NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

THE INTEGRATION OF HOSPITALS: THE TRANSITION FROM A SYSTEM TO A SYSTEM OF SYSTEMS

by

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December 2014

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704–0188

1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** December 2014	**3. REPORT TYPE AND DATES COVERED** Master's Thesis

4. TITLE AND SUBTITLE
THE INTEGRATION OF HOSPITALS: THE TRANSITION FROM A SYSTEM TO A SYSTEM OF SYSTEMS

5. FUNDING NUMBERS

6. AUTHOR(S) Sean Michael Kugler

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number ____N/A____.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (maximum 200 words)

Hospitals are the foundation of our health care system and where the emphasis should be placed on providing quality health care while resolving the issues of rising cost and declining access. The architecture of operating as independent systems and competing for the patronage of the local population results in duplication in the acquisition of goods and services. When the probability of any individual requesting service at a hospital is in large part a factor of distance rather than marketing; emphasis should be placed in developing a mutually supporting network or system of systems to support the overall health of a community.

The problems such as these plaguing hospitals are examined from a systems engineering perspective to determine their causal mechanisms. Through the application of integration theory, a system of systems model for hospitals is created and shown to reduce costs and risk by increasing sustainability through optimization of the different business models strengths.

Physicians and hospitals have already begun integrating, albeit at a much smaller scale, via Accountability Care Organizations and joint ventures with noticeable reductions in cost and increased efficiencies. Hospitals need to examine and implement these models and form a network of hospitals for the purpose of shared resources and mutual beneficial agreements to reduce costs further and implement economies of scale.

14. SUBJECT TERMS Health care, Nonprofit, For-profit, Public hospitals, Systems, System of Systems	**15. NUMBER OF PAGES** 125
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	**18. SECURITY CLASSIFICATION OF THIS PAGE**	**19. SECURITY CLASSIFICATION OF ABSTRACT**	**20. LIMITATION OF ABSTRACT**
Unclassified	Unclassified	Unclassified	UU

NSN 7540–01-280-5500

Standard Form 298 (Rev. 2–89)
Prescribed by ANSI Std. 239–18

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THE INTEGRATION OF HOSPITALS: THE TRANSITION FROM A SYSTEM TO A SYSTEM OF SYSTEMS

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requirements for the degree of

MASTER OF SCIENCE IN SYSTEMS ENGINEERING

from the

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ABSTRACT

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LIST OF ACRONYMS AND ABBREVIATIONS

ACO	Accountability Care Organizations
AHA	American Hospital Association
CT	Computed Tomography
DOD	Department of Defense
EMMI	Energy, Matter, Material Wealth, Information
HER	Electronic Health Records
MIEN	Metastable, Internally agile, Externally adaptive, NON-reciprocating action
MIER	Metastable, Internally agile, Externally adaptive, Reciprocating action
O&M	Operations and Maintenance
SoS	System of systems
SE	Systems Engineering
VA	Veterans Affairs

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LIST OF INTEGRATION TERMS AND DEFINITIONS

The effectiveness of presenting integration theory relies upon the understanding of the appropriate definitions. The aim of presenting these terms separately is to mitigate misunderstanding caused by differing understanding based on another's definition. The following table defines the terms as provided in Gary O. Langford's *Engineering Systems Integration: Theory, Metrics and Method*, which was published in 2012.

Terminology	Definition
Attribute	Measure and measurement, configuration and structure, and constraint (e.g., time cost and scope), performance and loss due to achieving the performance of a function.
Alignment	Objects or processes (and their logical derivatives, e.g., functions or procedures, respectively) having cooperative association and affiliation.
Behavior	A behavior is describable in terms of observed reactions to influences of energy, matter, material wealth, or information. A behavior is the movement of objects by processes; processes that result in objects; objects interacting with other objects.
Boundary	The limit or extent of a domain; divides the essential nature of something from that of something else; or restricts properties and traits to one or another entity in some notional or corporal sense.
Cohesion	The manner in and degree to which the objects or processes relate to each other.
Coupling	The degree of dependency between objects or between processes.
Emergence	Any effect that produces a change in intrinsic properties, traits or attributes, that results by combining objects through the interactions of objects with EMMI.
Function	An action that is realized when objects interact. A function is the result of the interaction or integration of two objects. A function manifests itself as a trait of interaction. A function provides for use.
Interaction	Transfer of EMMI. Interaction is characterized by the transfer of something from one object (sender) to another object (receiver).

Terminology	Definition
Loss	Loss is relative, quantifiable difference in EMMI between the performance of a function at its target value and that measurement at any other value of performance.
Mechanism	Means by which objects and processes change. The effects of a mechanism are to transform an input EMMI into an output EMMI. A mechanism is that which operates in the context of forces.
Objects	We commonly think of an object as a fundamental element, entity, or representation. Objects are or represent material structures, material wealth, and information. Objects can be physical or abstract (e.g., intellectual). Objects have boundaries.
Process	A process can be articulated as a systematic pattern, a coordinated set of procedures, tasks, activities, or acts that result from the conversion of inputs into outputs. Process is an amalgamation of activities or tools that combine ideas.
Property	A property is embodied in an object that is physical or represents something that is physical. A property can be real (physical or material) or intellectual (concept, nonphysical, or intangible).
Trait	A trait is the nexus of the property along with its conditions that distinguish it from other traits.

EXECUTIVE SUMMARY

Health care is paramount in the minds of nearly every individual, young and old, in our society today; and foremost in importance is access to health providers. Hospitals are the central tenet of the health care system as they provide the physical and functional requirements from which life sustaining processes are facilitated. It is because of this fact that many of today's hospitals perceive they must obtain the means to provide care regardless of the probability of occurrence or nature of the infliction. This belief is noble and in an ideal world would seem possible. Unfortunately, this situation is not the case. Advances in medical science and technology, changing demographics, increasing life expectancy and other factors have rendered this objective unattainable.

A way forward that emphasizes the quality of health care and address the business of making a profit from the profession is to think in terms of encouraging joint ventures that advantage the different types of tax structure and organizational uses of investments and grants. These joint venture arrangements between two or more independent health care businesses are called a system of systems (using the vernacular of systems engineering). To implement a system of systems architecture and maximize economies of scale, there must be a change in the behavior of hospitals away from the concept that they need to provide every procedure that is feasible. If hospitals become more specialized or provide a smaller subset of procedures and then integrate with surrounding hospitals or care facilities that provide a different subset of specialties, a broader range of care can be provided at a reduced marginal expense and mitigates risk. Hospitals may reduce the need to purchase and maintain equipment, staff, and the knowledge base that is only seldom utilized by the facility, opting to serve the community in a particular area of care, and allowing other hospitals assume the roles in different areas.

The rising costs of health care and the ability to be granted access to the nation's health care system has developed into a plaguing issue that neither politician nor the people have been able to solve. Although there have been on-going attempts by the Federal government to stem the tide of rising costs and provide access through programs like Medicare, Medicaid, and recently the Affordable Care Act, prices continue to rise.

The genesis of the problem of rising health care costs germinate from the reality that hospitals operate as businesses, versus operating as service orientated establishments for the good of the community, as do their more successful European counterparts. Similar to corporate America, all hospitals are categorized as public, nonprofit, or for-profit, and likewise compete against each other for the right to provide care to patients. These distinctions are for tax and not medical purposes, and unfortunately, consumers of medical services do not willing choose to partake of their service as they would with any other business.

Each of these different business models (public, nonprofit, and for-profit) have differing strengths and weaknesses when facing economic instability, and obtaining capital. These factors affect their ability to implement new technical innovations, diagnose patients and keep abreast of the rapidly expanding knowledge base. Public and nonprofit hospitals are especially susceptible to economic instability as they are required by law to provide services to the community regardless of the individual's ability to pay. This makes public and nonprofit hospitals predisposed to financial insolvency from uncompensated care, bad debt and charity care which continue to rise at an alarming rate.

Public and nonprofit hospitals typically use profitable medical procedures to offset the costs of unprofitable procedures to provide these services to the community. Profitability of hospitals ensures their sustainability and enables them to upgrade their facilities with the current technology. If expenses continue to outpace revenues, then hospitals will be unable to expand or upgrade causing them to lag behind the advances in medical science resulting in the reduction in the quality of care or worse, their closure.

In a capitalist economic society, it is important to have multiple organizations performing the same function in order to foster competition, facilitate efficiency and to lower costs to the consumer. Contrary to other businesses, the competition between hospitals in a community have resulted in rising costs, reduced efficiency and declining access.

According to the American Hospital Association (AHA 2014), hospitals in aggregate since 2000 have provided $413 billion worth in uncompensated care to

patients, an average annual rate of growth of 5.75%. Based on this data and the average rate of growth, an annual aggregated cost for uncompensated care for hospitals is forecasted to be $73.10 billion annually by the year 2022. Those who do not have insurance or the capability to pay, more times than not, are pushed into bankruptcy in part due to the high costs of health care. According to a study on the leading causes of bankruptcy in the United States resulted in the following conclusions (Himmelstein et al. 2009):

- 62.1% of all bankruptcies have a medical cause;
- Most medical debtors were well educated and middle class; three quarters had health insurance; and
- The share of bankruptcies attributed to medical problems rose by 50% between 2001 and 2007.

Health care is community problem and not a nationwide problem. Health care is an issue that revolves around a limited radius from the individual's residence, and people are not concerned with what transpires in health care beyond their individual sphere of influence. The issues of sustainability of the hospital business models and the accessibility by patients cannot be expected to be solved solely as encapsulated in the notion of local issues; nor will implementing change through sweeping regulations, laws, and processes on a nationwide scale improve the structural problems with the manner in which health care is practiced currently. What may work in one community may not work in an adjacent community. What may work in one state may not work in another state.

This thesis examines the problems plaguing hospitals from a system engineering perspective to determine their causal mechanisms. Through the application of integration theory, a system of systems model for hospitals is created and shown to reduce costs, and risk by increasing sustainability through optimization of the different business models strengths. Integration as defined by Langford (2012) is the "unification of the objects through their interactions of energy, matter, material wealth, and information to provide system level functionalities and performance." Integrating of processes and objects enables emergence that facilitates greater functionality, and process improvement that is

incapable by any single entity itself (Langford 2012). Systems and systems-of-systems are:

- Systems are Metastable, Internally agile, Externally adaptive, and are formed by NON-reciprocal action (MIEN); and
- System of systems are Metastable, Internally agile, Externally adaptive, and are sustained by Reciprocal Action. (MIER).

Systems are comprised of different objects through their interaction or exchange of EMMI (Energy, Matter, Material wealth, and Information). A system is a group of elements that have the properties of being agile when perturbed, adaptive to their environment and context, are dynamically stable as a result of their agility and adaptively, and are a consequence of changes that are irreversible (Langford 2012). System of systems are an assemblage of dependent or independent systems that interact through the exchange of EMMI in the temporal or spatial domains. Modeling a business as a system means that the elements that comprise the system are interacting to maintain a stability that sustains the integrated whole.

The combination of System Engineering Processes and Integration theory have enabled the discovery of new solutions to existing problems resulting in greater functionality and better systems. Systems form the very foundation of every aspect of modern civilization, but systems have limitations or boundaries (Langford 2012). Integration of multiple systems into a System of systems enables the expansion of those boundaries into new discoveries and greater functionality.

Take for instance, two of the leading technology institutions - IBM and Microsoft. In the early 1980s, IBM was the leading producer of personal computers (PC), but they did not have the knowledge base, capacity nor will to expand into the software business needed to make the PC market a reality. A partnership was born between IBM and Microsoft with IBM producing the hardware, and Microsoft producing the software. The integration of these two company's products, operating as a system of systems revolutionized the computing world.

Hospitals acting independently, performing the same tasks, competing with one another as "systems," requires them to maintain redundant functions, and prevents them

from using economies of scale. When the probability of any individual requesting service at a hospital is in large part a factor of distance rather than marketing; emphasis should be placed in developing a mutually supporting network or system of systems to support the overall health of a community. Hospitals must specialize and integrate into a system of systems within a community to eliminate redundant functions, increase access, and reduce costs.

Within a system of systems architecture, public hospitals would assume the greater percentage of patient's under-insured or without insurance, augmented by non-profits, as they are funded by taxpayers, leaving nonprofits and for-profit hospitals to invest in new technology accessible by the public hospitals. It may seem callous or unsympathetic to the underserved populations, but in actuality, the payoff would be in the form of a more robust health care system with each hospital serving a unique purpose based on its strengths. Granted, with hospitals working in the hypothesized system of system does not solve the problem of rising uncompensated care cost, but it does transfer the risk to the hospitals most able to absorb the rising costs. This thesis discusses ways to reduce these risks.

Physicians and hospitals have already begun integrating, albeit at a much smaller scale, via Accountability Care Organizations and joint ventures providing noticeable reductions in cost and demonstrating increased efficiencies. A synopsis of the most common benefits of integration seen by the research done by AHA in 2014, as reported in the *Trendwatch Publication*:

- Hospitals that joint venture see improved coordination across care continuum and increased cost efficiencies.
- Hospitals that joint venture have greater access to capital for smaller or financially distressed hospitals and support of risk assumption and innovation.
- Larger organizations spread the fixed costs associated with running a health care system over a greater number of patients.
- Consolidation of administrative functions, including management and human resources.

- Greater size allows health care organizations to purchase supplies and drugs at lower costs (economy of scale).

Hospitals need to examine and implement these models and form a network of hospitals for the purpose of shared resources and mutual beneficial agreements to reduce costs and implement economies of scale.

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ACKNOWLEDGMENTS

I was originally expecting to graduate in June of 2015 after completion of a group project for the Systems Engineering and Analysis curriculum. When I received news that I was to be separated from the Navy in February of 2015, it devastated me and my family. As a result, I needed to develop and complete a thesis in a single quarter, a feat that I considered almost impossible.

I will be forever grateful for the support of my family and the faculty of the Systems Engineering department for their unwavering support as I forged ahead.

Many individuals have supported me, but I would like to provide special acknowledgment to my family members. My children have endured two years with a thesis-focused father, who was at times a grumpy man. I thank you for your patience and love.

Meanwhile, my loving wife has juggled roles as supporter, comforter and cheerleader throughout the process. She has sacrificed much of what she wanted and needed to do. And to think that before this, we came from sea duty, where I was deployed nearly three-fourths of our two-year tour aboard the *USS John C. Stennis*. Throughout our journey together, she has had the strength of love to overcome any hardship. I truly married my best friend and biggest supporter.

Additionally, I would like to thank Dr. Gary Langford for his consistent support, advice, and direction. His guidance is a large reason why I was able to complete this paper. I also would like to thank Professor Mark Stevens for his academic counsel, motivational talks, candid expectations, and understanding of my situation.

To both of these outstanding gentlemen, I am forever grateful.

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I. INTRODUCTION

A. BACKGROUND

Foremost in the minds of the American populace today is the fundamental debate on whether top-quality health care is a right. The rising costs of health care and the ability to be granted access to the nation's health care system has developed into an issue plaguing both government and the populace (CEA 2009). Although there have been on-going attempts by the Federal government to stem the tide of rising costs and to provide access through programs like Medicare, Medicaid, and recently the Affordable Care Act, prices continue to rise. It is the belief of the author that these programs only attempt to ease the burden of paying for health care while not addressing the issues of providing affordable health care.

Hospitals are first categorized as either public, nonprofit or for-profit and then further distinguished as specializing in these treatment areas: acute, physiological, cancer, or pediatrics. Public hospitals, as the name suggests, are funded and managed by taxpayers and government appointed managerial boards. Nonprofits and for-profit hospitals distinguish themselves from public in that they are privately owned but are governed by different laws with regard to funding and distribution of profits obtained by services rendered. Nonprofits' revenue are obtained by issuing tax-free bonds (indebtedness), endowment funds, patient compensation, grants and donations, and any profits must be reinvested within the hospital programs or the purchase of assets. The hospital is restricted by law from distributing profits that would enrich any member. For-profits, on the other hand, obtain funding from private investors (shareholders), bank loan, and patient compensation but are not restricted from re-distributing of profits to shareholders in the form of dividends or increased share price. For-profit hospitals are required to pay income taxes on their profits in addition to local property taxes to the municipality and state, unlike public and nonprofit establishments. In a capitalist economic society, it is important to have multiple organizations performing the same function in order to foster competition, facilitate efficiency and to lower costs to the consumer. However, is competition the best system for our hospitals when it comes to

controlling costs and providing access? Recent history in regard to health care would argue otherwise.

American hospitals, regardless of tax identity, act as “systems” operating independently from each other. A system is a group of elements that have the properties of being agile when perturbed, adaptive to their environment and context, are dynamically stable as a result of their agility and adaptively, and are a consequence of changes that are irreversible (Langford 2012). Langford also states that systems are bounded and are an assemblage of multiple formerly independent entities that continuously interact in order to achieve an objective. Within a system, if any entity was removed, the result would be a drastic alteration in the makeup of the original system. The integration of these different entities results in an expected or unexpected emergence (Langford 2012) that shows in the form of a joint venture. The overall purpose of the system is to magnify capabilities or increase performance (Langford 2012). A basic hospital system is comprised of patients, care providers, insurance companies and “a” hospital. For instance, the integration of insurance companies into the hospital system enabled more people to obtain medical services that may have been previously inaccessible due to cost. This integration allowed for a group of people to offset any individual’s costs each would otherwise have to cover alone. This result was a positive and expected emergence from the system. An unexpected emergence from the integration is that the reliability upon insurance companies to pay was ineffective in stifling the rising costs of medical care; additionally, it resulted in higher premiums and fewer covered people.

The sad truth is that there is no single solution that will miraculously reverse the rise in health care costs and increase access to health facilities. There has been no shortage of ideas, or government attempts at regulation, or another government subsidized program that has proven successful. Year after year the topic of conversation revolves around rising cost and reduced access. The reason presumed by the author is that solutions have centered on paying for health care. As long as ideas only address new and different ways of paying, costs will continue to rise, and access continue to decline.

The purpose of this thesis is to augment the substantial amount of writings on today's health care systems by proposing a fundamental shift in how hospitals operate. Medical care is local, community oriented, and their operations should not be based on tax laws, but on how best to serve the community as a whole. For a business to reduce costs, it must reduce its expenditures. Successful businesses worldwide have evolved from an individual, to a system, to a network of systems, which will be referred to for the remainder of the thesis as a System of systems (SoS). Hospitals must become less fixated on providing every form of care and become more selective and less competitive within a community.

This thesis intends to show that the problem of rising costs and reduce access does not come from their tax exemption status, or even the fact that they operate as businesses, but from their current architecture. Hospitals acting independently, performing the same tasks, competing with one another as "systems," requires them to maintain redundant functions and prevents them from using economies of scale. The fact is that the majority of people attend the hospital that is closest to them and are not persuaded by marketing or whether they are public, nonprofit or for-profit. Therefore, this thesis aims to show that hospitals must specialize and integrate into a system of systems within communities to eliminate redundant functions, increase access, and reduce costs. Customers will no longer need to be local, and local people may have to travel for health services.

To provide support for this theory, a foundational discussion of the history of hospitals within the United States, their tax status and how it currently serves their purposes, followed by an overview of factors that hinder operations will be presented. Using the concepts of Integration theory presented in Gary Langford's *Engineering Systems Integration: Theory, Metrics and Methods*, (2012), the system of system architecture is derived. The validation of the theory will show that physicians and hospitals are already engaged in similar changes, on a smaller scale, with the Accountability Care Organizations (ACO) and through joint ventures with growing success nation-wide.

