p < .001$, which was significant. This hypothesis was rejected. Modern healthcare noted that between 2016 and 2017 not for-profit hospitals in the U.S. experience a 1.4% decline in its

annual expense growth rate, which suggest these expenses decreased for this group of suppliers. This reduction was realized with both the labor and supply expense. These expenses were initially projected to increase; however, the industry attributes decrease to the industry shift toward outpatient care and increased ambulatory competition (Kacik, 2018).

H3: Joint Commission Accreditation (JCAHO) will show a negative influence on SER%.

The standardized coefficient for JCAHO hospital accreditation was $\beta = -0.007$, with a $p < .001$. This suggest that SER% was decreased by 0.7% per 1 standard deviation for hospitals that are JCAHO accredited, which supported this hypothesis.

H4: Teaching Status designation will show a positive influence on SER%.

The standardized coefficient for AMA medical school affiliation teaching status was $\beta = 0.00404$ and was significant with a p-value $< .0281$. In addition, the standardized coefficient for Council of Teaching Hospital teaching status was $\beta = .00987$ and was significant with a p-value $< .0026$. These findings support the hypotheses that the teaching status characteristic has a positive influence on supply expense.

H5: General Medical/Surgical service type providers will show a positive influence on SER%.

The standardized coefficient for general medical/surgical providers was $\beta = 0.00404$ with a p-value $< .0281$. These findings confirmed that SER% was positively influence by this characteristic and was significant, supporting the hypothesis.

Summary

While not all the hypotheses were supported in our model. It is important to note that *all* the categories of hospital characteristics (demographic, descriptive and service-type designation) selected for this model were shown to moderate the dependent variable (SER%) for HGPO members.

Table 5: Hypotheses Results and Summary

HYPOTHESIS	RESULTS	SUMMARY
H1: Metropolitan demographic characteristic will show a negative influence on SER%.	NOT SUPPORTED	This suggest that providers located in metropolitan areas are experiencing positive influence on SER%. This can be attributed to these provider’s diverse case mix and high patient volume.
H2: Not for Profit HGPO member hospitals will have a positive influence on SER%.	NOT SUPPORTED	Not for Profit member hospital findings were insignificant. However, Non-Federal, Government controlled hospitals exhibited a negative SER% influence validating that ownership and controlling entity does have some level of influence on SER% for HGPO members.
H3: Joint Commission Accreditation will have a negative influence on SER%.	SUPPORTED	Hospital accreditation with the JCAHO did exhibit a negative influence on supply expense for HGPO member hospitals. Providers that possess this accreditation are suggested to be linked to efficient development of structural, process, and outcome standards as well as improving financial and organizational effects, program evaluation, and measurement of quality.
H4: Teaching status will have a positive influence on SER%.	SUPPORTED	Teaching status as designated by the Council of Teaching Hospitals and Medical School Affiliation showed a positive influence on SER%.

H5: General Medical Surgical Hospitals will have a positive influence on SER%.	SUPPORTED	General medical surgical hospitals showed to have a positive influence on SER%.
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IV.4 Additional Findings

The purpose of this section is to elaborate on significant findings that were not hypothesized. Although there were no assumed outcomes for these characteristics, these findings may serve as a catalyst for expounding on these characteristics within the research field. This section will provide an overview of each characteristic (i.e. demographic and utilization service type) that was found to be significant, as well as its relationship to the dependent variable.

Table 6: Demographic Characteristics (Region):

Variable of Interest	Relationship to DV	<i>p-value</i>
Midwest Region	+	<.0001
South Region	+	<.0001

Many healthcare systems are strategically located on a geographical basis with several studies documenting large geographic variation in regard to health expenditure (Reschovsky, 2014; Fisher, 2009; Congress of the United States Congressional Budget Office, 2008). The demographic characteristic of region being discussed here is categorized by the U.S. Census Regions and Division in the U.S., which divides the country into four main regions for population registration purposes; Northeast, Midwest, South and West. Healthcare facilities such as hospitals and clinics are positioned in specific locations, evolving the concept geography into a forecaster of health utilization, expenditures and outcomes (Soria-Saucedo, 2016). However, to fully analyze this demographic characteristics, the data would have to be transformed and analyzed by Dartmouth Atlas Projects' categorization of Hospital Referral Region (HRR) which