B. ORIGINS OF HOSPITALS IN THE UNITED STATES

The history of medicine and care for the sick and injured is as old as the existence of mankind. Even in the absence of physical evidence, it is probable that early man attempted to stop the bleeding when injured or was compassionate towards those in their company inflicted with an illness. Although, since recorded history there is significant evidence of the practice of medicine, including procedures conducted on human specimens in early Egyptian society, to the use of herbs and minerals, and even the study of anatomy at a medical school in Alexandria (Retief 2006). Individuals have studied the human body and made discoveries for centuries, but for the purpose of this thesis, medicine and the study thereof is considered separately from the physical establishment in which the sick congregate in the hopes of receiving care. When defined within this context, the concept of a "hospital" has changed over human history. Early hospitals have little resemblance to what today's establishments one visits to obtain relief from illnesses.

Hospitals have had different connotations based the civilization and time frame, but they have had one very important use, and that is to segregate the sick from the healthy populations (Scarborough 2013). Segregation of the sick was very important to prevent wide spread panic or paranoia, but more importantly health care providers needed to contain whatever disease was present. From a military perspective, the wounded were segregated from the other elements of the army in order to localize care but also to maintain the moral of the men still engaged in battle. If these units were constantly exposed to the sight of "military hospitals," the soldiers' will to fight would quickly evaporate for fear of ending up like those poor souls. Historically, mankind has always attempted to isolate and separate what it did not understand. Leper colonies were established over fear of what inflicted the individual and physiological asylums were used to house those that did not quite fit in society at the time. Over time and through the study of medicine and the human body, these institutions of segregation were primed for establishing institutions of care. By the time North America was discovered and people populated the land, the concept of a hospital evolved into an institution that not only segregated the sick but also attempted to provide care (Fillmore 2009).

Early hospitals in United States were facilities to house the diseased, dying, and mentally ill to protect the population from contracting the illness. Members of the population or family members would provide help and comfort to the sick or maimed, while knowledgeable individuals pursued the practice of medicine (Fillmore 2009). Knowledge of how to heal was rudimentary and typically passed down through the generations, which when combined with the lack understanding of diseases and bacteria, meant that little was done in an attempt to heal the infliction (Fillmore 2009). Time and rest seemed to be the gold standard to cure the sick. Thus, these facilities were harbingers of diseases, underfunded, and inadequately maintained (Sulz et al. 2011). Health care, under the auspices of untrained caregivers, in forbidding circumstances, presented a dreary condition of the in-patient populous. These horrendous conditions prompted many of the earliest hospitals to become subsidiaries of Protestant and Catholic religious organization (Sulz et al. 2011). The historical link between religion and health care continues to resonate with the general public. Parishioners of these churches saw the condition of the inhabitants as a path to religious sanctification and a pathway to heaven; this was the beginning of the significant involvement of churches in creation of establishments that evolved into what is currently known as “hospitals” (Sultz et al. 2011).

Since the U.S. Constitution protects freedom of religion, and churches have had a long standing of being exempt from taxes imposed by the state and federal governments, early hospitals sprouted up nationwide, mainly as charitable organizations that provided care without the expectation of compensation (Sultz et al. 2011). These institutions served the local populations that for the most part consisted of members of the various churches. These members either felt obligated or responded to their duty to support these “hospitals” as a service to God and to community (Sulz et al. 2011). The sick and wounded could go to these facilities supported by the church and receive whatever care was available. If they went to a physician, they would be required to pay for the doctor’s services. These humble beginnings from antiquity through the 19th century brought forth the notion of free health care.

For much of early 19th and early 20th century, the notion of free health care in the United States was predominant and pervasive. However, with the influx of new immigrants and the migration from rural areas into the growing metropolitan city centers, the situation of "free" began to change. Combined with new discoveries in the medical sciences and the need for established location within the cities to house the sick, local governments became more involved in providing access to health facilities (American Essential Hospitals 2014). Public hospitals came about during the era of the second industrial revolution after the Civil War, as the populous of the United States migrated towards urban areas, and cities. According to the website of America's Essential Hospitals:

> Public hospitals in the United States emerged from institutions, notably almshouses that provided care and custody for the ailing poor. Rooted in this tradition of charity, the public hospital traces its ancestry to the development of cities and community efforts to shelter and care for the chronically ill, deprived, and disabled.

Thus, began the creation of non-religious affiliated care facilities. Religious (charitable) and public (charitable and tax payer supported) care facilities (hospitals) continued to grow nationwide as the population grew. These facilities provided care to individuals regardless of capability to pay, a concept that is well-founded in today's health care debate because of the origins and history of the concept of hospital (Sultz et al. 2011). The next step in the evolution of the hospital began with professionalization of the medical practitioners near the end of the 19th century – the country doctor was displaced by the institution doctor (Fillmore 2009).

Professionalization of physicians and nurses brought about the establishing of nonprofit institutions as the advances in medical science provided greater ability to care for the sick (Sultz et al. 2011). The origins of the nonprofit hospital was to establish facilities to provide research, and training to those seeking a medical profession and continue to advance the medical sciences, which was not possible through charitable donations from the local population. The beginnings of a professional medical corps, research and training led to advancements in medical care and most importantly improved quality care for the patients. Now hospitals did not just seek to care for the

patient until they were well enough to leave, but they sought to learn and teach new physicians and nurses; this came at a price. Whereas before, health care was provided without compensation, physicians and nurses now needed to be compensated for their knowledge, expertise, and their time (Fillmore 2009).

The establishment of a professional medical corps coupled with advancements in medical science spurred the growth of the health care industry, enabling profit to be obtained for services provided. No longer could these institutions remain financially viable on donations and grants alone. These institutions needed to be compensated for the service they provided to the patients.

In capitalist economic systems, businesses compete with one another for their piece of the market share to maintain and improve their financial viability to sustain and operate in today's society (Shaw 2010). Hospitals that were established as a charitable organization for the good of the community and humanity were being transformed into businesses.

The next evolution of the hospital came about through the financial insolvency of many of these nonprofit and public hospitals during the 1960s, alerting investors of an opportunity to profit in the health care system (Sloan et al. 1983). This brought about the creation of investor owned for-profit corporations that owned and managed hospitals for the purpose of making a profit (Cutler 2000).

Before proceeding into a discussion of the business structure of hospitals, it is important to differentiate between the early origins of hospitals and that of the doctors and nurses. Even before the establishment of the United States, there have been doctors and nurses who received pay for the services they rendered. Many of them were what are now referred to as private practice or self-employed. Those who worked within the religious founded institutions or early public hospitals received compensation from the organization or government but not from the individual patients to which they rendered care (American Essential Hospitals 2014). It was the professionalization of a medical corps that brought about the patient paying for the services rendered within hospitals (Fillmore 2009).

C. THE BUSINESS OF HEALTH CARE

Hospitals started out as places to separate the healthy from the sick, evolved into charitable organization serving the local community, then were transformed into a business. In the United States, businesses orientate themselves based on the tax code to suit their purposes, and hospitals are no different. The following is a brief discussion on definitions, advantages and disadvantages of public, nonprofit, and for-profit types of hospitals.

1. Public Hospitals

Public hospitals are government (federal, state or municipality) financed and managed facilities—for example a military hospital (Veteran Affairs), or national research center. Public hospitals are funded through tax payers and operate in accordance with the state or federal budgetary constraints, and thus in most cases do not charge patients. However, in some instances public hospitals may bill Medicare, Medicaid, or private insurers for elected surgeries. Since public hospitals are financed by the government, they are exempt from paying local or federal taxes on the profit they receive and are exempt from local property taxes. According to a recent American Hospital Association report conducted in January of 2014, of the current 5,723 registered hospitals, 1,037 (18%) are local or federally funded. Public hospitals today provide the largest share of the cost of uncompensated care compared to operating cost based on a 2006 Congressional Budget Office report that compared public, nonprofit and for-profit hospitals. This difference of uncompensated care provided to operating costs unrecovered is mainly because public hospitals are more likely to be located in impoverished neighborhoods, inner cities, and rural areas where the probability of having insurance is much lower than in more affluent areas (Congressional Budget Office 2006).

An advantage of being funded publically is that the source of funding is provided by the local or federal government budgetary appropriations. For instance, nonprofit and for-profit hospitals provide service to patients and receive compensation for services rendered; and if no services are rendered, then there is no compensation. Publically funded hospitals receive appropriations at the beginning of the fiscal year based on

projections and trends of operating history, regardless of services rendered during the budgeted year. Therefore, publically funded hospitals do not have to provide care in order to cover expenses associated with services provided, as they receive funding at the beginning of the fiscal year or at predetermined interval throughout the year.

A disadvantage of being publically funded is that they are constrained by the appropriations determined by the governmental budgetary committees and thus are subject to budget cuts. Decisions by the government to reduce, balance, or change appropriations would adversely affect the operations and thus the care provided by public hospitals. In the event that funding is reduced or inadequate, it is very difficult for public institutions to obtain other sources of financing due to the regulations imposed on them, and it is unlikely that the government will provide additional appropriations.

2. Not-for-profit (Nonprofit) Hospitals

Nonprofit institutions fall under the IRS code 501C and defined as institutions that are "organized and operated for exempt purposes" (Internal Revenue Service 2014). Hospitals can be considered a "charitable" organization enabling them to claim exemption from taxation based on providing relief of the poor, the distressed, or the underprivileged...providing advancements in education or science as long as they continue to provide a community benefit (Internal Revenue Service 2014). The Medicare Newsgroup website defines a nonprofit hospital as "A facility that does not pay either state or local property taxes or federal income taxes, and proves certain community benefits in accord with state and federal guidelines." A legal stipulation for nonprofit organizations is that they cannot engage in activities that may be interpreted as influencing political campaigns, nor can their earnings benefit any shareholders or individuals. According to the tax code there are minor differences in "not-for-profit" and "nonprofit" organizations, but for the purposes of this thesis they will be considered synonymous. The American Hospital Association report conducted in January of 2014, states of the current 5,723 registered hospitals, 2,894 (51%) are nonprofit community hospitals.

The exemption of state property taxes and federal income taxes is a considerable advantage for hospitals to have over for-profit hospitals. For example, in a study conducted by William Gentry and John Penrod from the National Bureau of Economic Research, (1998) concluded that the aggregate exemption of income taxes in 1995 was $4.6 billion, combined with an aggregate property tax exemption of $1.7 billion. Although they were arguing for the termination of hospitals nonprofit status, the staggering amount indicates a financial advantage for hospitals to operate as nonprofit organizations. Another advantage of nonprofit organization is the ability to obtain capital through the issuance of tax- exempt bonds. Tax-exempt bonds are appealing to many investors since the interest income received by holders of the bond is exempt from capital gains taxes, unlike the capital gains investors receive from for-profit hospitals. The ability to issue tax-exempt bonds provides a substantial portion of these hospitals operating capital in addition to individual donors who receive tax-credits for their donation to the hospital.

Profits, on the other hand, are not allowed to benefit any particular stakeholder or individual but must be reinvested into the organization (Sloan et al. 1983). Depending on the mindset of the local populace (since donations are typically local), the prospect of earning a return on an investment might limit the willingness of people to donate to their local hospitals. Since these exempt hospitals are nonprofit, they do not pay federal or state income taxes on those profits, increasing the amount to invest in new equipment, facility upgrades, research projects or any other capital investment they choose to embark upon.

There are, however, some disadvantages of operating a hospital in a nonprofit status. Nonprofits are restricted from obtaining capital from investors who expect some form of ownership or influence in the hospital in return for that investment. Nonprofit hospitals can only obtain capital via donations or endowments, tax-exempt bonds, and payments from in-patient services. Donations are unpredictable as well as obtaining reimbursement from patients via their insurers or payment plans. The interest rates on tax-exempt bonds fluctuates and typically decline when the stock market is gaining; so investors may opt to invest in stocks over bonds during good economic times. The

problem arises with donations and endowment investments when the hospital must adhere to the desires of the person donating of setting up the endowment. In most instances, these funds are obtained for a particular purpose and cannot be used for purposes other than for what they were intended. For example, an investor whose portfolio is based on shares of common stock, where the motivation for investing is financial gain, is unlikely to make an endowment contribution despite the financial ability to do so. Since a stock investor is motivated by financial gain, they could completely disagree with the corporations activities, but still invest if the return is acceptable. If the hospital decided it needed to discontinue a program supported by an endowment or donation due to financial concerns, they stand a good chance of losing the support from the party setting up and maintaining the endowment.

In order to claim a nonprofit status, the hospitals must show a level of community benefit that equivalent to the tax exemptions they receive (Alexander et al. 2009). These benefits can be in the form of community investment, or programs the nonprofit sponsors, among other activities. The largest detractor from being a nonprofit hospital is the legal requirement to provide care to those who neither have insurance nor any ability to pay for the care rendered. This situation leads to substantial amounts of bad debt, or uncompensated care from governmental programs that reimburse only a fraction of the actual costs of care. The situation is only exasperated in economic downtimes when there is a reduction in donors and bond holders, while at the same time an increase in individuals without insurance and greater enrollments in government subsidy programs. In fact, these very factors ushered in the investor-owned for-profit hospitals as the nonprofit hospitals were unable to remain financially solvent (Sloan 2000).

The changing economic environment of the 1970s due to high inflation and lower expected economic growth resulted in decreased donations and tax revenue to offset the rising costs of the care. Nonprofit and Public hospitals were unable to remain financially solvent and began closing their doors or were acquired by for-profit organizations (Cutler 2000). This trend has continued and remains vibrant in today's uncertain economic environments. The increase of for-profit hospitals has sparked a dialogue from those concerned about the deterioration of quality care and the refusal to treat the uninsured by

those whose fiduciary mandate requires consideration of the primary stakeholder requirements for nonprofit. It is the profit motivation of for-profits that many of believe is the cause for rising health care costs (Kuttner 1996).

3. For-profit Hospitals

Beginning in the late 1960s, for-profit investor-owned corporations took root within the health facility infrastructure; the first and largest of these corporations was the Hospital Corporations of American (HCA) (Kuttner 1996). According to a Medicare Newsgroup article, "For-profit hospitals have historically been based in the southern part of the United States, particularly in Florida and Texas. But in recent years, investor-owned hospitals have expanded nationally, purchasing often financially distressed facilities or stand-alone hospitals that are in need of access to capital for expansion." The lure of earning investment returns from such a large percentage of a substantial amount of the nation's Gross Domestic Product (GDP), (i.e., 18%), gave way to an influx of venture capitalists and investors into health care environment (Sloan 2000). Increased access to the capital was needed to further growth and to partake in the recent medical innovations that bring with them the promise of efficiencies and better care.

As with the nonprofit businesses, the for-profit hospitals are permitted to earn a profit. The for-profit hospitals are owned by corporations or private investors through the issuance of shares of stock to shareholders. Shareholders invest in the activities and operations of the hospital that is then converted into a source of revenue. The shareholders have the expectation that as activities of the hospital expand the share price might increase along with profitability. An increase in the share price or issuance of dividends is a positive return-on-investment resulting in a financial gain of the shareholders. These investments in common stock provide a marketable source of financial support from institutional investors which in turn the hospitals can use as capital to fund operations, or to invest in capital improvements, such as making advancements in information technology, procuring new equipment, hiring additional employees, or completing facility expansion or upgrades.

A significant advantage of for-profit hospitals is their ability to obtain capital through financing obtained from enthusiastic new investors. These investors are eager to support advances in medical technology that have a possibility of returning an increase on their investment. Despite the motivations of these investors, the increase access to capital has greatly enhanced the capability of health care professional to provide medical care by covering the rising costs in the technology and the associated highly skilled workforce required to use this technology (Cutler 2000). There has been an on-going effort within the health care institutions to unite in an effort to stem the growing costs of health care and compensate for the increase numbers of individuals who are the patients without insurance or those that are underinsured. The advantage of for-profits in obtaining capital could benefits other hospitals if they are successful in their efforts.

The primary disadvantage for for-profit hospitals is the emphasis placed by the investors on earning a return on investments. That monetary return is a strong attractant to interest in the for-profit's stock. The rule of supply and demand is a strong, driving market force that helps to increase the price of shares. Businesses with a strong, increasing stock price are able to market various corporate securities to attract additional investments in the business.

Another disadvantage of operating as a for-profit hospital is the tax payment obligation. Since they are corporations, private citizens with a profit motivation, there are no tax exemptions or credits. They must pay federal and state income taxes and state and local property taxes. Donations, endowment funds and loans are not tax exempt, and investors must pay capital gains tax on their increases. A net result of having to pay taxes, and possibly dividends to shareholders is a reduction in the profits obtained, which may result in the inability to reinvest in the hospital infrastructure and modernize equipment. For-profit hospitals can obtain capital by attracting more investors so this may preclude them from requiring a profit to upgrade their facilities. There is no requirement to pay back investors unlike nonprofit hospitals that must pay back bondholders plus interest on tax-exempt bonds issued.

4. Profitability Is Not the "Real" Problem

There are many critics who castigate for-Profit hospitals saying that making a profit off individual's ailments causes an increase in inadequate care and higher prices for the same procedures being conducted at nonprofit and public hospitals (Cutler 2000). Although based on research conducted on hospitals in Florida by Frank Sloan et al. reported that "Investor-owned system hospitals and nonprofit hospitals are virtually identical in terms of after-tax profit margins, percentages of Medicare and Medicaid patient days, the dollar value of charity care, and bud debt adjustments to revenue (1983, 28)." A more recent study conducted by Hull et al., in 2006 revealed a reluctance of nonprofit hospitals to engage in innovation in the fear that it would harm their ability to provide current services if the venture would prove too costly. From a for-profits' perspective, innovation has the potential to increase their return-on-investment, and the increase in available capital enables them to take such risks. Scientific and technological innovation is the primer for increased quality care and reduction in costs as new and more optimal solutions become available. It is for this very reason that many nonprofit and for-profit hospitals today have integrated their businesses through joint-ventures and agreements that have enabled each to obtain greater prominence and sustainability.

In recent years, the United States has experienced a shrinking of the middle class and uncontrolled immigration into the country that is resulting in an increase in individuals unable to afford health care. The shrinking middle class results in fewer individuals able to donate to charitable organizations as well as those with the ability to afford health insurance (Rosenman 2012; Watkins 2009). Uncontrolled immigration is changing many regions' demographics resulting in the rise of underserved people who cannot afford health care or use the emergency rooms as personnel doctors (Mohanty 2005; Asbury 2013; Wolf 2008). These two factors alone have resulted in loss revenue as the hospitals are not compensated for the care (indigent care) they provide to these individuals; care that is required by law in accordance with the tax exemption status.

These circumstances may exuded tremendous hardship on the ability of these institutions to remain financially stable while providing quality health care. This reality has led to significant changes in how hospital administrators cope with the uncertainty.

Today, hospital administrators face financial uncertainty from indigent care, the increase in chronic illnesses, and changing insurance compensation from government and private insurers. As uncertainty grows so does the risk that the hospital will no longer be capable of providing the programs and care as it has done in the past.

D. WHAT AILS THE CURRENT HEALTH CARE SYSTEM

Health care is paramount in the minds of nearly every individual, young and old, in our society today; foremost in importance is access to health providers. Hospitals are the central tenet of the health care system as they provide the physical and functional requirements from which life sustaining processes are facilitated. It is because of this fact that many of today's hospitals believe that they must provide care regardless of the probability of occurrence or nature of the infliction. This belief is noble and in an ideal world would happen. Unfortunately, this situation is not the case. Advances in medical science and technology, changing demographics, increasing life expectancy and other factors have rendered this objective unattainable.