is the gold standard for analyzing geographical influences of healthcare in the U.S. and has documented glaring variations in how medical resources are distributed and utilized in this country (Wennberg, 1996). With some surface comparisons of HRR, we see that growth in healthcare costs in the top 25 HHRs corresponds to the finding of our study. Using the trends in 2006, 31.9% of the increase in the top 25 largest HRRs occurred in the South region and 24.7% in the Midwest Region while the Northeast region contributed 23.5% and the West region contributed 9% to the annual growth rate in healthcare costs (Fisher, 2009). Healthcare costs continue to rise in these regions, which explains how we could see a positive influence on supply expense in these U.S. Census regions. It has been postulated that analyzing data in 4 large regions (Northeast, Midwest, South, West), could wash out any regional differences especially if much of the variations are on a smaller level (e.g., rural vs. urban areas) and the larger region is examined (Daffner, 2010). Moreover, our knowledge-based pertaining to the variation of small and large geographic areas relative to hospital spending remains inadequate (Soria-Saucedo, 2019).

The field and literature have established that geographic variations is not random and hospital demographic characteristics concerning geographically based factors need to be considered and meticulously studies as unexplained variation between regions and geographic area remains (Fischer, 2003; Congress of the United States Congressional Budget Office, 2008; Daffner, 2010; Institute of Medicine, 2013; Rosenthal, 2012). Further analysis is needed that could not be done with this data set for this empirical analysis, but the findings are significant, nonetheless.

Table 7: Demographic Characteristics (Region Division):

Variable of Interest	Relationship to DV	p-value
East North Central Region Division	-	0.0003
East South Central Region Division	+	0.0169
Mid-Atlantic Region Division	+	<.0001
Mountain Region Division	+	<.0001

The variable of US. Census Region division are the 4 US regions West, Midwest, Northeast, and South each broken down into two or more subregions. The East North Central Region division is part of the Midwest Region, The East South-Central Region division is part of the South Region, the Mid-Atlantic Region division is part of Northeast Region and Mountain Region division is part of the West Region. The standardized coefficient for hospitals in the East North Central Region, $\beta = -0.009$, $p < 0.0003$, also indicated a decrease in SER% by 0.9% per 1 standard deviation for this demographic hospital characteristic. All other region division experienced a positive influence on supply expense and were significant.

Surgical procedures (Daffner, 2010, Reschovsky, 2014, Goodney, 2010) and utilization of services (Parker, 2010; Curtis, 2006; Burke, 2010) differ between geographical regions and distribution of healthcare resources are designed to respond to local demands. The field has postulated that the geographic variance in hospital spending prospectively is attributed to the interaction of several components such as the underlying prevalence of morbidities, differences in the demographics and socio-economic status of populations, overuse and misuse of medical technologies, and differences in the approaches to treatments (Soria-Saucedo, 2016). Hospitals located in the same HRR behave significantly different in their utilization of resources. This variation of utilization is present in both lower- and higher-spending HRRs, which translates that there are high-spending facilities located within low-spending regions and low-spending hospitals in high-spending regions (Institute of Medicine, 2013). Healthcare decision making

occurs at the either the provider- or organizational-level, such as hospitals or physician groups, not at the geographic region level which could also explain why the drivers of variability in hospital spending have not been delineated concretely.

Table 8: Demographic Characteristics: Controlling Entity and Rural hospitals

Variable of Intrest	Relationship to DV	<i>p-value</i>
Government, Nonfederal Controlling Entity	-	<.0001

The standardized coefficient for Nonfederal, Government hospital $\beta = -0.017$, $p < .0001$ showed that SER% was negatively impacted by this hospital characteristic. Non-Federal, Government controlled hospitals exhibited the ability to influence supply expense validating that ownership and controlling entity does influence supply expense for HGPO members. While we expected For-profit hospitals to have the supply chain infrastructure and profit-margin motivation to maximize the HGPO and show a negative influence in supply expense, it was indeed the opposite. Microeconomic theory suggests that For-Profit organizations have the ability to attain high-production efficiency better than other forms of ownership structure given the strong incentives for profitability (Ahem and Molari, 2004, Shen, 2005). However, our results showed that Nonfederal, Government hospitals showed a negative influence on supply expense.

Variable of Intrest	Relationship to DV	<i>p-value</i>
Critical Access Hospital	-	<.0001
Sole Community Provider	-	<.0001
Rural Referral Center	+	0.0002

Rural hospitals with special Medicare payment provisions include: Critical Access Hospitals (CAH), Sole Community Hospital, Medicare-Dependent Hospital and Rural Referral Centers. The standardized coefficients for Critical Access Hospitals $\beta = -0.03$, $p < .0001$ and Sole Community Providers $\beta = -0.013$, $p < .0001$ indicated that SER% was negatively influenced by 3%

and 1%, respectively per 1 standard deviation for these characteristics which are both located in designated rural areas. Again, rural providers with CMS as a main payor were not expected to be able to capable leveraging the HGPO capabilities. CAHs and Sole Community Hospitals showed a negative influence on supply expense. While rural referral centers showed a significant, positive influence on supply expense, this makes sense from an industry perspective as rural referral centers are high-volume acute care facilities that treat an array of complicated cases. In general, these facilities have an unpredictable and complex case mix, which make it a challenge toward strategizing supply chain operations.