A poll by Rasmussen in a National Survey of 1,000 Likely Voters conducted in June, 2014, revealed that health care ranks in the top three of issues important to voters, with 67% of likely voters indicating "Very Important." According to a study conducted by the Council of Economic Advisors (CEA) to the President, health care makes up 18% of the nation's Gross Domestic Protect (GDP) and is expected to rise to 34% by 2040 if significant measures are not implemented to curb the increase in health care expenditures. Factors such as our aging population, increases of chronic illnesses, e.g., diabetes and heart disease, (not to mention the current Ebola epidemic) suggests that no one is immune from having to partake at some point in their lives of services provided by our health providers. The concern is that these trends will continue causing growth in health care expenditures concurrent with dwindling revenues; this is directly caused by uncompensated care and partial reimbursement through Medicare and Medicaid. The result of the current system will cause many hospitals to close their doors or be acquired by other organizations. The consequence of these trends is a continuing increase in health

care costs, longer waits to visit with the health care providers for a shorter time, and greater exposure to contagious disease during the process.

Hospital closures result in loss of available care facilities from which individuals can receive the needed attention and the preponderance of these closures will occur in low income areas, which are among those most in need of sufficient care while not fully compensating the service provider. The reason for a hospital closure typically revolves around financial factors such as lack of accessibility to capital resulting in a reduction in available assets (equipment, supplies, and a sufficiency of skilled health care practitioners). Without sufficient capability, these hospitals are unable to take advantage of innovative concepts like Electronic Health Records (EHR), which facilitate increased communication that in turn contributes to the reduction in redundant care resulting in economic efficiency.

1. Factors Plaguing Our Health Care Facilities

There is a well-known saying that the only two things that are guaranteed in life are death and taxes. Substituting “death” for “heath care services” would be appropriate. Just as we cannot expect not to pay taxes, we cannot expect to go through life without utilizing the services provided by the nation’s health care system. As with any business there are issues that must be addressed and situations that must be overcome. Therefore, it is imperative that individuals and decision makers engage in a meaningful dialogue pertaining to the realization of the current health care environment and understand the potentially disastrous implications of maintaining the status quo.

a. Economic Instability

The economic viability of any enterprise is the leading indicator of its sustainability. Companies that continue, over successive periods, to have expenses grow at a faster rate than revenues, will assuredly cease to be a contributor to the economic base within the community. This out-of-control spending applies even more so when the operational domain of the hospital in the community in which it operates succumbs to economic downturns. During these times, cash flow is reduced causing many organizations to cut back on production and maybe even cut labor costs in order to

weather the current economic conditions. Likewise, consumers can simply deny purchasing products when times are lean. Hospitals, unlike other businesses and corporations, cannot simply reduce the amount of products produced or cut other expenses such as marketing. Unfortunately, just because the economy in a particular region is experiencing hardship, it does not reduce the community's need for quality health care. Morally and legally, hospitals cannot choose to have fewer patients even if supporting them creates costs in excess of what is allowed in current budgets.

The reality is that in during times of economic instability, hospitals will continue to care for the same amount of patients that they do during good economic times, with the exception of elected surgeries and other care that is not mandatory for the wellbeing of the patient. Bad economic times do not decrease the amount of people requiring care, as it does reduce the amount of people requiring a new car! Figure 1 below shows the percent of hospitals having to make drastic changes during the recent recession. Hospitals must and do make changes to their operations in a time of economic instability, but they cannot adjust to the degree that other businesses can. Based on this analysis three-quarters of the nation's hospitals cut administrative costs or delayed capital investment (i.e., facility improvements, IT upgrades), and half had to let employees go. What the analysis does not show is that these reductions did not come with reductions in amount of people receiving care, as one would expect in a standard business model with a product reduction.

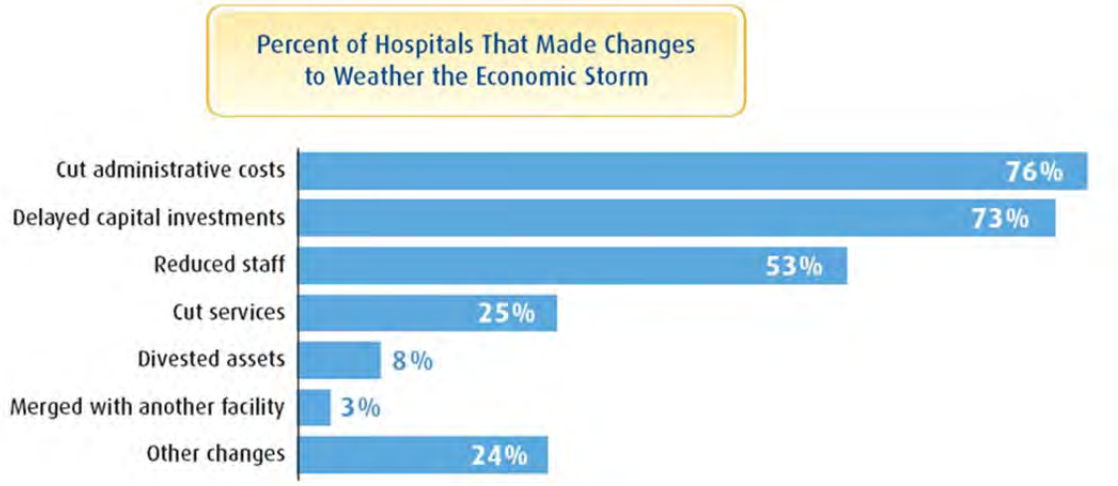

Figure 1. Percent of Hospitals that Made Changes to Weather the Economic Storm
(from AHA 2010)

The real difference between hospitals and other businesses is that if consumers do not have money to purchase the product then they do not obtain the product from the producer; this is contrary to hospitals that have to provide care regardless of the patient's ability to pay. Economic instability has a greater, far-reaching effect on hospitals than other businesses in the form of increased enrollments in government subsidized programs and loss of insurance coverage. Figure 2 was obtained from the same AHA analysis indicating the percentage of hospitals that had to make adjustments during the recession and indicates some of the more devastating effects.

An astounding number of hospitals saw an increase in bad debt, charity care combined with an increase number of patients using government subsidized insurance that covers only a portion of the overall costs. Also to note is the reduction in the number of elective procedures which hospitals use to offset the losses from unprofitable procedures and indigent care (uncompensated care). These factors directly reduce operating margins and access to capital.

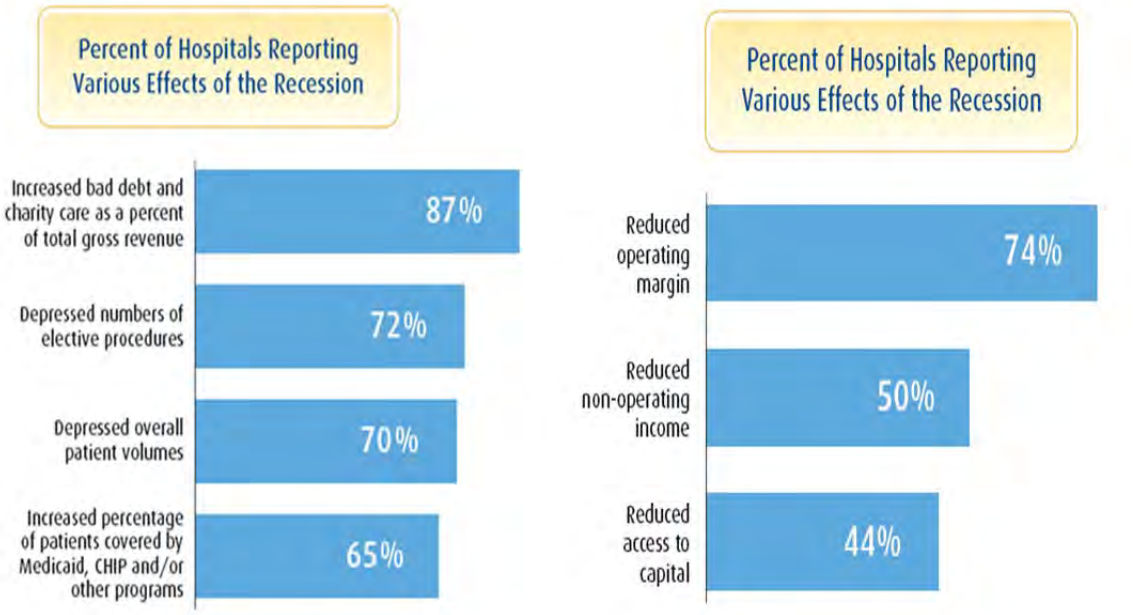

Figure 2. Percent of Hospitals Reporting Various Effects of the Recession (from AHA 2010)

A more serious concern for hospitals during economic instability is that the problem rolls downhill accumulating its destructive prowess as businesses lay-off workers in order to reduce their losses. When businesses reduce labor costs, they increase the amount of people without insurance coverage since many employees receive their coverage from their employers. In fact, based on the 2010 Census, and reported in an article by Hubert Janicki (2013, 1):

> More than half of the U.S. population (55.1 percent) had employment-based health insurance coverage in 2011, and among the employed population aged 18 to 64, over two-thirds (68.2 percent) had health insurance through their own employer or another person's employer.

A significant majority of American citizens obtain their health care coverage from their employers, and when these companies are faced with a situation to reduce expenditures, the first alternative is typically the reduction in work force. When companies do not need to produce as much, they do not need to employ as many workers. Companies reduce expenditures on their balance sheets, but the ultimate end result is an increase on the

government's balance sheet of once insured workers now needing medical care coverage resulting in uncompensated or undercompensated care on many of the hospitals balance sheets.

The result of loss of employment is an increase in enrollment of government programs. Programs like Medicaid and Children's Health Insurance Program (CHIP) in addition to other programs that aim to support low income populations, which only reimburse a percentage of the overall costs (AHA report 2010). Therefore, when other businesses reduce expenses, it has the potential to increase the amount of bad debt, charity care, and uncompensated care that hospitals must contend with. In addition to contending with problems in expenditures, they must also contend with problems in obtaining revenue.

Regardless if the hospital is public, nonprofit, or for-profit, they must all obtain outside sources of revenue from taxes, contributions, or investors. Volatility in the local or national economy impacts the organizations ability to continue current or to acquire new contributors resulting in reduced revenue. If individuals do not have sufficient financial resources in excess of required living expenses and obligations, their ability to donate to nonprofit organization, or invest in for-profit organization becomes increasingly unlikely. Municipal, state and federal governments will face reduced tax revenue and if required to balance budgets will have to make concessions on how much or if any funding is available. Without reliable revenue these institutions will need to find new sources, change their cost structure, or collaborate in some manner that supports independent operations. The alternative is to cease to be economically sustainable in an environment in which the problem is worsening with the changing demographics and longer life spans of today.

b. Capital Obtainment

Economic capital is the life blood of any organization regardless of profit motive. The availability and ability to obtain new source of capital is a primary concern of leaders within the hospital administration because its obtainment in sufficient amounts ensures sustainability and facilitates options (Alexander et al. 2009). Without excess capital,

businesses are unable to obtain new equipment, sustain operations, and invest in the late information technology that has proven to be a precursor to better medical care and communication between care providers. Better information technology leads to a reduction in redundant tests and allows for more informed diagnoses if the care provider is aware of the medical history of the patient.

Medical science has advanced exponentially over the past decade that has increased the survivability of cancer patients, children with life threatening diseases, and diabetes and pharmaceuticals to mention a few (McCabe et al. 2014). In regard to capital obtainment, the Medicaid Newsgroup website, claims "depending on economic conditions, for-profit hospitals can have better access to capital than nonprofits that expand by issuing debt through tax-exempt bonds. This fact gives them a significant advantage when competing against public and nonprofit hospitals and may be leading indicator of why many nonprofits have opted to transition to for-profit status (Cutler 2000; Sloan 2000). Hospitals are in much need of ways to compensate for rising costs associated with health care, especially from good and services purchased. According to a recent study conducted in 2012, the American Hospital Association states:

> Hospitals are the place where the most complex care is provided for ill and injured patients, and they account for the largest share (33 percent) of the health care dollar. Spending on hospitals care has grown more slowly than spending on other health services as hospitals have worked hard to make care more effective and efficient. (Cost of Caring 2012, 1)

These goods and services are what are spent before any care is actually provided with a large percentage coming from wages, salaries and employee benefits (Figure 3). In fact, the study concluded that those "goods and services accounted for 63 percent of overall growth in spending on hospital care from 2006 to 2010."

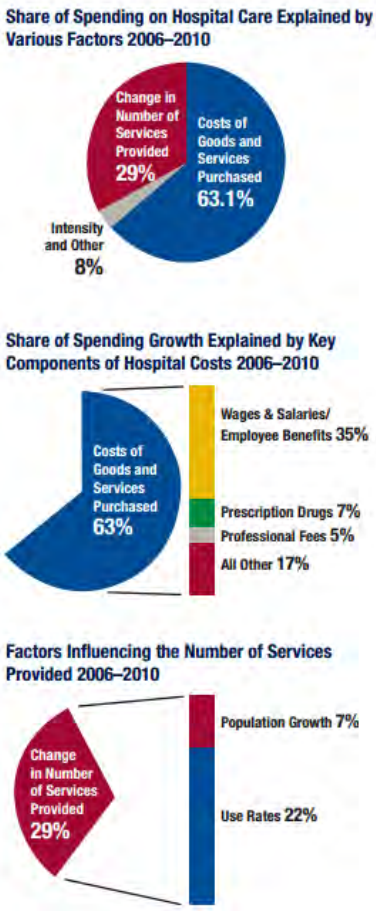

Figure 3. Share of Spending on Hospital Care (from AHA 2012)

When businesses have insufficient capital to make payroll, or to pay for other services, they may have to obtain business loans as a short-term solution. When borrowing capital from a bank, there is an associated cost called a "Use Rate." Use rate fluctuates depending on the availability of cash in distribution or by the lending service. The problem with borrowing money to cover expenses is that the interest accumulated between the time of borrowing and paying back depletes even more cash reserves. If the use rates are high, the interest could be substantial and must be factored into the costs of operating a business. As Figure 3 points out, "use rates" accounted for 22% of the 29% of spending on hospital care, which resulted in a change of services offered.

The AHA report, “Cost of Caring” in 2012, states that the driving factors for the growth in costs are:

- The rising costs to hospitals of the goods and services used for patient care;
- Increasing demand for care due to aging and chronic conditions; and
- Administrative and regulatory burdens.

Regardless of the reasons for rising costs, hospitals must account for the rise in costs either by reducing expenses or obtaining more capital, neither of which are simple.

Even though public and nonprofit hospitals are primarily not focused on obtaining profits, a contention that is addressed later, they must still be concerned with the maintaining a sufficient capital reserve to enable them to offer the programs they feel provide the best “societal change” and community benefit. These programs are the reason donors continue to support the organization.

c. Risk of Innovation

Change is inevitable and needed in business enterprises continuing to seek new and improved processes or capabilities. The danger of not continuing to conduct research, adopt lessons learned from other organization, or implement advances in technology will eventually leave the organization outmoded or incapable of fulfilling its intended purpose.

Risk is an intrinsic component of innovation because of the uncertainty that lies within its implementation. If there was no risk associated in enterprises that innovate, then enterprises would proceed without constraint. Unfortunately, this means that there is a probability that a particular venture will fail or not deliver as expected resulting in a loss of investment. Organizations, notably nonprofit organizations, have a tendency to hesitate in making investments in equipment, for example. This risk aversion is especially prevalent with nonprofit hospitals, since the loss of capital may result in the inability to continue to deliver a particular service to the community.

Motivation is another reason why organizations strive to innovate (Hull et al. 2006). For-profit organizations must continually find better and less costly processes to reduce their overhead in order to increase their profits. The fiduciary responsibility of for-profit organizations beholds them to find a "better, faster, cheaper" way of conducting business for the enrichment of shareholders. Therefore, for-profit organizations continually strive to create or adopt new technologies that directly lead to increase profits. In contrast, nonprofit organizations are not so committed nor bound by a fiduciary requirement to stakeholders to increase their return-on-investment. That being said, it does not mean these nonprofit organizations are not motivated to implement innovative ideas; it is just that their motivation is to a lesser degree and formulated from a different perspective than that of for-profit organizations.

Organizational responsibility to the community is a primary consideration when comparing the abilities of nonprofit and for-profit hospitals to innovate. According to Clyde Hull and Brian Lio (2006, 57) in their comparison of both of these types of organizations' ability to innovate, they state:

> A for-profit organization is much more free to spend in the pursuits of profit – and is often required to do so – while a nonprofit needs to pursue societal change while informing is supporters of such change and maintaining a careful cost-service balance for their end clients.

Hull and Lio continue further to specify that nonprofit organizations are bound by their supporters and the law to provide services that benefit the public.

d. Uncompensated Care Costs

Uncompensated Care, bad debt, and charity care are situations that all hospitals must contend with, and are a substantial contributor to the overall expenses of a hospital. According to the American Hospital Association (AHA) uncompensated care is defined as:

> Overall measure of hospital care provided for which no payment was received from the patient or insurer. It is the sum of a hospitals "bad debt" and charity care it provides. Charity care is care for which hospitals never expected to be reimbursed. A hospital incurs bad debt when it cannot obtain reimbursement for care provided; this happens when patients are unable to pay their bills, but do not apply for charity care, or are unwilling

to pay their bills. Uncompensated care excludes other unfunded costs of care, such as underpayment from Medicaid and Medicare.

Normally, hospitals cannot calculate the cost of care at patient in-take because the nature of the infliction and the degree of care required is unknown. Once patients are admitted, they cannot be turned away (Emergency Medical and Treatment Labor Act (EMTLA)). Regardless of the circumstances, the hospital must expend its resources in the hope of being reimbursed, but unfortunately because of high health insurance premiums and lack of employer-provided insurance, there is a high risk of not receiving payment in full. Another possibility, especially when it comes to grave issues such as cancer or pediatric care where the duration and specialty care required be enormous dependent on the length of stay in a hospital or if alternative living accommodation e.g., Ronald McDonald Homes, must be obtained. These costs can quickly accumulate and exceed the average American's capacity to pay, even if insurance covers a substantial portion. If the patient or their insurance providers do not pay in full, there is no other recourse for the hospital other than to take the loss.

The hospital's uncompensated care costs affect the bottom line of the financial statements in determining the percentage of profits the hospital can use to upgrade facilities, buy new equipment, or increase the staff to reduce the ratio of care providers to patients. With regard to for-profit hospitals it could affect their ability to pay out dividends which could result in loss of investors and therefore capital to the hospital. In reality, the repercussion of high uncompensated care extends beyond the walls of the hospital into the community in the form of lost tax revenue. The worst case is the closure of the facility reducing access to care for local residents.

Uncompensated care costs are the largest drain on hospitals operating margins, and the biggest contributor to hospitals inability to remain financially solvent. The American Hospital Association publishes annually an aggregation of the uncompensated care absorbed by the nation's hospitals. According to their records, hospitals of all types since 2000 have provided $413 billion worth in care to patients. Figure 4 is the data taken from AHA Annual Survey Data in January of 2014, revealing the cost of uncompensated care reported by all registered hospitals in the United States. The two trends (Figure 5)

that are most concerning and easily discernable from the data is the decrease in hospital from 1980 to 2012, while at the same time an increase in the amount of uncompensated care reported.

To calculate the uncompensated care, the researchers first calculate on a "hospital by hospital basis" the amount of uncompensated care and then add in the "bad debt" and charity care. The sum is multiplied by the cost-to-charge ratio (ratio of total expenses to patient/other revenue), which allows for comparability across hospitals.

National Uncompensated Care Based on Cost*: 1980-2012 (in Billions)
Registered Community Hospitals

Year	Hospitals	Uncompensated Care Cost	% of Total Expenses
1980	5828	$3.9	5.1%
1981	5812	$4.7	5.2%
1982	5796	$5.3	5.1%
1983	5782	$6.1	5.3%
1984	5757	$7.4	6.0%
1985	5729	$7.6	5.8%
1986	5676	$8.9	6.4%
1987	5597	$9.5	6.2%
1988	5499	$10.4	6.2%
1989	5448	$11.1	6.0%
1990	5370	$12.1	6.0%
1991	5329	$13.4	6.0%
1992	5287	$14.7	5.9%
1993	5252	$16.0	6.0%
1994	5206	$16.8	6.1%
1995	5166	$17.5	6.1%
1996	5134	$18.0	6.1%
1997	5057	$18.5	6.0%
1998	5015	$19.0	6.0%
1999	4956	$20.7	6.2%
2000	4915	$21.6	6.0%
2001	4908	$21.5	5.6%
2002	4927	$22.3	5.4%
2003	4895	$24.9	5.5%
2004	4919	$26.9	5.6%
2005	4936	$28.9	5.6%
2006	4927	$31.2	5.7%
2007	4897	$34.0	5.8%
2008	5010	$36.4	5.8%
2009	5008	$39.1	6.0%
2010	4985	$39.3	5.8%
2011	4973	$41.1	5.9%
2012	4999	$45.9	6.1%

Source: Health Forum, AHA Annual Survey Data, 1980-2012

Figure 4. National Uncompensated Care Based on Cost (from American Hospital Association 2014)

The purpose of presenting the data in graphical form is to highlight the data in order to more easily analyze the data and it more clearly indicates some key points made earlier in the introduction. The first measure is the rapid loss of hospitals from 1980–2001; a loss of 920 hospitals over a 21 years, with an average of 44 hospitals lost annually nationwide. The trend subsides after 2001, levels off and then the number of hospitals increase and stabilize around 5000 hospitals. Although the data does not give an indication of why this occurs, Figure 6 may provide the answer.

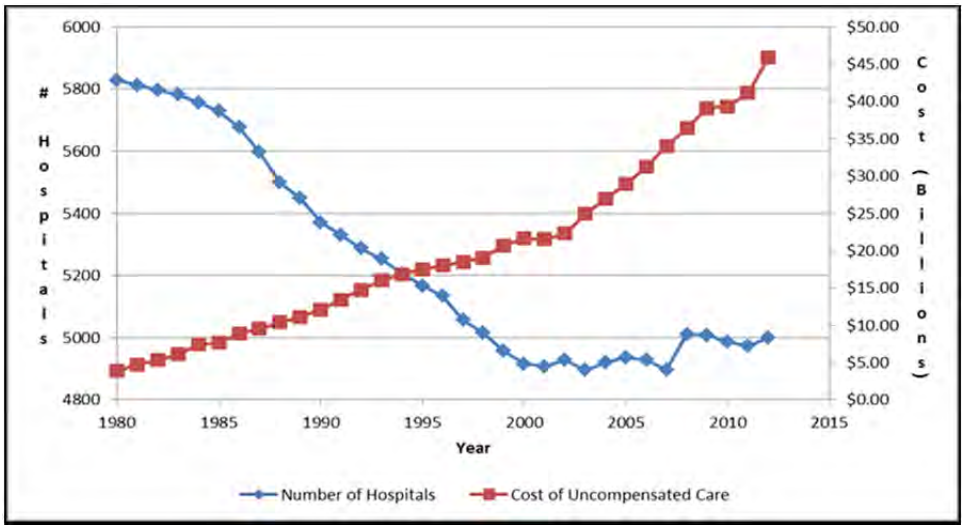

Figure 5. Graphical Plot of the Number of hospitals (all types) registered in the United States for a given year, and the Aggregated Uncompensated Care Costs of those hospitals for the same given year.

Mergers and acquisitions are common in business and help sustain economic growth. Mergers enable a failing business to acquire additional support through the infusion of assets, or combine forces to increase market share. Acquisitions occur to remove competition or increase a company's holding by buying out a failing business. Figure 6 depicts the announced mergers and acquisitions between hospitals from 1998 to 2012. Mergers and acquisitions have become common place beginning in late 1970s and have been augmented by an increase in conversions from nonprofits to for-profit status, in conjunction with an increase in joint ventures (Cutler 2000). The purpose of these endeavors is an attempt to remain financially solvent in an environment of increasing

health care expenditures and reduced revenues. The combining of resources and operating as a system may give indication of why the sharp decrease in hospital closures.

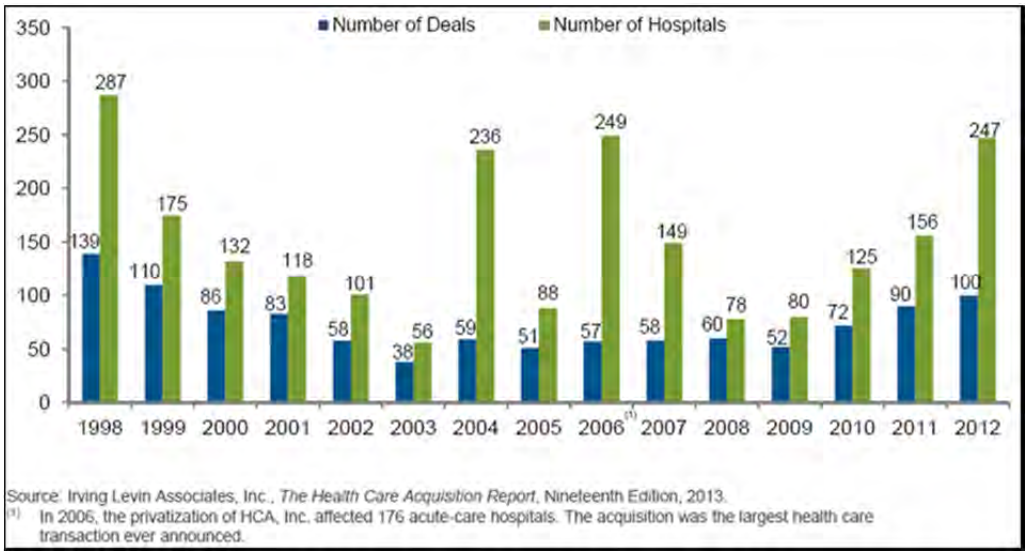

Figure 6. Number of Deals and Number of Hospitals (Irving Levin 2006)

The second disturbing trend is the rate of growth of uncompensated care costs remained relatively stable during the same time period that the nation was losing hospitals, but then sharply increases when the number of hospitals levels out. One reason for this sharp increase can be attributed to the number of economic recession (see Figure 13, Chapter III, Section B), unregulated immigration, and rising health insurance premiums which resulted in substantial losses of jobs and employer provided health insurance (economic instability).

The data provided by the American Hospital Association presented an opportunity to conduct a Time-Series forecast to see what the estimated growth of uncompensated care would be in 10 years if solutions were not implemented to plateau or decline the growth rate. If the past is any predictor of the future, Figure 7 shows that the costs could be expected to grow resulting in estimated aggregate costs of 73.1 billion dollars (Table 2) by the year 2022. That is a significant loss for all hospitals to continue to absorb. The loss does not just reside with the hospitals; the effect extends into loss tax revenue from

for-profit hospitals, and indirectly increase governments appropriations to support public hospitals. Cost of uncompensated care burdens both hospitals and government.

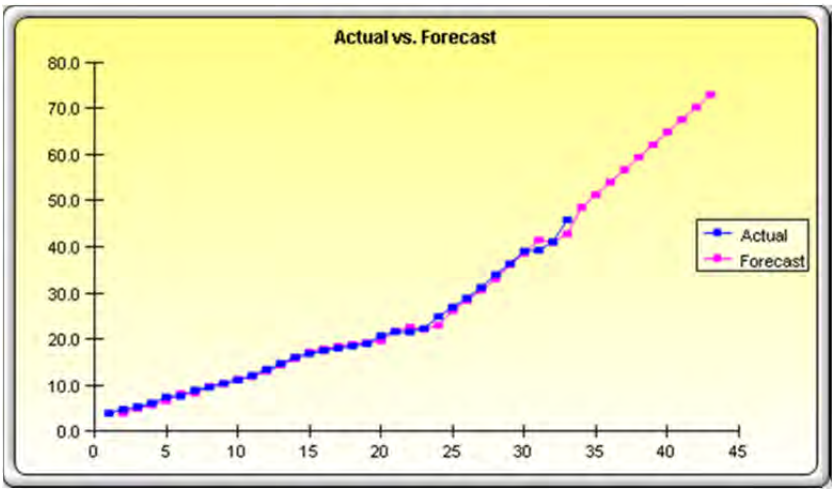

Figure 7. Double Exponential Smoothing Time Series Forecast of Uncompensated Care Costs from 2013–2022 based on the data provided by the AHA Annual Survey.

Table 1. Numerical Forecast of the Aggregated Cost of Uncompensated Care for hospitals (all types). Based on AHA data, it is approximated based on 5000 hospitals nation-wide.

Forecasted Cost Uncompensated care	
Year	Cost (Billions)
2013	$ 48.62
2014	$ 51.34
2015	$ 54.06
2016	$ 56.78
2017	$ 59.50
2018	$ 62.22
2019	$ 64.94
2020	$ 67.66
2021	$ 70.38
2022	$ 73.10

From this analysis of the growth in uncompensated care costs, it is evident that hospitals cannot continue to maintain activities as they have done previously. The growth

of the population and increase in undocumented immigration will only cause these numbers to rise (Mohanty 2005; Wolf 2008). Cost of Uncompensated care is a real problem facing our nation's hospitals.

e. Diagnosing Ailments

People throughout history have been inflicted with unknown diseases and have died with the cause of the death be attributed to an accepted causal factor based on the past experience of the health care practitioner. Historically, medical science has been rudimentary at best and barbaric otherwise, with much of the care was being provided in isolated facilities and with the majority occurring at home. Hollywood movies provide a sense of what early medical care consisted with doctors carrying their small black bags to render aid to the inflicted. Diagnoses were based on experience or what the doctor might have read previously, but information was neither readily available nor shared widely within a geographic area. The human brain appears to categorize events based on previous experience to understand the vast amount of information it encounters every second of every day (Ambrose et al. 2010). Thus, when an individual develops symptoms similar to that understood by a doctor's previous experience and extent of knowledge, a diagnosis was rendered and care provided. As long as the knowledge base and medical procedural practices remained limited, these care facilities could indeed provide "quality care" to every patient.

For instance, it was not too long ago when people would develop flu-like symptoms and be treated for the common flu. Unfortunately, this diagnosis could and did lead to many misdiagnoses of the core problem; one masking itself as the flu that may lead to the premature death of the patient. Viruses, like Ebola, which are significantly more dangerous than the flu virus, is one such example as is evident in the epidemic that now plagues some western African countries. Advances in technology have led to more discoveries of how and why individuals get sick, which directly leads to the increase in the ways doctors provide care.

A study was published by National Center for Policy Analysis in which it summarized the findings of Sandra Boodman article on misdiagnosis in hospitals. The results of the study were alarming. Key findings of the study were:

- An estimated 10 percent to 20 percent of cases are misdiagnosed, which exceeds drug errors and surgery on the wrong patient or body part, both of which receive considerably more attention;
- One report found that 28 percent of 583 diagnostic mistakes were life threatening or had resulted in death or permanent disability;
- Another study estimated that fatal diagnostic errors in U.S. intensive care units equal the number of breast cancer deaths each year--40,500.

Modern science and technology has increased the capabilities of doctors to diagnose problems in the human body, but human are fallible. Unfortunately, modern, expensive equipment used by highly skilled medical practitioners is extremely expensive. Nonprofit hospitals can ill afford such luxuries. For-profit hospitals can afford very specialized and costly equipment; often entering into partnerships with nonprofits and to provide access for better diagnoses and faster access to the requisite medical treatments.

f. Expanding Knowledge Base

The complexity of the human body and the exponential growth in scientific discoveries continuously add to the knowledge base. The finite mind of any care provider could not possibly reconcile the amount of information present. The technological advances in machines and computers that enable care providers to diagnose and treat patients are becoming increasingly more complex. People's current lifestyles, the exponential rise in the need for chronic care, the litigation that results in massive amount of tests, as well as many other factors have led to an explosion in health care costs. As more and more people become ill, and a greater number of individuals cannot afford the basic costs of health care, the more hospitals have to absorb tremendous losses. These losses are ever more apparent in hospitals (nonprofit and public) that are required by law to provide services regardless of the individual's ability to pay (Alexander et al. 2009).

Since these types of hospitals strive to provide care regardless of the situation, they must acquire the new equipment, ensure the required tests are performed, and be

knowledgeable in every facet. This stringent set of requirements requires increase labor costs, management oversight, and capital investment that may be beyond the capability of the hospital.

E. PURPOSE OF RESEARCH

The proceeding sections have outlined some of the many problems associated with the current health care system. Health care is approximately 1/6 of the nation's economy and is as complicated to understand as the current tax code. Researchers, politicians, and health care facilitators have invested countless labor-hours in an attempt to resolve the confusion and problems to create a sustainable, reactive system. Unfortunately, the mere size of the problem does not lend itself to quick easy fixes, piece-wise methodology or just finding a way to pay for it. Throwing money at a problem has rarely if ever resulted in positive changes. Applying the systems engineering approach to solving problems necessitates that one must decompose the system to its basic elements as a means to simplify the complex. Only by simplifying the process can one effectively see the root causes of these problems and address them. Simplification and analysis of the business models of the three types of health care hospitals using systems engineering methods is what this research aims to do.

Health care is community and not a nationwide problem. By using the word community, it is meant to express that individuals do not concern themselves with health infrastructure and access to hospitals nationwide. Health care is an issue that revolves around a limited radius from the individual's residence or locale at the moment need arises. The issues of sustainability of the hospital business models and the accessibility by patients cannot be expected to be solved solely as encapsulated in the notion of local issues. Implementing change through sweeping regulations, laws, and processes on a nationwide scale will not improve the structural problems with the manner in which health care is practiced currently. What may work in one community may not work in an adjacent community. What may work in one state may not work in another state.

Currently, the hospitals active in each community are made up of public, private nonprofit, and private for-profit facilities that provide the same function of providing

health care. In many instances, the hospitals are overworked and understaffed, which results in long waiting times. Doctors and nurses must continuously move patients in and out as quickly as possible to make room for others. One reason for this, which the thesis attempts to address, is that most hospitals conduct themselves in a first-come, first-served basis (except for cases that a life-threatening), without regard for the seriousness of the ailment.

For instance, it is not uncommon for people to go see the doctor for the common cold. Upon check-in they enter the queue and proceed to wait. Behind them, another individual could enter suffering from abdominal pains and will also be checked-in and enter the queue. The difference between them is that the first could treat the ailment with over the counter medicine, while the second could be suffering from a ruptured appendix or something more serious. Regardless, of the nature of the infliction, doctors and nurses must expend time on the patient with a cold so they can eliminate an Ebola diagnosis, further delaying care to the individual with abdominal problems.

This thesis postulates that the major reason hospitals have resorted to this process of providing care is that they act as systems. Systems are self-sustaining without influence from outside entities. Once the boundaries of the system are established, there is minimal if any influence from the objects in their proximity. Therefore, as a system they must inherently provide care in all contingencies. To achieve this, hospitals must acquire the equipment and expertise and maintain them within the confines of their physical structure. The problem thus arises of underutilized equipment and personnel consuming space and financial assets. This consumption of assets results in trade-offs of what services the hospital can provide as they are constrained by financial limitations and physical space within the hospital.

The thesis hypothesizes that many of the problems currently seen in the hospital industry can be mitigated if not eliminated if the hospital infrastructure adopted a system of systems methodology. In so doing, these hospitals would enhance the benefits to society through mutual cooperation, but remain within the confines of the law and addressing stakeholder needs. Through mutual cooperation, hospitals within a community could maximize their strengths, minimize weaknesses, and eliminate redundant functions

that are major contributors to the high cost of health care. The foundation of the hypothesis is found in the theory of integration, and supported by System Engineering viewpoints on sustainability, and risk reduction.

The current "system" perspective impedes workable solutions to updating the nation's current health care system. Just as the corporate sectors of the nation are transitioning from a system to a system of systems and obtaining maximum benefit, so should the hospitals. Adopting a system of systems enables greater adaptability to foreseen and unforeseen circumstances that arise, thus reducing risk to the participating facilities. When hospitals can change with the environment, they are more sustainable reducing the amount of hospital closures nation-wide and within a community. Enabling hospitals to remain open and viable, increases access, reduces wait times, which directly enables doctors and nurses to provide greater care to those in need of it most.

Based on the fundamental change in the way the health care providers deliver services, the for-profit model appears to be flawed. Recent trends in the financial viability of nonprofit hospitals are clearly moving towards lower profitability and possibly bankruptcy and closure (Harrison and Sexton 2004). Further, these nonprofit hospitals lack the capital for specialty medical equipment to perform diagnoses with a higher degree of certainty, in addition to acquiring personnel to conduct complex treatment regimes that require higher medical skills and specialized facilities. Public hospitals suffer the same decline in profitability and are therefore more susceptible to economic problems with politicized budgetary processes.

This thesis introduces the concept of health care business models as system of systems to deal with declining profits and strained budgets.

II. LITERATURE REVIEW

A. WHAT IS SYSTEMS ENGINEERING

Systems Engineering (SE) is an interdisciplinary approach to solving problems. Benjamin Blanchard and Wolter Fabrycky's text on System Engineering and Analysis provides a foundational analysis of System Engineering and will be used as the primary source on the discussion of Systems Engineering Processes. At the core is the cognitive thought process of viewing everything initially as a "black box" and then decomposing the black box into its many subsystems, and then further decomposing subsystems into their respective components. The hierarchical decomposition enables the ability to view the system from a much smaller vantage point. The breaking down of a complex system into smaller entities facilitates better understanding of the individual components functions, and interfaces with other components.

From the vantage point of components functions, it is more easily discernable if the requirements, what the system needs to provide, are met. The function of the component is its desired output or its purpose, the reason it exists within the overall system. The functions are mapped to individual components and integrated with other components to achieve a desired objective.

The process of Systems Engineering is a "structured approach to analyzing systems and solving problems" (Langford Lecture 1 2014). Models are used such as the prototypical System Engineering Vee Diagram (Figure 8) to aid in the deconstruction of the problem or need to obtain the root functions or requirements (Blanchard and Fabrycky 2011). The identification of the requirements from a more manageable perspective reduces the probability of overlooking a vital components or needed function that could result in the failure to meet the systems objectives.

The Vee diagram is only a tool to focus the System Engineers in their cognitive problem solving process. When the Systems Engineers are presented with a problem or requirement, they begin by conducting a stakeholder's analysis through interviews, research, and feasibility studies to develop a concept of operations (CONOPS). The

CONOPS enables the Systems Engineers to visualize how the system will be used in its operational environment. By asking pertinent questions of what the stakeholders actually require the system to do, and through the development of a CONOPS, stated and derived requirements are revealed. The requirements are then mapped to functions, which are then mapped to components (objects) through the design process. When stated and derived requirements are mapped to components, this ends the "Decomposition and Definition" phase of the System Engineering Process.