The findings for Government, Nonfederal hospitals, CAHs, and Sole community hospitals can be explained by the recent motivation from CMS to curtail healthcare spending. In 2013, the Centers for Medicare & Medicaid Services (CMS) introduced its first mandatory bundled payment program by randomizing metropolitan statistical areas (MSAs) into the payment model (Haas, 2019). This is just one of many measures that the CMS is taking to curtail hospital spending. The mandatory bundled payment program issues hospitals a bundled payment that essentially covers all services from hospitalization through 90 days following discharge, to entice hospitals, clinicians, and facilities to partner in the effort of reducing spending and improving the quality of care (Haas, 2019). In 2012, CMS completed a program that tethers hospitals Medicare reimbursement to their readmission rates (i.e. the percentage of patients that must return care within 30 days of being discharged). As a result, the 30-day readmission rate decreased to 18.5% in 2012. The decline continued through 2013, with readmission averaging less than 18% within the first eight months. CMS created the Health Care Innovation Awards, which funded up to \$1 billion in awards to 107 organizations that has implemented the most compelling innovative ideas to delivering better health, improved quality of care and lower costs

to people enrolled in Medicare, Medicaid and the Children's Health Insurance Program (CMS, 2014).

While it cannot be determined what CMS initiative contributed to the negative influence on supply expense seen in Government, Nonfederal hospitals, CAHs, and Sole community hospitals, it illustrates how the payors can motivate hospitals to implement cost-savings measures into their supply chain plans. It is important to note that by CAHs being limited to their critical-access status, they are the least likely to have an on-site intensive care unit (ICU) versus other acute facilities, provide cardiac catheterization, or have sufficient surgical facilities. Rural Referral Centers are rural tertiary hospitals that primarily treat patients that have been referred to them from a surrounding rural acute care hospital. Sole community hospitals are the only hospital serving a community and are not acute care hospitals but are heavy providers of inpatient care (CMS, 2015). This partially explains why CAHs and Sole Community Providers showed a negative influence supply expense while supply expense increased or Rural Referral Centers. CAHs do little to no emergency surgery or cardiac care while Rural Referral Centers treat more serious acute conditions including surgery. Hospitals providing this type of care usually show an increase in supply expense due to supply spend as these facilities must be equipped for all common medical occurrences as being the frontline destination before referral to specialty hospitals decreasing the likelihood of leveraging the savings potential of a HGPO (Abdulsalam, 2017). Sole Community Providers are inpatient hospitals that can better plan for supply expense, these are the specific facilities targeted by programs such as the bundled payment program and readmission reduction incentives.

Table 9:Utilization Service Types Characteristics

Variable of Intrest	Relationship to DV	<i>p-value</i>
Psychiatric Care Hospital	–	0.0004
Other Intensive Care Hospital	+	0.0233
Cardiac Intensive Care Hospital	+	<.0001
Acute Long-term Care Hospital	+	<.0001

Again, the hospital service type designation and specialty influences spending and is likely linked to the complexity of the care provided (Osborne, 2015). Children’s psychiatric and Rehabilitation specialties are at the low end of total supply expense while Surgical and Orthopedic specialties ranked the highest (Abdulsalam, 2017). It makes sense that Intensive Care Hospitals, Cardiac Intensive Care Hospitals and Acute Long-term Care hospitals showed a positive influence on supply expense while psychiatric care hospitals showed a negative influence and the literature widely supports this. The hospital spends for Intensive care and Acute Long-term Care are unpredictable and expensive. Hospital stays that involves the patient spending time in the intensive care unit (ICU) are of interest because critical care costs have been increasing for decades, to approximately 13.4% of hospital operating costs in 2005 (Halper, 2009). Because ICU stays represent a costly segment of health care spending, it is important to understand patterns and variation in ICU utilization and it corresponds to the findings of this study showing Intensive Care as hospital characteristic to positively influence supply expense. Acute Long-term Care hospitals are for patient that require 25 days or more of hospitalization. The average length of stay is typically 30 days for patients requiring prolonged ventilator use, or ongoing dialysis for chronic renal failure, intensive respiratory care or complex wound care. Acute Long-term Care hospitals are similar to an ICU and have complex medical needs and are critically ill (Ernesthealth.com, 2019).