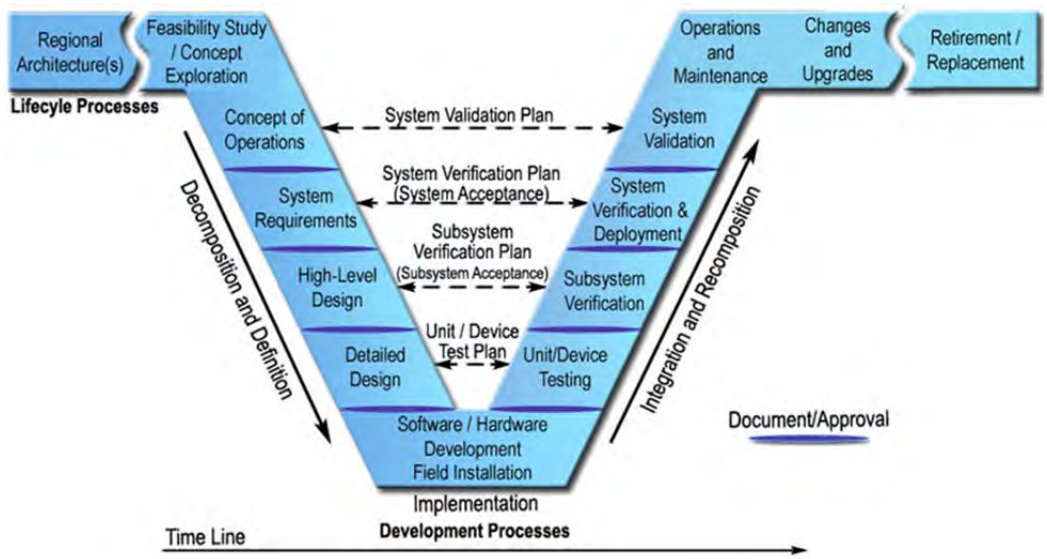

Figure 8. Prototypical System Engineering Vee Diagram (from Federal Highway Commission 2014)

As the System Vee clearly indicates, the process continues with the combining of the chosen components into larger components until realization of the ultimate system through the Integration and Recomposition. The upward climb of the right side of the Vee diagram is a process of integrating smaller components or objects into larger objects that have defined interfaces and interactions to produce a particular function. Although individual components are tested during design for compliance to requirements, the overall testing of the system takes place in the Verification and Validation phases of the integration process.

Verification determines if the system being built *is the right system* while Validation determines if the *right system was built* (Langford 2014; Blanchard and Fabrycky 2011). There is a very distinct difference between these two words. Verification answers if the system built provides the required functionality stated by the stakeholder, whereas Verification answers the usability of the system by the stakeholder in its operational environment. These are two very different statements. Even though a particular system delivers the functionality desired by the stakeholders, if they are unable to use the system in its environment then the system is not suitable.

For instance, assume a self-defense system is required against a sea-skimming missile launched from a shore establishment. After the requirements are stated and derived, the particular system is built and fielded where it proceeds through laboratory, and isolated tests during the verification phase. Each component of the system succeeds in performing its required function in the detect-to-engage sequence and achieves the objective of destroying the incoming missile. The system has been "verified" as acceptable. The next step is to integrate the system into the fleet and test it in an operational environment. What is discovered is that the detect-to-engage process requires a variety of steps that must be performed while the operator is engaged in numerous other functions that results in a failure to destroy the incoming threat. The system was not suitable for the operator, thus it failed its "validation" tests. Furthermore, there may be an unexpected emergence when integrating the self-defense system with other ships, resulting in electromagnetic interference of the guidance system, again resulting in a failure of its validation tests.

The combination of System Engineering Processes and Integration theory have enabled the discovery of new solutions to existing problems resulting in greater functionality and better systems. Systems form the very foundation of every aspect of modern civilization, but systems have limitations or boundaries (Langford 2012). Integration of multiple systems into a System of systems enables the expansion of those boundaries into new discoveries and greater functionality.

B. INTEGRATION THEORY

1. Introduction

The purpose of integrating objects is to achieve greater functionality that is not intrinsic within any object alone (Langford 2012). In this thesis the bulk of the concepts and theory associated within integration was obtained from Gary Langford's *Engineering Systems Integration: Theory, Metrics, and Methods*. The purpose of using this text is based on the clarity of Langford's presentation. Therefore, in order to reduce the complexity in an already complex subject as health care, the author has chosen to base integration theory as it is clearly and usefully defined by Langford's book.

Integration as defined by Langford (2012, 174) is the "unification of the objects through their interactions of energy, matter, material wealth, and information to provide system level functionalities and performance." Integrating of processes and objects enables emergence that facilitates greater functionality, and process improvement that is incapable by any single entity itself (Langford 2012). Others define Integration as cited in Langford's book as a unifying process (Kirk, Raven, & Schofield 2009) or the common understanding that when combining functionalities the "whole is greater than the sum of its parts."

In one aspect or another all things are integrated in order to provide a function or serve a purpose depending on where the viewer defines the boundary lines. An atom is an object that is integrated with other atoms to form molecules, which are integrated with other molecules resulting in a substance that is used by other objects. Hydrogen molecules are integrated with Oxygen molecules to produce water. The integration of these two molecules provides the function of "to hydrate" for much if not all living organism known on earth. If this model is accurate, do we need to look at everything from an atomic structure to understand how objects interact or the degree of integration that exists? Fortunately, NO, since we can separate and combine objects based on boundaries associated with each object. By determining boundaries, properties and attributes associated with each object, it is then possible to classify the aggregation of objects as either system or system of system based on the emergent properties. In fact,

according to Langford “boundary conditions are described in terms of the observed reactions to influences of Energy, Matter, Material Wealth and Information (EMMI) on the boundary of an object (or process)” (2014, Lecture 1).

The first step in understanding integration is to define the boundaries that the objects are subjected to so as to separate what is important and what is not. According to Langford’s text (2012, 30) and for the purpose of integration, boundaries are comprised of physical, functional, and behavioral limitations. Each boundary is unique for each object or aggregation of objects and are key to understand how and where differing objects interface with each other. Because the boundary conditions are unique, any changes within the structure or its objects results in functional changes that alter previous boundary. Although, Langford’s definition for objects incorporates the abstract or intellectual property, for the sake of the simplicity in regard to hospital integration, the term of “object” will refer to the physical embodiment of hospitals and parts, and not their intellectual property.

Beyond the determined boundary of a system or system of system is the “environment,” which is not isolated and is out of scope for this research and therefore considered to be of no consequence to the system in question. Contrarily, the environment still interacts and shapes the system through exchanges of energy and information, but these interactions do not directly affect the system from performing its functions (Blanchard and Fabrycky 2011). For instance, the recent Ebola outbreak in Sierra Leon did not directly affect the majority of hospitals in the United States, but the mere presence of an outbreak caused many hospital administrators to review their practices and processes in regard to epidemic outbreaks.

In the process of determining the boundary, the end of one boundary does not constitute the start of another boundary (Langford 2012). The boundary determines where the interface must take place and to what degree. The interface between objects is the crux of integration. Without two or more objects interfacing, then there is no integration (Langford 2012).

a. Physical Boundary

The physical boundary (Figure 9) is the actual tangible dimensions, construction, and any other physical limitations of the object, such as the walls and floors. These physical boundaries determine what the hospital can and cannot provide. The physical boundaries may also contain outside structures that prevent the expansion of the hospital, such as surrounding fences, or natural barriers such as bodies of water or mountains. For instance, the size of the hospital will determine how many beds it can accommodate as well as equipment it can house within its physical boundaries. At full capacity, the hospital cannot increase its capabilities for one function without giving up space used for another function. If the hospital desired to incorporate a new ward or to establish a burn unit, the decision would result in the loss of beds or some existing capability it provides. Therefore, it is imperative to understand the physical limitations associated with individual objects when considering integration so as not to attempt to force a system to do what it is not capable of doing.

b. Functional Boundary

"A functional boundary (Figure 9) results from the uses of an object as manipulated by another object via the connection between the two objects" (Langford 2012, 31). The connection between two or more objects results from the interaction between those objects (Figure 9). When a patient visits a hospital (two objects interacting), the functions of 'to provide service' and 'to receive care' are enabled. Following the style in Langford 2012, functions are denoted with single quotation marks and processes are designated with double quotation marks. Functions enable the uses of objects, in this case enabling the health care provider to examine the patient and determine what regimen should be followed. The functions carried out by the participants involve two or more objects. The importance of functions lies with their performances. Performances are measureable; consequently, functions can be related regardless of the type of business.

c. Behavioral Boundary

A behavioral boundary (Figure 9) arises from the existence (or non-existence) of functions or objects. People react to functions if they exist, consequently people change their behaviors to use a function or avoid the use of a function. Likewise, people react to functions if they do not exist. As an example, if there is no provision for a patient to register when entering an emergency room, i.e., the function of 'to register' does not appear to exist, then the patient may either sit and wait for someone to come to the emergency room to question those waiting, ask others in the waiting room, or begin to explore other reaches of the hospital to register. Similarly, objects present or not present drive patients' behaviors. The importance of behavioral boundaries derives from existence, non-existence, or changes in functional and physical boundaries. In essence, behavioral boundaries can be substantially displaced in time and space from physical objects – through the objects themselves (or lack of objects) and through the functions that emerge from interactions between objects (or lack thereof).

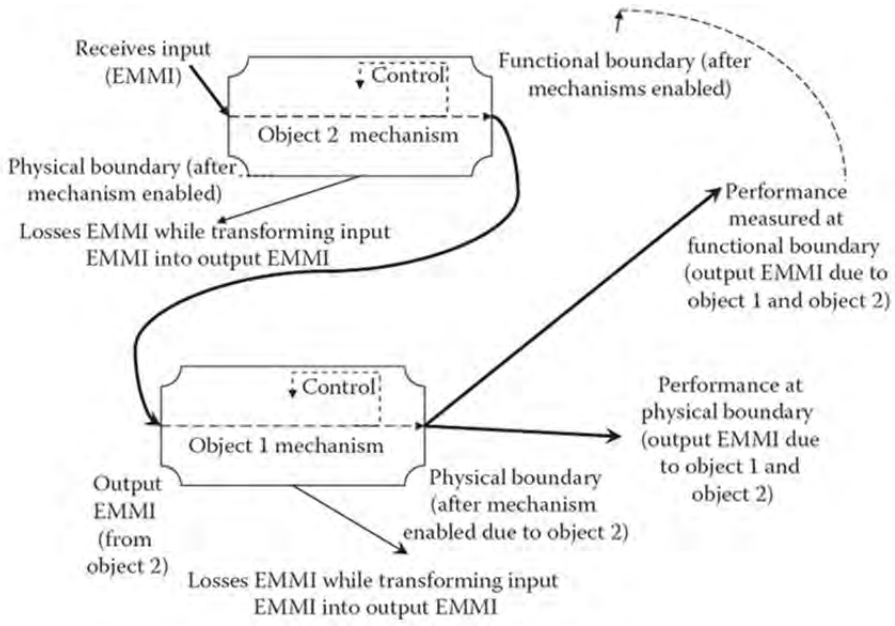

Figure 9. Physical, Functional, and Behavioral Boundaries of a System (from Langford 2012)

Behavioral boundaries are also defined by an individual's anticipation of what may occur because of an activation of an objects mechanism (Langford 2012). The 2014 Ebola epidemic found cases within hospitals in the U.S. with individual doctors and nurses being exposed prior to identification of the virus. The anticipation that hospitals in the U.S. may have patients exposed to the virus could result in individual's reluctance to seek medical care.

2. Interaction: Cohesion and Coupling

As boundaries delineate the extent of an objects influence, the magnitude of objects interaction determines degree of influence between objects within a system. Two objects need not be in physical contact with each other in order to influence each other. For instance, from an atomic nature, the repulsion of like charges is produced by an electrical force produced by the charge. The two charges are not physically contacting each other prior to their influence being felt by the other. This force is measurable and it causes a change in behavior. Thus, the two charges interacted with each other across their boundary conditions. There was an exchange of Langford's reference to EMMI that resulted in an interaction. The interaction is only noticeable or measureable if there is sufficient cohesion and coupling between objects (Langford 2012).

The change in behavior through interactions is a result of the observable or measurable concepts of cohesion. Two objects must have a measure of "cohesion" for an interaction to take place. Cohesion as defined in Langford's text is "formed by interactions of EMMI…and any manner and means of interaction may result in a form of cohesion." Or as Langford more succinctly phrases it, cohesion is relation-by-degree. In contrast to cohesion's "relation-by-degree" is Langford's (2012, 17) concept of a direct connection characterized by a "relation-in-fact." Langford defines coupling as "the manner in and degree to which the objects or processes relate to each other," or the dependency between them. By using the term "degree" in both definitions, Langford insinuates that there is a range in which two or more objects will interact.

For example, take a situation in which there are three people walking in the woods. Two of the individuals speak the same language, but the third does not nor do

they have even the slightest understanding of the language. During their time in the woods one of the individuals yells out “HELP” within a distance for the other two to hear. The other two immediately stop walking when they hear the third person yell. At this point there is cohesion among all three individuals in the worlds as there is a perceived change in action caused by the individual yelling. Thus, there is an interaction among the three individuals. Although, only one of the individuals understands what “HELP” means and responds in the direction of the sound, the remaining individual who does not understand the meaning of the word continues about his day. The one individual who understands is said to have a causal relation with the individual yelling for help. That causal relation manifests itself through the actions that are now dependent on that understanding. There is a stronger relationship of cohesion and coupling between the two individuals speaking the same language resulting in a higher degree of interaction.

Objects are the physical manifestation of matter that possesses an intrinsic form and function. Objects interact across their boundary conditions through the exchange of EMMI. The degree of cohesion and coupling lead to an emergence of a property, attribute or trait that is fundamentally different from the original objects separately. Interaction between objects leads to integration that characterizes the development of a system through their exchange of EMMI (Langford 2014).

3. System or System of Systems

Within the study of integration, there must be the capability to distinguish if the objects comprise a system or a system of systems. The importance of this fundamental concept cannot be overshadowed, as it is the essence of the integration process. To start, Langford defines the two as follows:

- Systems are Metastable, Internally agile, Externally adaptive, and are formed by NON-reciprocal action (MIEN); and
- System of systems are Metastable, Internally agile, Externally adaptive, and are sustained by Reciprocal Action. (MIER).

As the definitions imply, both systems and system of systems are metastable, internally agile, and externally adaptive. Metastability is often used in physics to describe

state of a system for a duration of time compared to its least energy state. With respect to hospitals, the least energy state would be a non-operational hospital, essentially an empty building. They are metastable, because they have the propensity to become unstable when in the presence of an outside force. For example, a hospital that does not adjust their internal processes to lack of outside resources and that does not adapt to specialty skills that are needed to serve their local community is stable in its operations. It is said to be stable. However, revising internal processes to accommodate shortages from suppliers, and adapting medical specialties to response to community needs is said to be metastable.

a. System

Systems are comprised of different objects through their interaction or exchange of EMMI. The system has defined boundary's in which the objects interact. Although, not every object within a system must interact with every other object to be included (Figure 10). Each of the objects is independent or dependent on each other for their existence within the system and interacts randomly or on consistent bases. Thus, a system is an assemblage of individual objects with consistent or episodic exchange of EMMI to facilitate a required function that is different or possibly greater than the functionality of the individual objects (Langford 2014). Each object in the system serves a function or has a purpose. Therefore, a change in any one of the elements fundamentally changes the system. A hospital under control by its own management, with clear delineation with other businesses and other hospitals, that is agile and adaptive, and that through its operations advances the distinguishing characteristic that the sum of its benefits to its patients is greater than any of its individual parts, is a system.

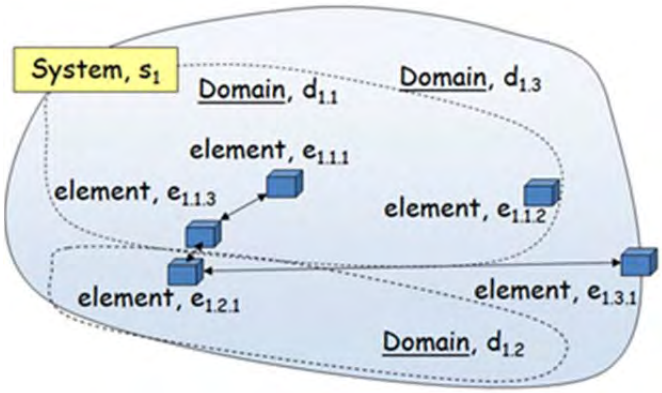

Figure 10. Graphical representation of interacting objects that comprise a system (from Langford lecture, 2014)

b. System of systems

System of systems are an assemblage of dependent or independent systems that interact through the exchange of EMMI in the temporal or spatial domains (Figure 11). The interaction may be temporary or long-term, and may encompass the whole or only a fraction of the individual systems. The boundaries of the individual systems determine the degree of their interaction. Systems interact in order to obtain greater value, each receiving something in return that it is unable to achieve independently.

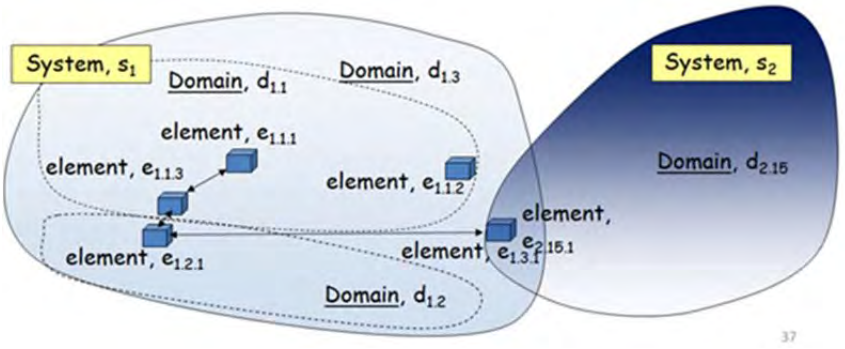

Figure 11. Graphical representation of interacting systems composed of objects that interact episodically to comprise a system of system (from Langford lecture 2014)

c. Businesses as Systems and System-of-Systems

Modeling a business as a system means that the elements that comprise the system are interacting to maintain a stability that sustains the integrated whole. General systems theory (von Bertalanffy 1968; 1972) posits that a system can be modeled as pair-wise interactions that culminate in an integrated whole (Langford 2012). A more general interpretation suggests that these interactions create relations between physical objects that can aptly be considered systems working together in concert as a system of systems. Extending this notion of businesses as systems means that when businesses work together they are systems interacting as systems in a system of systems. In a system of systems, each system works for its own benefit and participates with other systems toward a common goal that would otherwise be unachievable individually (Langford 2014).

C. RISK MANAGEMENT

Risk accompanies all factors of life as no one can foretell the future with any degree of exactness. A principle within Systems Engineer to reduce risk is to incorporate Risk Management processes to mitigate the level of uncertainty that is associated with risk.

Risk is defined differently based on a particular enterprise perspective. For the purpose of this thesis the International Council of Systems Engineering (INCOSE) process to risk management will be used. INCOSE defines Risk and Risk Management in the following ways:

- Risk – A measure of uncertainty of attaining a goal, objective, or requirement pertaining to technical performance, cost and schedule.
- Risk Management – recognition, assessment, and control of uncertainties that may result in schedule delays, cost overruns, performance problems, adverse environmental impacts, or other undesired consequences.

Risk cannot be avoided nor can it be completely eliminated; at best risk can only be contained and mitigated through implementation of processes and management. The objective of Risk Management according to INCOSE is to *"ensure the delivery of a system and its associated processes that meet the customer's needs on time and within*

budget." To achieve this objective, INCOSE recommends the implementation of the following management activities:

1. Identify the potential sources of risk and identify risk drivers;
2. Quantify risks, including both the probability of occurrence and seriousness of impact, and assess the impacts on cost (including life cycle costs), schedule, and performance
3. Determine the sensitivity of these risks to project, product, and process assumptions, and the degree of correlation among the risks;
4. Determine and evaluate alternative approaches to mitigate moderate and high risks;
5. Ensure that risk is factored into decisions on selection of specification requirements and design and solution alternatives; and
6. Take actions to avoid, control, assume, or transfer each risk.

Risk management is inherent in any administration that intends to be successful. Hospitals are not immune to risk. Contrarily, they assume a much greater risk in operational activities than do average corporations because of their Good Samaritan traditions. In an attempt to mitigate the financial risks associated with the increasing health care costs and uncompensated care, hospitals have begun spreading the risk over multiple entities in order to reduce their individual risks. Hospital administrators, be it community or corporate managed, have begun transitioning from the traditional framework of a "system" to a mutual beneficial "system of systems" to reduce risk and obtain greater value (Sloan et al. 1983; Woolhandler and Himmelstein 2004; Pitney 2011; Kuttner 1996; Song and Reiter 2010; GAO 1997; Rotarius et al. 2005).

D. SUSTAINABILITY

The importance of health care to the American public, which many see as a fundamental right (Rotarius et al. 2005), must have stability. Stability means that health care must be economically sustainable. For an object to be stable, it must maintain an intrinsic trait enabling it to apply a restoring force that offsets the effects of a de-stabling force or action (Langford 2012). Hospitals that can joint venture to provide expensive equipment, serve a new patient demographic, or provide cost-effective indigent care can

overcome their deficiencies in inefficient uses of cash (Sear 1991). Stability enables the object to return to the status quo. The ability to stabilize hospital losses with offsetting services that develop profits creates a dynamic metastability that helps sustain the delicate balance between success and failure of a hospital. This metastability ebbs and flows with the changes that affect a system or system of systems. Changes to a system necessitate greater resources and means to acquire and use those resources. Hospitals that recognize the sustainment benefits of working together rather than competing thrive in a geographic region (Moody's 2014).

Another interpretation of sustainability of an organization is presented by Eve Mitleton-Kelly (2011, 1), in her analysis of two London based hospitals that were required to make substantial changes to prevent their dissolution. In the study she states:

> Organizational sustainability is not a continuation of the status quo... it is a continuous process of co-evolution with a changing environment. It is a dynamic process underpinned by learning; it creates new structures and ways of working to adjust and to continue adjusting to a changing set of conditions.

In the continuously changing economic and demographic environment of the U.S., hospitals, must as Mitleton-Kelly suggests, create a structure that enables increased sustainability based on the environment in which the hospital finds itself for these establishments to survive.

A nonprofit system, with its limited access to capital may not have sufficient resources to deal with the issues that reduce its ability to recover needed money from unfunded or uncompensated care provided. A for-profit system may have access to capital, but cannot provide the quality of service for all types of patient groups as many of these activities are unprofitable. Public hospitals may need to increase their budgets, triggering increased taxes, to remain within acceptable bounds for providing health care and its related costs.

Sustainability is the result of redundancy imbedded within the architectures of the various establishments that enable them to weather the changes in their environment. Redundancy within a system increases the cost of operations but mitigates the risk

associated with those activities. For example, nonprofits risk associated with increasing cost for uncompensated care can be mitigated through interaction with for-profits' greater capacity for obtaining capital funding. The mutual cooperation's increases each organization redundancy, thus providing greater sustainability.

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III. EXAMINATION OF THE CURRENT SYSTEMS

A. INTRODUCTION

There is no shortage of scholarly reports comparing nonprofits and for-profit hospitals based on numerous metrics, such as community benefit (Alexander et al. 2009; Rotarius et al. 2005); and cost effectiveness (Sloan 2000); and provision of care to the poor (CBO 2006). In the United States there is no shortage of critics who demonize profits, especially when those profits have societal implications.

Given that hospitals in the U.S. started off as charitable organizations, is it really the taxation status that determines the behavior of the nation's hospitals, or is it the concept that hospitals in the United States are commercially orientated? Is profitability of hospitals the real issue in the rising costs of health care or is that hospitals have acted independently and for too long have clung to the concept of providing care regardless of the cost?

B. HOSPITALS AS SYSTEMS

Systems can be considered as an aggregation of objects to obtain a desired objective and increased functionality (Figure 12). Below is a high level representation of what typically constitutes the hospital system. Hospitals interface with every object in order to accomplish the function of "provide care." Each object provides a specific function that enables the system to exist in its current architecture. The corporation and government provide capital dependent on the taxation status, as well as management of the facilities. Patients and doctors interact with each other based on the required medical care. Patients and insurance companies pay for the medical care provided by the assets of the hospital and the expertise of the doctors and nurses. Governments establish regulations that govern how the hospitals are to engage in provision of the care and how they are managed and financed through the business entity. There interaction requires a strong interaction between them and the elimination of any object within the system will fundamentally change it and possibly cause it to fail.

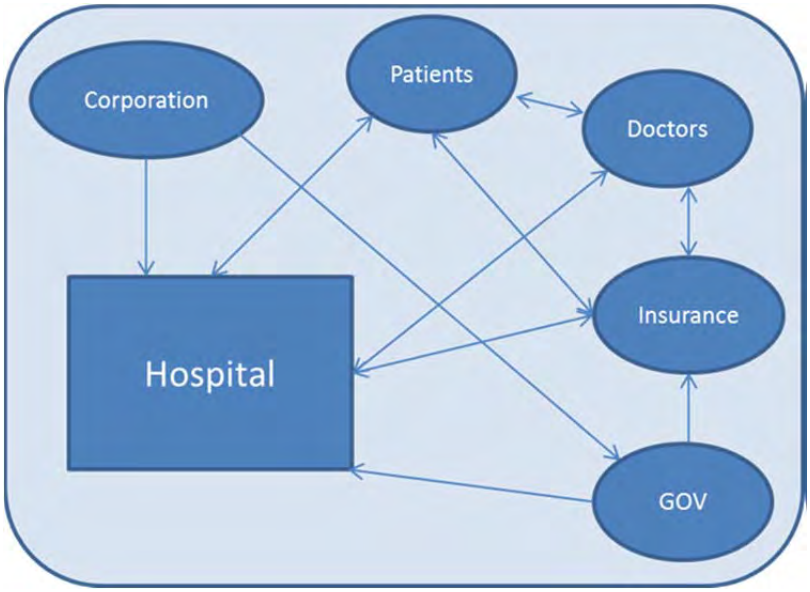

Figure 12. Conceptual aggregation of objects that form the current hospital system

Systems are important, but they are metastable, i.e., dynamically agile and adaptive. A failure in any object within the system causes strain and inefficiencies within the system as a whole. The trend that is jeopardizing this system architecture is the rising costs of health care. Rising costs results in the dependency of the patients upon insurance company to pay for the cost of care or the hospital must assumes a loss if the patient or insurance companies are unable to pay. Insurance companies in attempt to mitigate risk increase the price of premiums on both the patients and doctors. Governments subsidize care for the poor, but only a fraction of the cost goes to the hospital leading to the increase in uncompensated care that the hospital must absorb. These fractures in the system are causing many hospitals to turn away individuals without credible means to pay (unless life threatening), close their doors limiting access, or are acquired by larger nonprofit organizations e.g., Sutter Health, or for-profit organization e.g., Hospital Corporations of America.

The most prominent weakness of this system structure is its inability to adapt to ebbs and flows of its environment. As stated in the prior chapters, the fundamental breakdown in how care is paid for and with the reduction of the middle class bind of losing employer-sponsored health insurance but not having discretionary income to buy

private health insurance but not having discretionary income to buy private health insurance, and consequent increase in individuals at or below the poverty line (Figure 13) has led to a significant rise in uncompensated care or government subsidized reimbursement. Hospitals are under tremendous pressure to continue to care for their local populace and to provide quality care with shrinking marginal returns. Hospitals as businesses cannot continue to operate in this type of environment.

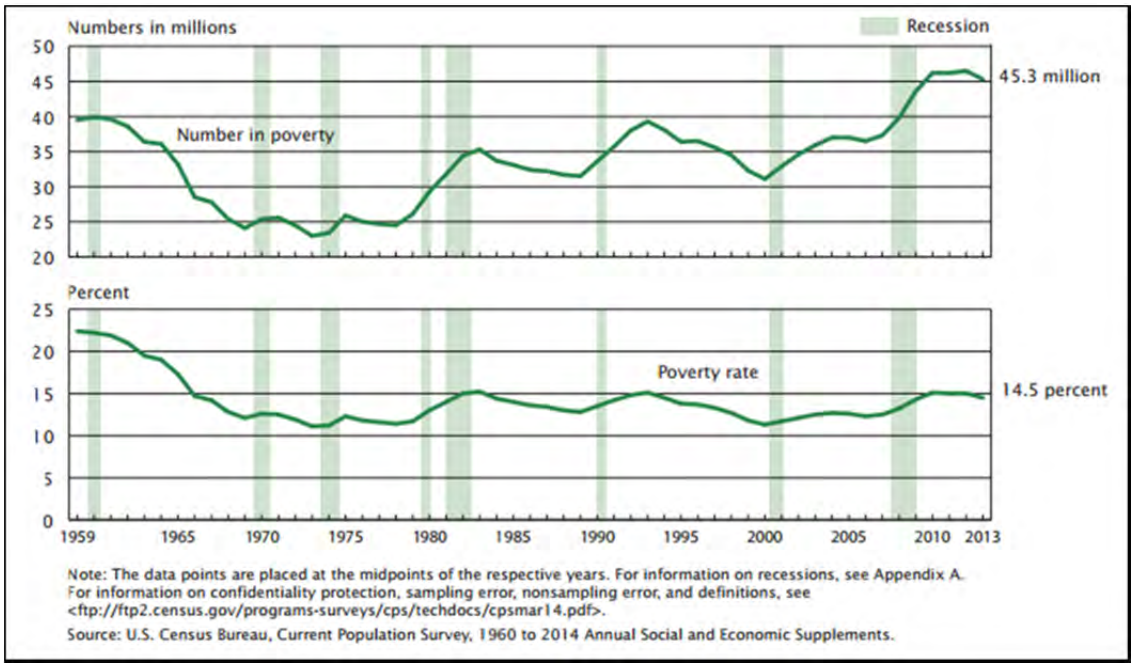

Figure 13. Annual Social and Economic Analysis of Poverty in the U.S. (Census Bureau 2013)

For example, since nonprofit hospitals make up the preponderance of community hospitals (51%) in the United States, they provide a good indicator of how expenses have exceeded revenue. The below are the results of a study of the profitability of nonprofits conducted by Moody's Investment Services (2014). The outcome of the study showed that the profitability of nonprofits continue to decline (Figure 14) and that the median expense growth rate (Figure 15) exceeded the median growth rate. Moody attributes these declines to the following:

- Low rate increases from commercial payors and rate cuts from Medicare and Medicaid;

- A payor shift to governmental payors from commercial payors;
- An increase in high-deductible health plans with higher levels of patient responsibility contributing to increases in bad debt and lower health care demands;
- A shift to lower reimbursed outpatient visits and observations stays from inpatient admissions.

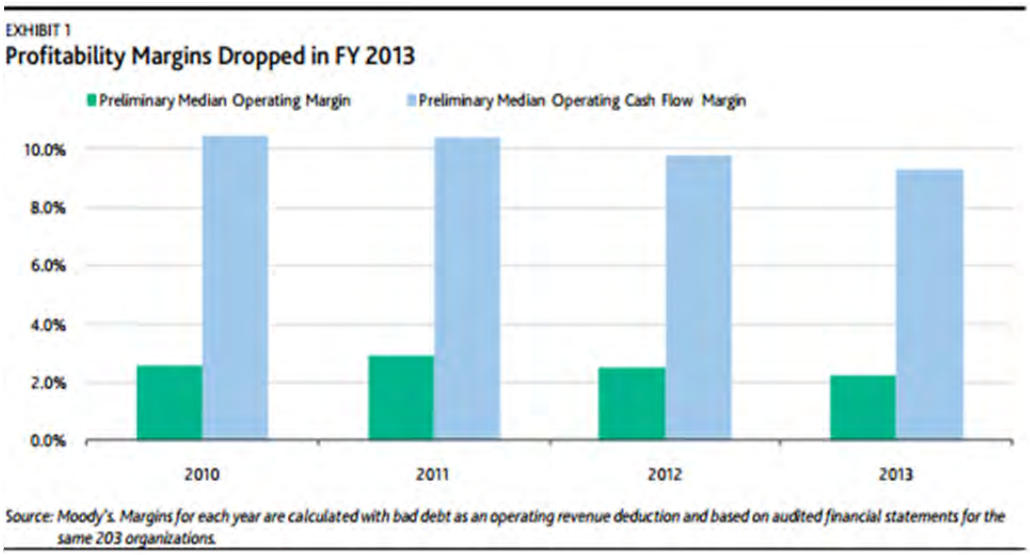

Figure 14. Profitability Margins of Hospitals (2012 – 2013) (Moody's 2014a)

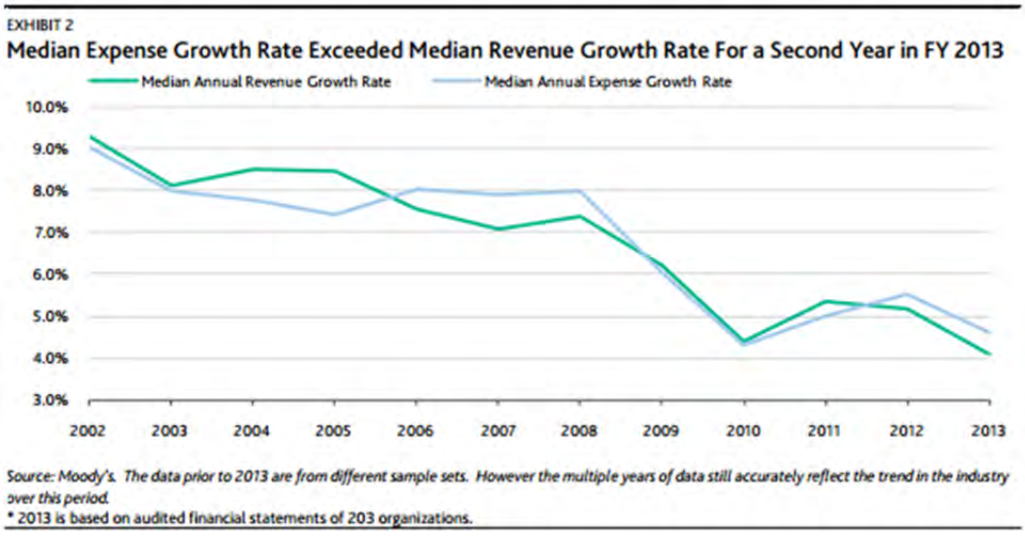

Figure 15. Median Expense Growth Rate Exceeded Median Revenue Growth Rate (Moody's 2014)

Recall from the discussion on Economic Instability and Capital Obtainment in (Chapter I), the profitability of hospitals ensures their sustainability and enables them to upgrade their facilities with the current technology. If expenses continue to outpace revenues, then hospital will be unable to expand or upgrade causing them to lag behind the advances in medical science resulting in the reduction in the quality of care or worse, their closure. Unfortunately, the sad fact is that median expenses will continue to rise as the rate of increase in uncompensated care costs continue to rise. Similar data for public and for-profit hospitals was unable to be found, but it is reasonable to assume that the indictors used by Moody would translate to those hospitals balance sheets in like manner.

C. UNINTENDED CONSEQUENCES OF A SYSTEM STRUCTURE

The purpose of this section is to highlight a few of important unintended consequences of hospitals acting as independent systems. There is a tendency in systems not to understand how that system affects other systems. Individuals within the system develop perpetual tunnel vision and narrowing of their viewpoints of the rest of the world without specialized thinking about issues outside of their own system.

1. Specialization of Hospitals

In most cases, the average individual would conclude that specialization is a positive system structure. Specialization typically promotes better quality as the individuals are experts in that stated field. As the saying goes, “a master of all, is a master of nothing.” On the other hand, specialists are able to hone their skills into a fine art and become more efficient. They can see flaws in a process that others will miss. Lessons are learned quicker through repetitive actions. There is also a reduction of outside distractions or need to cloud the mind with matters not pertaining to the chosen task. This perception is the purpose of the development of many specialty hospitals established across the country. Unfortunately, with specialization there comes a cost of limited availability.

Two of the best known specialty hospitals in the United States are (1) Cancer Treatment Centers of American, a for-profit Cancer specialty hospital, and (2) Shriners Children Hospitals, a nonprofit pediatrics hospital. Both of these organizations are

comprised of multiple hospitals located throughout the nation in various states. Both are world renowned with a positive reputation of providing quality care and obtaining success rates that surpass most hospitals. Although, some critics boast that these institutions success rates are flawed due to the demographics they most often serve (Begley 2013). Regardless of how they achieve those "successful" results, the problem is not in the care or cost of care of these facilities, but in their locations.

The locations of Cancer Treatment Centers of America and Shriner Children hospitals in the United States are depicted in Figures 16 and 17, below. These top two quality care organizations are geographically dispersed throughout the country requiring a significant percentage of patients to incur relocation expenses during their stay at these hospitals. This distribution requires individuals to commute long distance or be away from home for substantial periods of time. This time-distance issue leads to exorbitant costs to the patients receiving care.

Figure 16. Cancer Treatment Center of America locations
(from Cancer Treatment Center of America, 2014)

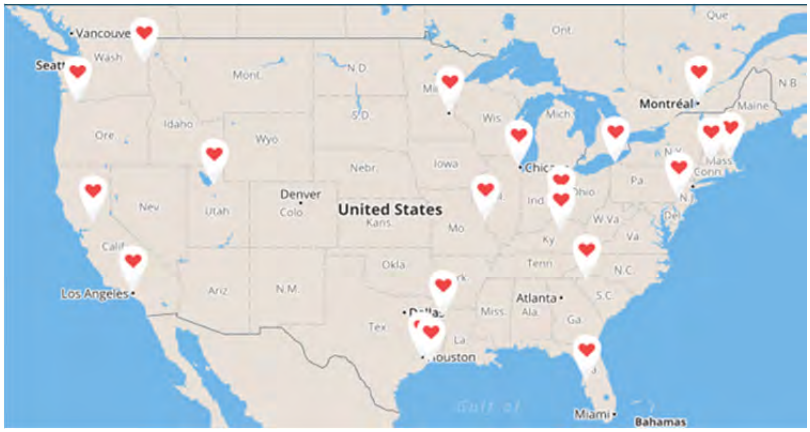

Figure 17. Shriners Hospital for Children Locations
(from Shriners Hospitals for Children 2014)

Patients seeking care from these specialty hospitals must provide their own funding to obtain accommodations at institutions such as Ronald McDonald Houses. Granted, there are other hospitals that provide the care that the specialty hospitals do, but specialization has proven in many aspects to provide a better product. It is this perception (behavioral boundary) of better care that these individuals are seeking.

Regardless of motivations, individuals continue to obtain medical care from these hospitals and incur substantial costs and significant disruption to their lives. All of these costs have to be absorbed by insurance or the individual families. If the costs are absorbed by the families, many times it leads to financial ruin or the hospital ends up writing off the cost of care as uncompensated care costs when the family is unable to pay.

Health care is central to a community, meaning that majority of individuals' experience with hospitals primarily resides within a certain radius of their home. Primarily hospitals are categorized as acute care facilities with specialty clinics located in sporadic locations throughout the region. The difference between specialty care facilities and the acute care hospitals is the quantity of procedures that each performs, and the attention that each hospital can give to their patients.