Variable of Interest	Relationship to DV	<i>p-value</i>
Total Admissions	+	0.0044

Standard utilization indicators include: bed size, total admissions, occupancy rate, average length of stay, and total inpatient days (Cantor, 2009). However, of these normal utilization indicators only total admissions showed a significant effect on supply expense. This study initially planned to investigate hospital utilization, but as with the region variables, the variance in total admissions would require more in-depth analysis in order for produce any findings of this variable that would be of value to the field.

Variable of Interest	Relationship to DV	<i>p</i>-value
Hospital Services Provided through Satellite Locations	+	0.001

Satellites are a lower cost setting in which to provide care with the use of mid-level providers and more flexible staffing (i.e. medical assistants versus RNs). Satellite locations are usually leased spaces that reduce capital costs. These locations are usually more convenient than the hospital removing complicated routes within large buildings to reach outpatient clinics and providing free parking. Ambulatory care satellites can and should match the standards for service of most community-based physician's offices: free parking; ground floor access; and courteous, prompt and personal care. Satellite location do not usually have the supply chain infrastructure of traditional hospitals. In addition, satellite clinics often function without a full-bodied infrastructure for treating moderate to severe illnesses that are associated with hospital, and services provided at these locations that can require costly urgent patient transfers, often by air, to tertiary care centers (Ferguson, 2015). So, while these locations are more cost-effective and convenient for the patient, this convenience could lead to satellite location not leveraging the HGPO as the supply chain executives that are responsible for purchasing and procurement at the parent hospital are also tasked with these smaller satellite clinics. While this finding was not hypothesized on, the results are to be expected.

Variable of Interest	Relationship to DV	<i>p-value</i>
Supplies Purchased Directly through Distributor	+	0.0031

Hospital systems are attempting to ditch the distributor and have started to contract directly with manufacturers, while using their own storage and distribution channels. Doing so, these systems takes on the financial risk and usually over purchasing (Hochfelder, 2017). In some models the hospital uses one distributor for the whole system but as a single, stand-alone buyer, without the bargaining leverage of an HGPO, this can lead to paying more for supplies than your counterparts that leverage the HGPO (Dula, 2004). Some healthcare systems, especially those that recently merged, may be using multiple distribution companies trying to leverage the multiplicity of hospitals within the system for bargaining power with distributors (Hochfelder, 2017). These efforts and manpower of contract negotiation, purchasing and procurement could be handed off to the HGPO and still will not surpass the leverage member hospitals gain from HGPO membership. What is also clear is that the distributor is where much of the cost containment occurs as seen in the above literature, hospitals are trying to remove the distributor altogether or trying to leverage bargaining power, it suggests that any hospital purchasing directly from the distributor is going to spend more on supplies. This finding is in concert with what was expected based on literature, expert and real-world experience, and in accordance with the known buying power of the HGPO.

Variable of Interest	Relationship to DV	<i>p-value</i>
Participant in Healthcare	+	0.0044

This finding of hospitals that participate in a healthcare network had an increase in supply expense is void in the literature. What we do know is that increased hospital spending will drive an increase in healthcare networks premiums making them largely unaffordable for most low-

income families (Altman, 2018). Further analysis into this variable would be warranted in order to make a notable contribution to the field.

V DISCUSSION

The literature is devoid of research analyzing hospital supply expense and any factors that has the ability to influence supply expense for HGPO members. There are no studies that utilize the Economies of Scale theory, as it relates to the purchasing aggregation power of HGPOs. Many studies evaluating the supply expense of HGPOs are attempting to investigate a small sample of hospitals, specific categories, and one particular HGPO. These perspectives generate misleading outcomes and do not tell the full story.