2. Health Care: A Causal Mechanism in Bankruptcy

The reality is that U.S. consumers spend billions on medical expenses annually and can easily bankrupt even those who are insured, and especially the under-insured and non-insured. A significant cost factor is the expenses that are not covered by the average insurance company; costs associated with commuting, lodging, subsistence, and lost wages due to absence. In fact, medical bills are the leading cause of bankruptcies in the United States according to a study in 2007 and published in *The American Journal of Medicine.* The results of that study that looked at 118,308 petitions filed in the U.S. between January 25 and April 11, 2007 (Himmelstein et al. 2009) are summarized below.

Table 1 Demographic Characteristics of 2314 Bankruptcy Filers and Comparison of Medical and Nonmedical Filers, 2007*

	All Bankruptcies	Medical Bankruptcies	Nonmedical Bankruptcies	*P* Value Medical vs Nonmedical Bankruptcies
Mean age	44.4 years	44.9 years	43.3 years	.01
Debtor or spouse/partner male	44.5%	44.9%	44.3%	NS
Married	43.9%	46.3%	40.1%	.02
Mean family size—debtors + dependents	2.71	2.79	2.63	.02
Attended college	61.9%	60.3%	65.8%	.02
Homeowner or lost home within 5 years	66.7%	66.4%	67.8%	NS
Current homeowner	52.3%	52.0%	53.2%	NS
Occupational prestige score >20	87.3%	86.1%	89.8%	.01
Mean (median) monthly household income at time of bankruptcy filing	$2676 ($2299)	$2586 ($2225)	$2851 ($2478)	.002
Debtor or spouse/partner currently employed	79.2%	75.5%	85.0%	.001
Debtor or spouse/partner active duty military or veteran	19.4%	20.1%	18.4%	NS
Market value of home (mean)	$147,776	$141,861	$159,145	.03
Mean net worth (assets—debts)	−$41,474	−$44,622	−$37,650	NS

*Bankruptcies meeting at least one of the following criteria: illness, injury or medical bills listed as specific reason for filing OR uncovered medical bills >$5000 or >10% of annual family income OR, lost ≥2 weeks of work-related income due to illness/injury, OR depleted home equity to pay medical bills.

Figure 18. Medical Bankruptcy (from Himmelstein 2009)

The conclusions reached by the researchers based on this data were:

- 62.1% of all bankruptcies have a medical cause;
- Most medical debtors were well educated and middle class; three quarters had health insurance; and
- The share of bankruptcies attributed to medical problems rose by 50% between 2001 and 2007.

3. Protecting the Public

Society requires separating the sick from the health in order to prevent the spread of infectious diseases. Hospitals are an ideal choice to assume this role. The problem with operating in the system structure and under the premise that they need to be able to provide all known care to any individual that comes through their doors, is that situations arise that got overlooked. A recent example is the Ebola breakout in West Africa.

The Ebola epidemic in West Africa created a real need for qualified health practitioners and volunteers to travel to these locations and to provide as much medical care as they could. A problem arises when these individuals could have been exposed to the infectious disease and due to incubation periods do not show signs of it prior to coming home. One such example is the return of Kaci Hickox, a Maine resident, who returned home via New York. Due to her time in West Africa, the authorities felt it pertinent to quarantine her for an estimated 21 days (the estimated incubation time for Ebola) in an attempt to prevent the disease from spreading. The problem is that the hospital to which she was taken did not possess suitable quarantine facilities (Figure 19) to accommodate Ms. Hickox. Much of that controversy has recently been the subject of the front page news. Below is a picture of the ad hoc facilities created for Ms. Hickox after her return from West Africa.

Figure 19. Kaci Hickox New Jersey Quarantine Tent after returning from West Africa adhering to the 21 day government requirement.

The reason for such unaccommodating facilities (a non-insulated tent) is that hospitals do not regularly need to maintain well-equipped quarantine space because they are rarely used, nor do they have the excess space or capital to keep them operable. To construct and maintain a space in a hospital in the rare occasions it is needed is an inefficient use of available assets. Specialty care presents a real problem for hospitals when they have to provide a solution for any instance that may arise, yet they cannot do everything given their resources and demand for specialized services.

Consequently, the Center for Disease Control has only 20 fully functional quarantine facilities nation-wide, located near the entry ports into the United States from aboard (Figure 20). Unfortunately these facilities do not take into account the possibility of infectious disease entering from port facilities or from those who cross the boarders. The government has accepted the risk that the threat of individuals coming through these ports of entry is less than those coming via air transportation.

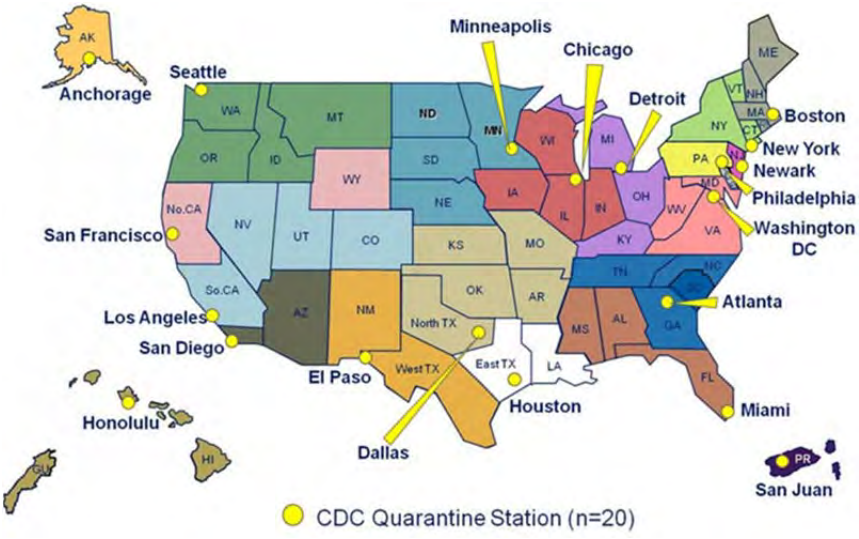

Figure 20. CDC Quarantine Station (from Center for Disease Control 2013)

The author presumes that this is a calculated decision based on the financial requirement to maintain facilities nation-wide when their utilization is limited. This presumption is difficult to justify in the event that the United States might experience an Ebola breakout before the government can isolate the spread of the disease effectively.

The lesson of the recent Ebola outbreak in West Africa is that facilities need to be located in every community or at least having the ability to support nearby communities.

If every hospital did not act independently, but instead aggregated into a community system of systems, sharing responsibility for providing care within that community, then the costs associated with maintaining little used equipment is spread over the entire system of systems. Not every hospital in every community must provide for every need. Unfortunately, due to the independent nature of hospital systems, the mindsets of the hospitals are often sufficiently similar that they resist forming a joint venture. Their notion is that the market is theirs to lose. If it is rarely needed and the hospital does not require it, then why expend limited assets on providing it. Therefore, in most cases, none of the hospitals provide for the specialized need. What if community hospitals in every region integrated with each other and each provided a low probability of use need and therefore spread the cost equally among all of them? Community appreciation and individual care would increase (Langford 2014).

The integration of each individual hospital system in the community through shared responsibilities and assets provides a more robust health care system of system. A system of systems promotes greater sustainment and adaptability, and would increase the community's capability in addressing current and future crises. Hospitals should reach out to corporations and invest some of their best practices in an attempt to reduce expenses, risk in innovation and increase their capabilities.

D. JOINT VENTURES HELP OFFSET LOSES AND REDUCES RISKS FOR HOSPITALS

As part of a broad strategy that "investigates" a market, these companies are exploring the means to participate in a market opportunity that may not be economically viable to go it alone. Through joint venture, these companies can determine how their business operations must change to be competitive and also discover if their business objectives are satisfied by the use of a mix of assets and skills that were not available before they joint ventured. The notion of a short-term means of convenience sometimes turns into a long-term partnership that recognizes that the participants in the partnership

do in fact need each other to carry on with the business that they explored as a joint venture. It is the mere combining technology, assets, processes, and skills that often opens new markets or provides access to markets that otherwise would be not economically feasible.

Joint Ventures as defined by the Internal Revenue Service "are created when two or more persons enter into an arrangement to invest in a project and the parties share the control, benefits and risks of the project (Salins 1999)." They are set up between companies who want to develop a short-term means of improving profits and reducing risks. Joint ventures are an effective means of nonprofits and for-profits to participate with each other in pursuit of a common goal to overcome the economic burden of uncompensated care costs and provide a higher quality of care. Recall from Chapter II, Section D that "Sustainability" is the result of redundancy imbedded within the architectures of the various establishments that enable them to weather the changes in their environment. The joint venture architecture accomplishes the necessary redundancy to enable sustainability. Sustainability is obtained by spreading the associated risk over both partners; increasing nonprofits' access to capital; and the use of a nonprofits' assets by for-profits to increase activities resulting in a strengthened share price.

According to an Internal Revenue Service's Continuing Educations document on Whole Hospital Joint Ventures by Salins et al., a typical joint venture between hospitals is structured similar to Figure 21. Each of the partners distributes assets based on the agreed upon terms. Based on the distribution of control, for sake of argument 50%, each will contribute their assets to the Limited Liability Corporation (LCC). As per the current law (IRS 501(c)(3)) for the nonprofit to maintain its exempt status, it cannot relinquish more than 50% control. For instance if the nonprofit's asset distribution is $50 million, then the for-profit asset distribution would be on the order of $25 million with the remaining $25 million distributed as cash to the LLC.

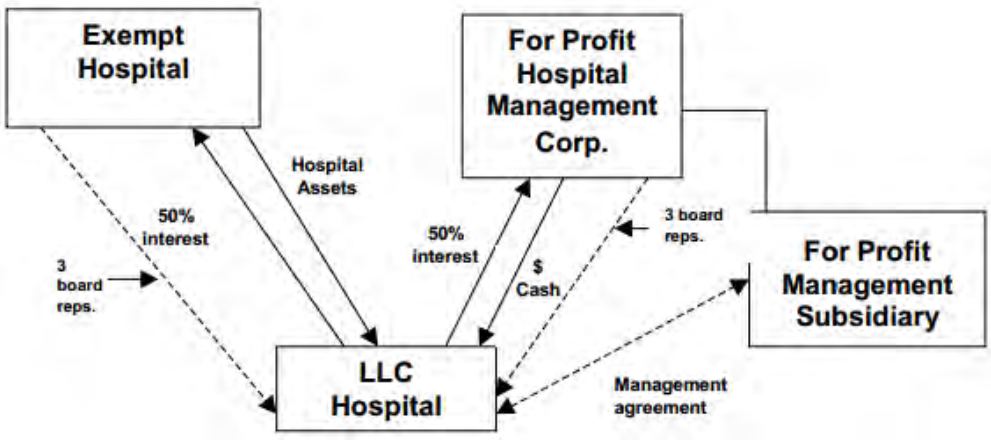

Figure 21. Typical architecture of a Limited Liability Corporation Whole Joint Venture (from Salins 1999)

Based on the discussion in Chapter 1 on Uncompensated Care, it is apparent that a uncompensated care costs are a significant risk to nonprofit hospitals, and to a lesser degree for-profit hospitals. A nonprofit system, with its limited access to capital may not have sufficient resources to deal with the issues that reduce its ability to recover needed money from unfunded or uncompensated care provided. These losses reduce the nonprofits' available cash reserves and ability to obtain assets that are used to stabilize a nonprofits' credit rating that facilitates the issuance of debt to fund future operations. In fact, according to a 2013 Standard & Poor's report (Figure 22) downgrades of nonprofit hospitals rose significantly in latter half of 2013 with the leading indicators e.g., weaker operating margins, cash flow, and coverage levels, trending towards similar results in 2014 and 2015 (Holloran 2013).

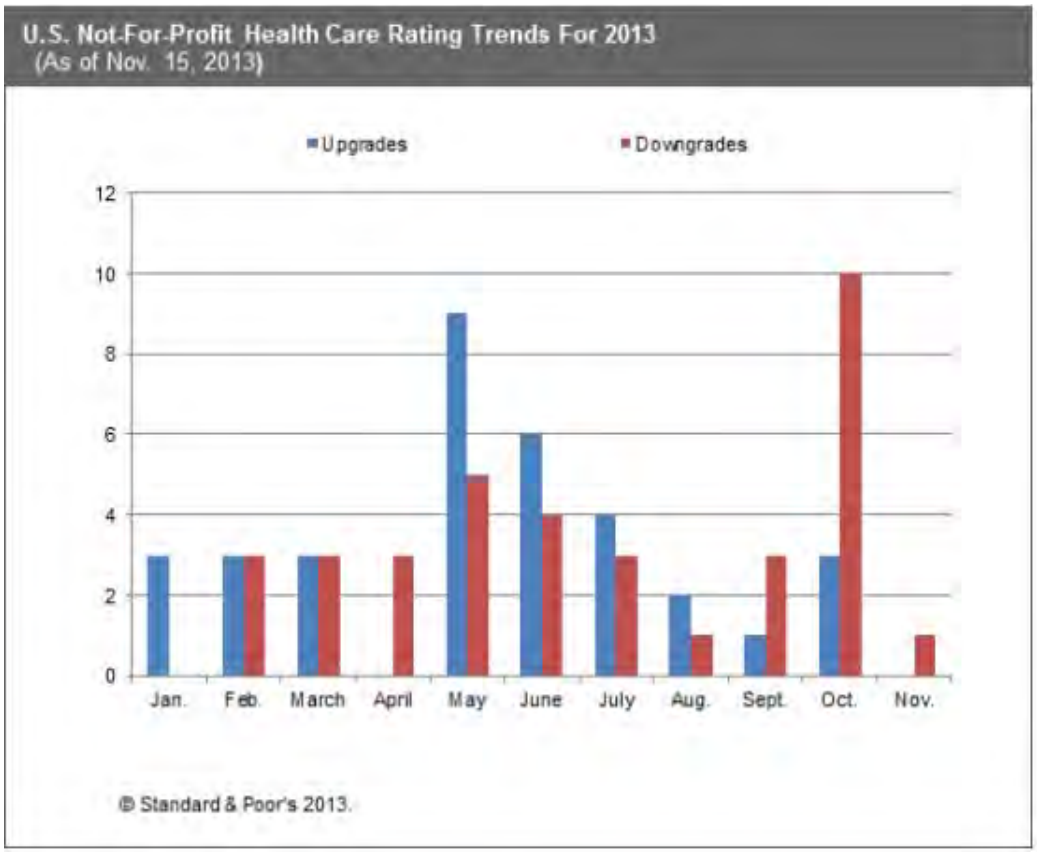

Figure 22. Trending downgrades and negative outlooks for not-for-profit hospitals (from Standard & Poor 2013)

To reverse this trend, nonprofits and for-profit hospitals are engaging in joint ventures to stave off the need to merge or be acquired by another company. This partnership enables the participating hospitals to continue operating with minor changes, and obtain value from the joint venture with reduced risks. Nonprofits obtain needed capital to secure funding through the issuance of debt at reduced "user rates" because of a strong credit ratings, that can offset losses associated with uncompensated care. For-profits can increase assets that bolster their share price, which in turn motivates shareholder and other potential shareholders to invest. These investments enable for-profits to engage in other joint ventures further strengthening their economic viability and marketability. Nonprofits' risks associated with increasing cost for uncompensated care is mitigated through interaction with for-profits' greater capacity for obtaining capital funding. For-profits can increase portfolios that increase share price with minimal capital

expenditure and at minimal risk of the venture failing. The mutual partnership enables each to take advantage of economies of scale, again reducing the risk involved and providing greater sustainability

In summary, there are several advantages of joint ventures over single companies competing for the same market. The primary advantage from a cost perspective is the economies of scale that derive from purchasing goods common to all of the partners in the joint venture. The primary advantage from a competitive advantage is the ability to apply appropriate technology and skills to the particular needs of the market segment served. A single disadvantage that can arise is the recognition by one or more of the partners to the joint venture that economic interests and long-term goals may not be compatible with long-term participation in the joint venture. For health care, the joint venture structure has been tested and proven over the past 30 years. For example, nearly 20% of all transactions by Merchant and Investment Banks are for joint ventures; the remaining 80% are acquisitions (Challenger 2003; Holloran et al. 2013).

E. HOSPITALS CAN LEARN FROM CORPORATE AMERICA

As previously mentioned in the section on Economic Instability, hospitals continue to strain under the increase pressures to provide care regardless of economic circumstance. This limitation is due in part to the unique nature of care facilities and the truth that everyone in their lifetime will want or need medical assistance; which is not true of every other business. Unfortunately, this circumstance inhibits hospitals from exploring ways in which to better conduct their business. That is not to say that hospitals cannot transition to more effective business models, as they have demonstrated throughout their history. Based on the tight money environment that they find themselves in currently, a new approach to managing care would seem to be natural to consider.

To meet the needs of the community at large, and provide for the social well-being of its citizens, hospitals could “outsource” or become more specialized within their community. Hospitals cannot continue to provide for every need and operate as a system as they have. Operating from a system of systems perspective will enable hospitals to

capitalize on some of the leading corporations lessons learned and body of knowledge that has enabled them to be successful in this rapidly changing world.

Take for instance, two of the leading technology institutions - IBM and Microsoft. In the early 1980, IBM was the leading producer of personal computers (PC), but they did not have the knowledge base, capacity nor will to expand into the software business needed to make the PC market a reality. A partnership was born between IBM and Microsoft with IBM producing the hardware, and Microsoft producing the software. The integration of these two company's products, operating as a system of systems revolutionized the world to what we know today.

A more recent example is the partnership of IBM and Apple that is expected to increase Apples representation in the corporate world and IBMs reputation in the consumer's eyes. According to an article by Ross Rubin, a writer for CNET, on July 26, 2014, "Under the deal, Apple, which has relatively low penetration in corporations, gets to tap into IBM's understanding of the enterprise world." IBM, for its part, gains access to popular devices and gives it more leverage to compete with services from Hewlett-Packard and Dell." Again, these businesses did not need to expend capital to develop capabilities or build facilities in order to expand their business enterprise. By entering into a partnership, i.e., operating as a system of system, each organization was able to operate autonomously, but integrating where they needed to combine functionalities. In this latest bid for a partnership, IBM did not need to create and build devices to compete with Apple, and Apple did not need to expend capital and compete with IBM to establish itself in the corporate world. Similarly, if hospitals would become increasingly specialized offering a limited array of services they would be better equipped, better funded, and more capable of providing for the social welfare of the community.

F. PROFITABILITY IN THE HOSPITAL ORGANIZATION STRUCTURE

1. Profitability is the Rule not the Exception

This section explores the profitability in regard to the organizational structure of the hospital. There is extensive research extolling the virtues of nonprofits and public hospitals commitment to the public good, while stating that for-profit hospitals are more

likely to moderate the care they provide in pursuit of profits (Cutler 2000; Sloan et al. 1983). Although this tradeoff of patient care for profits might be true in some instances, the notion that nonprofit and public hospitals do not seek profits is a bit misleading and contorts the public perception of the care they receive. In fact, both the public and private nonprofit hospitals can and do make profits (Cutler 2000). The difference between nonprofits and for-profits lies in what they are able to do with those profits. Since the motivations for profitability is well established for private for-profit hospitals, a discussion of their motivation is beyond the scope for this section and will focus on the public and nonprofit hospitals.