In exploring which hospital characteristics are most associated with influencing supply expense for HGPO members, we found key demographic characteristics that are significantly associated negatively impacting overall supply expense. Rural demographic characteristics appears to be more relevant than others. Critical Access Hospitals and Sole Community Providers, both of which are mostly rural hospitals that provide care for underserved populations presented with negative influences in overall supply expense. While it is tempting to explain this finding noting that these providers types normally receive government subsidy and financial assistance, this does not impact supply expenditures. This finding was unexpected as public, government-controlled hospitals in rural areas usually struggle to leverage the economies of scale due to low population density. The average length of stay for CAHs is limited to 96 hours or less, which also decreases the opportunity to scale (Hearld, 2016). These hospital environments usually present with limited access to capital funds, investments in critical plant and technological upgrades as well as experience critical workforce shortages (Bailey, 2014, Pink, 2014) which are usually associated with hospital operational environments that limit the success of supply chain streamlining processes (Deville, 2011). One possible explanation for this finding is that due to the financial constraints of this hospital type, they have an increased

motivation to decrease spending by utilizing HGPO contracts. CMS, since 2010 has been heavily investing in cost-savings mechanisms for its hospitals and can explain what we have seen with these findings. Metropolitan hospitals designated by the AHA must provide a significant amount of Medicare, Medicaid, and uncompensated care and participate in undergraduate and/or graduate medical education programs and research as well as be involved in professional and paraprofessional education and training programs. Teaching status is a hospital characteristic that does positively influence supply expense which could account for the positive influence we see in our study (AHA, 2018).

Ownership status, in particular non-federal government-controlled entities, showed the ability to negatively influence supply expense for HGPO members. Procurement and purchasing procedures that directly impact hospital spending practices are influenced by ownership, but these processes are usually more streamlined and with perfected cost-containment processes in for-profit hospitals (Shen, 2005). For-profit and investor owned hospitals usually invest heavily in supply chain consulting and business optimization strategies that would further enhance the ability to influence operating expenses. Finding no significant association with HGPO supply expense in the for-profit hospital type was unexpected. Nonprofit hospitals represent 60% of the approximately 5,000 acute care hospitals in the U.S. and must accept payment from Medicare and Medicaid programs on a nondiscriminatory basis. What could explain the negative influence of not-for profit hospitals supply expense is simply the CMS initiatives to reward hospitals that reduce cost-of care and more policy implementation has occurred to establish a minimum standard for all not-for-profit hospitals to meet to qualify for their hefty tax exemptions. The cultural and operational differences, such as strategic approaches to scale and operational discipline that once made for-profit hospitals better able to leverage the HGPO is migrating to

not-for profit hospitals who wish to maximize cost-savings for their incentives and tax exemption status (Rubin, 2015).

Hospitals in the East North Central Region of the US Census regions showed a significant association with HGPO negatively influencing supply expense. This finding is not due to the health status of the populations in the specific regions as marked regional differences in healthcare spending remain when controlling for health, with no evidence that health is decaying more rapidly in any region (Fisher, 2009). What makes this finding even more interesting is that the East North Central Region has the lowest cost of living of all hospital regions (U.S. Census). Research evidence suggests that quality of care, as well as health outcomes are better in lower-spending regions and that there have been no greater gains in survival in regions with greater spending growth (Fisher, 2009). Quality of care usually relates to quality hospital practices which could make hospitals in this region more likely to maximize HGPO resources. There may be something for healthcare supply chain executives to learn from the spending practices of hospitals in this region. Future qualitative studies into the specifics of these hospital practices could be a useful addition to the knowledge base of hospital spending reform.

While we hypothesized that hospital accreditation would decrease supply expense for HGPO members, the results showed that Joint Commission Accreditation (JCAHO) decreased supply expense while Det Norske Veritas (DNVHC) Accreditation did not. This finding was somewhat expected as there are more resources available to the JCAHO accredited hospitals and DNVHC does not provide any additional consulting or business optimization support as part of the benefits of the accreditation relationship.

Teaching status showed an increase in supply expense as expected. Outside of personal experience working at a teaching hospital and visualizing in the field how Nobel laureates can completely derail efforts of cost-containment, historically the organizational dynamics of teaching institutions lack motivation to reduce spending. The spending is thought to be justified as it is preparing the future of the medical profession. However, further understanding of the procurement and purchasing practices of the teaching hospital environment and how to streamline supply chain protocols to curtail spending are needed. This study provided the evidence of this hospital characteristic ability to negatively influence supply expense for HGPO members and the most logical next step would be determining appropriate interventions in teaching hospitals to encourage HGPO strategic utilization.

Undoubtedly, the most surprising finding of this study was the negative impact on supply expense noted in Psychiatric hospitals. On average psychiatric hospitals spend the least on supplies yearly with the bulk of supply spending on diagnostics and pharmaceutical spends (Abdulsalam and Schneller, 2017). The opportunity to leverage the buying power of the HGPO is less in these hospitals types who do not have substantial surgical supply spend categories (La, 2015). However a possible explanation for these findings is that there are financial incentives for this hospital service-type to maximize the use of its HGPO as individuals with the most severe and chronic mental illnesses experience high rates of unemployment, poverty and homelessness and often do not have personal resources or health insurance to pay for their hospitalization (Parks and Radke, 2014). General Medical Surgical hospitals did show a positive influence on supply expense as hypothesized in our study. This hospital type, unlike specialty hospitals, treats a wide range of common illnesses and streamlining of purchasing and procurement as well as control of inventory is very difficult. We expect that effectively leveraging the HGPO to curtail

supply expense would be difficult but these large hospital types can benefit from further research on how to counteract this challenge.

It is important that these findings are not interpreted in the lens of HGPOs not being effective in certain hospitals types and discourage its use in healthcare supply chain. Merely, these findings speak to the importance of creating a “nutrient environment” (Amarasingham, 2008) that allows the HGPO to flourish and reduce supply expense for its members. Collectively this work speaks to many significant associations between member characteristics and supply expense for HGPO members, with a goal of discovering these relationships and their influences to create the groundwork for further research exploration into this area.

VI CONTRIBUTIONS, LIMITATIONS, FUTURE RESEARCH, CONCLUSIONS

VI.1 Contributions

This study contributes to the body of knowledge on supply cost economies by providing empirical data concerning healthcare provider characteristics that are predictors of HGPO member supply expenses. By determining what hospital characteristics are associated with less than ideal for influencing supply cost for HGPO members, process improvement and provision of insight can begin among provider with these particular characteristics in upstream supply chain management to further develop the environment and its' conduciveness to successful HGPO utilization. This study also makes a significant contribution by developing a model to analyze factors affecting HGPO member supply expense and while hospital characteristics was the focus of this study, several other factors (hospital culture, population statistics, operational procedures, and etc.) may also affect the supply expense of HGPO members. This data, while very broad in nature and its level of analysis, is a beginning and presents a piece of evidence towards understanding factors associated with healthcare provider costs, which is the prime contributing factor to medical spending increases in the U.S. (Hartman et al, 2010). The findings have implications for policy makers, healthcare supply chain executives and hospital administrators. Government subsidy of HGPO membership costs with specific regulations to effectively manage spending behaviors maximizing the use of the HGPO could impact healthcare providers and cost of administering care. Healthcare and Supply Chain executives could use the insight of this research to empirically demonstrate the impact of provider characteristics on supply expense for HGPO members and delve into the forces behind these associations, establish some determinants of success in their organizations in effort to change the tides.

VI.2 Limitations

The findings of this study must be interpreted considering several limitations. The most significant limitation to this study is the inability to assess all hospital characteristics in our design. While I analyzed those characteristics indicated in the literature as high priority, there may be other characteristics with significant relationships this study failed to reveal. The causality and explanatory power of retrospective, cross-sectional studies are considered weak but any appropriate methods of analyzing hospital supply expense will most likely rely on secondary, retrospective data sources. Our findings are descriptive and highlight general trends and correlations, therefore definitive comments concerning the association between hospital characteristics and HGPO member supply expense changes are beyond the scope of this study. Employing a mixed method approach examining hospital characteristics and testing various interventions to manage HGPO member supply expense would be advantageous for the field. As a logical extension of this research it would provide a deeper understanding of hospital characteristics and their correlation with healthcare provider operations and environment, and how this can determine the success of HGPO utilization. Using the AHA Annual Survey data can introduce reporting inaccuracies, but this data set is the most comprehensive data available on hospital supply expense and other hospital characteristics. Our measures of association are dichotomous indicators and fully explain the relationships that exists, the contents or the strengths of these relationships.

VI.3 Future Research

This study, experiential in nature, observed overall supply expense as calculated by Abdulsalam and Schneller, 2017. The extension of the research would examine expenses via hospital expense categories and service lines, which is a common standard in healthcare supply

chain (Walsh, 2017). This would give specific areas associated with HGPO member hospital supply expense. Other future studies would include healthcare provider supply expense influences stratifying for HGPOs (i.e. Premier, Vizient, Healthtrust, etc.), which has not yet been pursued. Are each of the HGPO companies created equal in terms of abilities to influence supply expense? Many hospitals hold memberships with multiple HGPOs, and this too can be wasteful spending.

VI.4 Conclusions

In conclusion, the goal of this study was achieved and the relationship between healthcare provider characteristics and supply expense for HGPO member was explored using the Economies of Scale Theory as a theoretical framework. The findings suggest that HGPO member hospitals in rural areas commonly classified as safety net hospitals and hospitals in the East North Central Region show to have negative influences on supply expense. In addition, GPO member hospitals that are psychiatric hospitals and those with JCAHO accreditation also experience a negative impact on supply expense. It was also discovered that many of the characteristics expected to be impactful showed no meaningful association with HGPO member supply expense.

We must figure ways to initially influence supply expense in healthcare and particularly in provider spending keeping in mind that CMS reported that 32% of the \$3 trillion spent on healthcare in past years is related to hospital care. HGPOs leverage the Economies of Scale theory to aggregate purchasing and procurement for members and reduce supply expense tremendously channeling purchased through the HGPO contract portfolio. We know that HGPOs bring financial value, this study and the future studies will create the opportunity to take full advantage of this value and combat the rise of hospital spending and healthcare costs in the U.S.

APPENDICES

Appendix A: Classification of Rural Hospitals

Table 1: Medicare Payment Classifications of Rural Hospitals

Classification	Payment method	Eligibility criteria
Critical access hospital (CAH)	<ul style="list-style-type: none"> Reimbursement is 101 percent of allowable costs for inpatient, outpatient, laboratory, therapy services, and post acute services in swing beds (BBA 1997); If CAH owns and operates the only ambulance service within 35 miles, this service receives cost-based reimbursement; and While IPPS and OPSS do not apply, Medicare Part A and B deductible and coinsurance rules do except for pneumococcal pneumonia vaccines, influenza vaccines, related administration of the vaccines, screening mammograms, and clinical diagnostic laboratory tests. 	<ul style="list-style-type: none"> Distance from nearest like hospital Size (<25 beds) Formerly states could declare hospitals "necessary providers" to qualify¹ Provide 24-hour emergency care Average LOS<=96 hours
Sole community hospital (SCH)	<ul style="list-style-type: none"> Inpatient reimbursement is the greatest aggregate of the federal rate applicable to the hospital or the updated hospital-specific rate based on fiscal year 1982, 1987 (OBRA 1989), 1996 (BBRA 1999), or 2006 costs per discharge (MIPPA 2008); Disproportionate share adjustment (DSH): <ul style="list-style-type: none"> If DSH patient percentage (DPP) > 20.2%: Adjustment = 5.88% + .825*(DPP-20.2%) If DSH patient percentage (DPP) =< 20.2%: Adjustment = 2.5% + .65*(DPP-15%) Adjustment may not exceed a cap of 12%. (MMA 2003); and Volume decline adjustment: If caseload falls by 5% due to circumstances beyond the SCH's control, it may receive payments necessary to fully compensate for fixed costs (OBRA 1989). 	<ul style="list-style-type: none"> > 35 miles from nearest like hospital OR 25-35 miles from nearest like hospital AND <ul style="list-style-type: none"> Bed size (<50) OR Exclusive Medicare service in area OR Closer hospitals are inaccessible. OR Other hospitals are 15-24 miles but are inaccessible Driving time to next hospital >45mins.
Medicare-dependent hospital (MDH)	<ul style="list-style-type: none"> Inpatient reimbursement is the PPS rate plus 75% of the amount by which costs per discharge for Medicare patients from 1982, 1987 (OBRA 1993), or 2002 trended forward (DRA 2005) exceed the PPS rate; Disproportionate share adjustment <ul style="list-style-type: none"> Same as SCH No cap (DRA 2005); and Volume decline adjustment: If caseload falls by 5% due to circumstances beyond the MDH's control, it may receive payments necessary to fully compensate for fixed costs (renewed through 2011 in DRA 2005). 	<ul style="list-style-type: none"> Rurality Bed size (<100 beds) Not SCH eligible > 60% inpatient discharges to Medicare patients
Rural referral center (RRC)	<ul style="list-style-type: none"> Reimbursement is based on the urban PPS rate (OBRA 1989); and Disproportionate share adjustment: <ul style="list-style-type: none"> Same as SCH No cap; and; Exempt from demonstrating two of three criteria for geographic reclassification: Proximity to the redesignation area and that its wages exceed 106 percent of area's average wage. 	<ul style="list-style-type: none"> Rurality High case-mix intensity and sufficient supply of specialists OR Size (>275 beds) OR High referral volume

BBA: Balanced Budget Act; IPPS: Inpatient perspective payment system; OPSS: Outpatient perspective payment system; DRA: Deficit Reduction Act; OBRA: Omnibus Budget Reconciliation Act; BBRA: Balanced Budget Refinement Act.

¹ The Medicare Prescription Drug, Improvement, and Modernization Act of 2003 eliminated this provision, effective January 2006.

Appendix B: Abdulsalam and Schneller, 2017 - Supply Expense as a Percentage of Total Hospital Expense

Citation	Reference to supply chain expenses	Publication
Nyaga, Young, and Zepeda (2015, p. 340)	<p>“With supply chain costs estimated to account for more than 25% of hospitals’ operating budgets (McKone-Sweet et al., 2005).”</p> <p>In the article, supply expense per total expense is estimated to be 29%, on average, based on data from acute-care hospitals in California (2005-2009).</p>	<i>Journal of Business Logistics</i>
Young, Nyaga, and Zepeda (2015, p. 2)	<p>“It has been estimated that total supplies account for approximately 30% of a hospital’s operating budget and thus potentially represent an area for substantial cost savings (Burns & Lee, 2008; Montgomery & Schneller, 2007)”</p>	<i>Healthcare Management Review</i>
Chen, Preston, and Xia (2013, p. 391)	<p>“Historically, expenses for hospital supplies and materials have constituted up to 45% of a hospital’s operating budget (Kowalski, 2009).”</p>	<i>Journal of Operations Management</i>
McKone-Sweet et al. (2005, p. 4)	<p>“With the supply chain costing as much as 40 percent of the typical hospital’s operating budget, the strategic importance of hospital supply chain management is evident.”</p>	<i>Journal of Supply Chain Management</i>
Nachtmann and Pohl (2009, p. 5)	<p>“The average health care provider organization in our survey is spending more than \$100 million each year on supply chain functions, nearly one-third of their annual operating budget.” (The authors conducted a survey with 1,381 respondents.)</p>	White paper: Center for Innovation in Healthcare Logistics
Kowalski (2009, p. 90)	<p>“Historically, total supply expenses (cost of supplies plus all the labor costs related to operating the supply chain, including all the supply inventories in the laboratory, pharmacy, surgery, etc.) have consumed up to 45 percent of operating budget.”</p>	<i>Healthcare Financial Management</i>
Montgomery and Schneller (2007, p. 308)	<p>“Supply costs now represent as much as 31 percent of a hospital’s total cost per case (Schneller & Smeltzer, 2006)”</p>	<i>The Milbank Quarterly</i>
Landry and Beaulieu (2013, p. 469)	<p>“In fact, North American studies have found that more than 40% of a hospital’s expenses are related to supply chain activities (AHRMM, 2010; Chow & Heaver, 1994; Nachtmann & Pohl, 2009).”</p>	<i>Handbook of Healthcare Operations Management</i>
Conway (2011, p. 2)	<p>“40-45%: Total hospital operating expenses represented by supply chain.”</p>	White paper: Global Health Exchange
HFMA (2005, p. 7)	<p>[Data are presented as a bar graph]</p> <p>“Supplies as a Percent of Operating Budget”</p> <p>Small Hospitals (<\$35M-125M): 13%</p> <p>Mid-Sized Hospitals (\$125-315): 15%</p> <p>Large Hospitals (>\$314M): 17%</p>	White paper: Healthcare Financial Management Association

Note. AHRMM = Association for Healthcare Resource & Materials Management; HFMA = Healthcare Financial Management Association.

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VITA

Ken is currently a Region Director for Premier, Inc. where he manages the GPO business for members located in the Southwest region of the U.S. Premier, Inc. is one of the largest healthcare consulting organization in the United States, who provides opportunities for acute and non-acute healthcare organizations to find and share best practices in the area of supply chain, quality, safety, and patient care management.

In his previous role, Ken was a portfolio executive for a diagnostic imaging contract portfolio for another healthcare consulting organization in the United States. In addition, he filled the role of Contract Negotiator for Parkland Health and Hospital System in Dallas Tx.

Ken possess over 10 years of progressive experience in supply chain, sales and operations in such diverse industries as healthcare, construction, military automotive manufacturing, as well as hospitality and entertainment.

Ken is an active member of the North Texas Association for Healthcare Resource and Materials Management, which is an organization that is dedicated to the education and networking of healthcare Supply Chain professionals in North Texas.

Ken, who was born and raised in Dallas, graduated from the University of Houston with a B.S. in Supply Chain and Logistics Technology, and obtained his M.B.A. from the University of Dallas with a concentration in Healthcare Service Management.

Ken currently live is Dallas, Tx with his wife Crystal who is a practicing dentist and bio-medical research assistant at Texas A&M-Baylor College of Dentistry. Ken and Crystal have a four-year-old son, Kenneth II and a two-year-old daughter, Kensington. Ken and Crystal love traveling to Houston, which is where they met, to visit friends, family and their alma mater for special events.