Nonprofit hospitals, in the majority, concern themselves with uncompensated care, teaching institutions for interns and research (Cutler 2000; Alexander et al. 2009). Unlike for-profit institutions that distribute profits among stakeholders, nonprofit and public hospitals must reinvest these profits into the organization to modernize facilities and equipment, invest in research, and maintain prized programs, in additional to many other avenues in which they deem important. Frank Sloan et al. (1983) in *Investor-Owned and Not for profit Hospitals: Addressing Some Issues,* reveals that it's a "legal distinction …does not refer to the earning of profits, but rather to limitations on the distribution of profits, the ability (or inability) to receive tax deductible donations, and tax exemption." So to say that nonprofit and public hospitals do not have a desire to achieve profitability is a little naïve.

Take for example the Veterans Affairs (VA) Hospitals, a public (government) hospital funded by the tax payer contributions. Although the VA is subsidized by the taxes, it still maintains the ability to charge an individual's insurance and require patients to pay a copayment for particular procedures or prescriptions. Their annual budgets and operating costs in the majority are, however, subsidized and constrained by the government's annual appropriations. The use of the VA is to elaborate on how governments allocate funding and is synonymous with how states and municipal governments fund their public hospitals and institutions.

The federal government maintains an approved appropriations bill for the fiscal years allocation of the federal budget to the VA. The VA uses this funding to pay

operational and maintenance costs (O&M), provide for logistic necessities, in addition to writing checks to private enterprises that obligates the Treasury to honor. These appropriations are prepared based on historical data merged with expected expenditures. The end result is a fixed annual appropriation distributed among the public hospitals in the region. This fixed amount of capital must meet all the hospitals expenses for the entire budgeted year. Unfortunately there are significant uncertainties that the hospital must prepare for or anticipate.

Public hospitals have become the bastion for the poor in society (Cutler 2000) and provide much of the emergency care which makes up a large portion of the uncompensated care costs. Given a fixed amount of capital for the budgeted year, prudent public hospital administrators need to look for ways to cut expenses, but in addition to providing for the well-being of society, which requires continual reinvestments in the facility, upgrading processes, and acquiring advances in medical technology. How do these administrators obtain the necessary capital to make the improvements they need to their facilities given a fixed budget? If these administrators invest in their facilities early in the fiscal year they run the risk of not having sufficient funds to cover the O&M costs that arise in the latter portion. If they must expend much of their capital caring for public, they run the risk of having insufficient funds in the fourth quarter, and they are unable to invest in their facility due to lack of funds. Thus, a fixed budget handicaps public hospitals, which may lead to reduce care in order to ensure sufficient funds remaining at the end of the year.

To say that public hospitals provide better quality care because they are not motivated by profit is misleading. Public hospitals can make a profit and based on the reasoning of the preceding paragraph, they would benefit exponentially if they did make a profit.

What hinders them is the amount of uncompensated care that many public hospitals have to compensate for. Due to the increasing costs of emergency care, uninsured patient care (indigent care), and undercompensated care (Medicare & Medicaid) to the hospital, nonprofit and for-profit hospitals are limiting access in order to remain financially solvent. This retreat from providing for these types of patients has

increased the public hospitals' share of expenses. This increased share enhanced the uncertainty in planning for budget requirements in later quarters.

Without real evidence of the motivation of public hospitals in how they appropriate the capital, we can only speculate on the budgeting process based on the needs of the hospital. This discussion is not an attempt to impugn the hard-working hospital administrators managing these facilities; rather it is merely an attempt to provide pause for critics of profitability in hospitals by showing the motivation of other government organization. To show reasonable cause, the Department of Defense (DOD) is used as an example, due to the author's familiarity with them.

In accordance with the law, unused portions of the appropriations are returned to the Treasury. Returned appropriations are not categorized as savings to the government but are seen as over-appropriated funds that may need to be distributed to other organizations in following year budgets. Most would think that these institutions would be praised as good stewards of tax payer's money, but in reality these institutions are in a sense punished and many times see their future budgets reduced proportionally. Over-commitment of appropriations are investigated for poor fiscal management leading reprimands, bad performance reviews, and even to dismissal of administrators. This type of fiscal policy within the government has led to a particular mindset among these administrators. Administrators tend to be very conservative in approving expenditures in the early quarters, looking for ways to reduce costs so has to not over-commit the government, in order to have a surplus in the fourth quarter. To ensure they do not lose funding in subsequent years, organizations engage in massive end-of-year purchases in order to use up the remaining funds appropriated to them. These are the hazards of government's current fiscal policy following such practices, and it could provide indications of how public hospital administrators appropriate their budgets.

Public hospitals may not outwardly be motivated by profits, but using the preceding discussion it is far more probable that they manage finances in this manner, with a desire to be profitable. Profits are essential to expanding infrastructure, maintaining equipment, and pay the interest on capital obtained (Sloan et al. 1983). The dilemma that these administrators face is the uncertainty in providing care to those in

need. It is uncertain how much care they will have to provide in a given year. It is not unreasonable to speculate that public hospitals may reduce the quality of care in the first three quarters to ensure sufficient funds in the fourth quarter and prevent over-commitment. It is also not unreasonable to speculate that public hospitals attempt to have a surplus as they approach the end of the fourth quarter in order to invest in needed supplies, equipment and facility upgrades. If the hospital is able to in the same way produce a profit by reducing expenditures e.g., patient care, overhead, then those profits merely increase the administrators capacity to modernize their facilities. Therefore, to say that public hospitals are not in any way motivated by profits is misleading. Similarly, the private nonprofit hospital is comparable in their motivation for profit.

Nonprofit hospitals have the same requirement as public hospitals in providing care to individuals regardless of their ability to pay and to accept government subsidized program e.g., Medicare and Children's Health Insurance Program (CHIP), that pay only percentage of the cost for care. In fact, there is a perception that hospitals will care for patients even if they cannot pay (Alexander et al. 2009).

2. Can Hospitals Continue Solely as Independent Systems?

In general, there are four types of medical interactions with patients: outpatient, inpatient, subacute and residential. Outpatient medical facilities cover the most visits, but typically require appointments. Inpatient medical settings are found in hospitals and serve the needs for emergency care. Subacute medical settings offer short-term care where stays may be from 2–8 weeks. Residential medical settings are in-home service. Based on the level of care required and the rate of individuals requesting health care services, will determine the hospitals capability and capacity to provide care to those that need it. It is not unlikely that one or more hospital can be near or at full capacity resulting in long waits, while other hospitals have minimal patients. Operating as a system results in an inefficiency in the provision of care, which could be resolved through a network of hospitals working together in a system of systems.

Inherent in all systems is that the failure of any object in that system reverberates throughout every object in the system. The only way to repair the system is to repair the

component that has failed. When it comes to hospitals, the object that has failed is the ability for patients and insurance companies (private or government subsidized) to pay as prices continue to rise. This problem leads to large sums of debt, loss of capital, loss of the ability to acquire new equipment or expand, and when acting as a system, the system suffers alone. There is no upside when a hospital fails, it only hurts the community it serves in reduced access and loss of employment.

There must be a change in the behavior of hospitals away from the concept that they need to provide every procedure feasible. Hospitals must become more narrowly focused and provide a smaller subset of procedures and integrate with surrounding hospitals that provide a different subset of specialties to ensure the community it served in all aspects of health care. The effect of this action would be to reduce the need to purchase and maintain equipment, staff, and knowledge base that is only seldom utilized by the facility. Also, since hospitals are confined by physical boundaries it would increase the available space formerly occupied by seldom used equipment for those that are commonly used, increasing their capacity to serve the community's needs.

By integrating labor, administrative and managerial requirements accompanied with sharing of assets and intellectual property, hospitals can provide quality care at reduced costs. The larger the size of the organization enables the principles of economy-of-scale allowing larger purchases of supplies and prescriptions at lower costs (American Hospital Association 2014). Distributing the costs of care over a greater number of patients reduces the cost and risk to these organizations and also provides protection against the shifting demographics associated with health care.

G. A WAY FORWARD IN HEALTH CARE

In the next chapter, the thesis proposes a reorganization of the current health care system away from the system concept, towards a system of systems. Within the system of systems conceptualized organization, the strengths of the three organizational types. (public, private nonprofit, private for-profit) can be maximized through integration. Each organization focuses on its strengths, and institutional mandates for the betterment of the community and organization.

According to the American Hospital Association survey in 2012, “Rising costs to hospitals for the goods and services purchased to provide care accounted for 63 percent of overall growth in spending on hospital care from 2006 to 2010.” By integrating labor, administrative, and managerial requirements accompanied with sharing of assets and intellectual property, hospitals can provide quality care at reduced costs. The larger sized organization enables the principles of economy-of-scale allowing larger purchases of supplies and prescriptions at lower costs (American Hospital Association 2014). Distributing the costs of care over a greater number of patients reduces the cost and risk to these organizations and also provides protection against the shifting demographics associated with health care.

To accomplish this economy of scale there must be a change in the behavior of hospitals away from the concept that they need to provide every procedure that is feasible. If hospitals become more specialized or provide a smaller subset of procedures and then integrate with surrounding hospitals or care facilities that provide a different subset of specialties, then a broader range of care can be provided with each type of hospital sustaining their business within their niche. That niche might be specialized care for cancer patients, or focus on a demographic group with particular illnesses. Hospitals may reduce the need to purchase and maintain equipment, staff, and the knowledge base that is only seldom utilized by the facility, opting to serve the community in a particular area of care, and allowing other hospitals assume the roles in different areas. The reality is hospitals are confined by physical boundaries. Therefore, the distribution of specialized care or limited use equipment among the existing hospitals in mutual beneficial infrastructure will increase the hospital capacity to serve more of the community.

IV. A NEW APPROACH TO PROVIDING HEALTH CARE: A SYSTEM OF SYSTEMS VIEW

A. INTRODUCTION

The thesis hypothesizes that the many of the problems currently seen in the hospital industry can be mitigated if not eliminated if the hospital infrastructure adopted a system of systems methodology. In so doing they would in effect enhance the benefits to society through mutual cooperation, but remaining within the confines of the law and addressing stakeholder/shareholder needs. Through mutual cooperation, hospitals within a community could maximize their strengths minimize weaknesses, and eliminate redundant functions that are major contributors to the high cost of health care. The foundation of the hypothesis is found in the theory of integration, and supported by System Engineering foundational principles in Risk Management and Sustainability

The thesis aims to show that the current "system" perspective impedes workable solutions to updating the nation's current health care system. Just as the corporate sectors of the nation are transitioning from a system to a system of systems (IBM and Apple) and obtaining benefits, so should hospitals. Adopting a system of systems viewpoint enables greater adaptability to foreseen and unforeseen circumstances that arise, thus reducing risk to the participating facilities. When hospitals can change with the economic environment they are more sustainable reducing the amount of hospital closures nation-wide and within a community. Enabling hospitals to remain open and viable, increases access, reduces wait times, which directly enables doctors and nurses to provide greater care to those in need of it most.

The health care industry is very complex, thus a single idea or concept cannot, nor will it solve the current health care crisis of risings costs and reduced access. The genesis of the hypothesis is the understanding that hospitals conduct themselves as businesses; but unlike a prototypical product oriented visit, consumers of health care in most cases would rather not partake of their services. Meaning that the majority of patients consuming the service of health care do so because something is wrong and they are in need of help. Most people, if given the option, would choose for things never to go wrong

and thus forgo the need for health care, vice the alternative. Unfortunately, in reality, at some point in everyone's life they will require the expertise of qualified health care providers. The fact of this previous statement is precisely why it confounds (long-term) logic that hospitals within communities compete with each other as if they were businesses in pursuit of larger market shares.

It is because hospitals compete in the market and conduct themselves from a business prospective that they have oriented themselves into independent systems. Systems are important and they serve a genuine purpose. Modeling a business as a system means that the elements that comprise the system are interacting to maintain a stability that sustains the integrated whole. Fortunately, the corporate world has forged ahead and learned valuable lessons concerning systems. A system is constrained by limitations (physical, functional, and behavioral boundaries), and in order to expand while reducing cost and risk, corporations have integrated and adopted a system of systems viewpoint.

The following discussion presents the concept of hospitals (systems) integrating with other hospitals (systems) as systems-of-systems to reduce cost and risk associated with the growth rate of uncompensated care. Health care, for the majority of us, is local and central to a community with the probability of a person going to a particular hospital more a factor of distance than marketing. Based on this situation, hospital infrastructure could be organized in a manner that is central to a community, sustainable, and maximizes efficiencies without draconian changes to the business architecture. Applying concepts of integration theory to the current hospital infrastructure illustrates the benefits of community hospitals working together to ensure a more robust and sustainable environment.

B. HOSPITALS AS A SYSTEM OF SYSTEMS

Objects interact. Therefore, interactions create relations between physical objects that can aptly be considered systems working together in concert as a system of systems. Hospitals working together are systems interacting as systems in a system of systems. In a system of systems, each system works for its own benefit and participates with other

systems toward a common goal that would otherwise be unachievable individually (Langford 2014).

The discussion below builds off Figure 12 in Chapter II: Literature Review concerning hospital systems. Figure 23 shows the integration of each of the three types of hospitals typically found in any community. Where the individual objects (i.e., hospitals) intersect the systems signifies a temporal or spatial integration that is shown pair-wise, rather than in multiple relations. Currently law prohibits public hospitals entering into mutual beneficial agreements with for-profit hospitals. A governing principle of system of systems is that any object can be added or subtracted from the whole, and the whole would remain fundamentally unchanged, just as the model depicts. Removing a public hospital does not change the fact that a nonprofit and a for-profit continue to support each other.

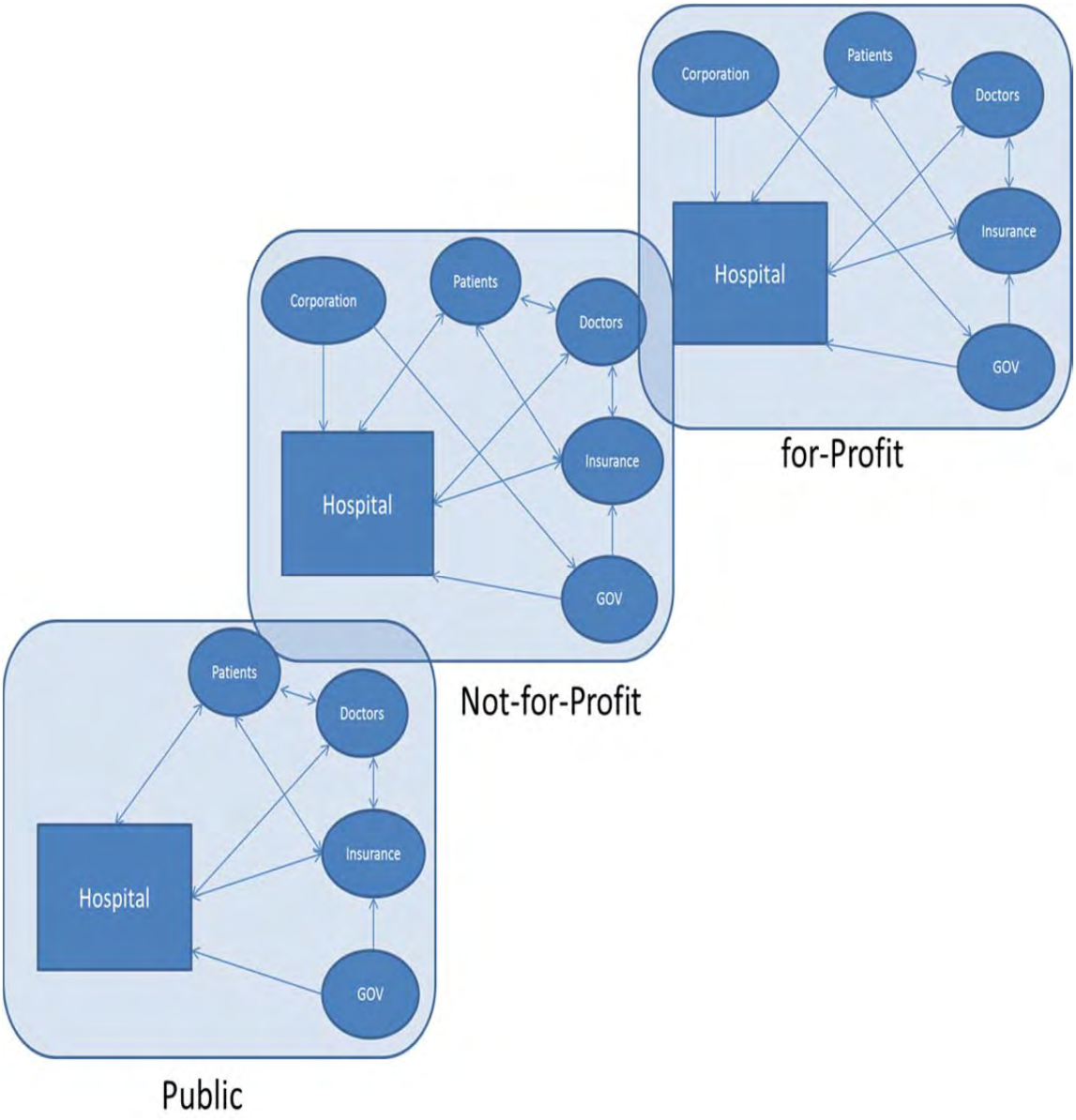

Figure 23. An Idealistic Pictorial of Systems Integrated Together as System of systems.

Integration requires that there be a measure of cohesiveness that signifies that an interaction has taken place. Thus, the hospitals represented in the model must be aware that the other exists and the influence (support, assets, capital investment, capabilities) they can have on them. This situation currently exists in every community as hospitals are well aware of each other presence. For a system of systems structure to be realized,

these hospitals must couple together in the sharing of assets, communication and through the distribution of patients.

For instance, Computed Tomography (CT) Scanning machines can cost a particular hospital upwards of $ 2.5 million and with installation of required shielding and safety measures, can reach anywhere between $4 million and $6 million (Glover 2014). This initial expense does not include annual operational and maintenance costs. Computed Tomography (CT) machines have revolutionized medical diagnosis giving doctors more information enabling them to make better diagnoses. When doctors are equipped with better information, they can often forgo the multiple tests that add up in costs over a protracted time to carry out diagnoses. The benefit definitely outweighs the cost, but that does not insinuate that every hospital is able to expend their limited capital on one or more of these machines. Those hospitals that are unable to invest in a CT, default to methods that are outdated, less accurate, and more time consuming. If all the hospitals were coupled together in a network were sharing of assets was common place then only small proportion of the community hospitals need to invest in a CT measuring machines. This aggregation would free up other hospitals to invest in various other medical instruments that could be used by other hospitals. This situation is only one example where a system of system (network) may show efficiencies, freeing up capital to use more efficiently to support the community.

Capital obtainment is a significant factor in any hospital. Each of the various types (public, nonprofit, and for-profit) must continue to seek alternative ways of obtaining capital for improvements. Working together, sharing assets as a system of systems frees up sources of capital that would otherwise have to be used to purchase additional equipment and upgrade their facilities. The value in the mutual partnership is that not every hospital has to purchase and maintain the same equipment. Agreements can be made within a community on which hospitals would acquire and maintain certain equipment, thus lower overhead. The capital saved can now be repurposed to other needs, such as electronic health records, or community programs.

For-profit hospitals have a greater propensity than do public and nonprofits to garner additional sources of revenue through investors buying shares. This capability

would place them in a solid position within the community to acquire machines, e.g., CT machines, for use by the network, thus improving the capability of physicians to diagnose ailments and reduce unneeded tests. Fewer tests mean lower costs. Fewer patients having to return to the hospital because of a misdiagnosed problem (repeat visits), means lower costs. Increasing the number patients utilizing the same equipment reduces the cost, allowing hospitals to capitalize on economies of scale. Figure 24 Below is a graphical representation of how economies of scale work—as more patients are served, the cost per patient is reduced.

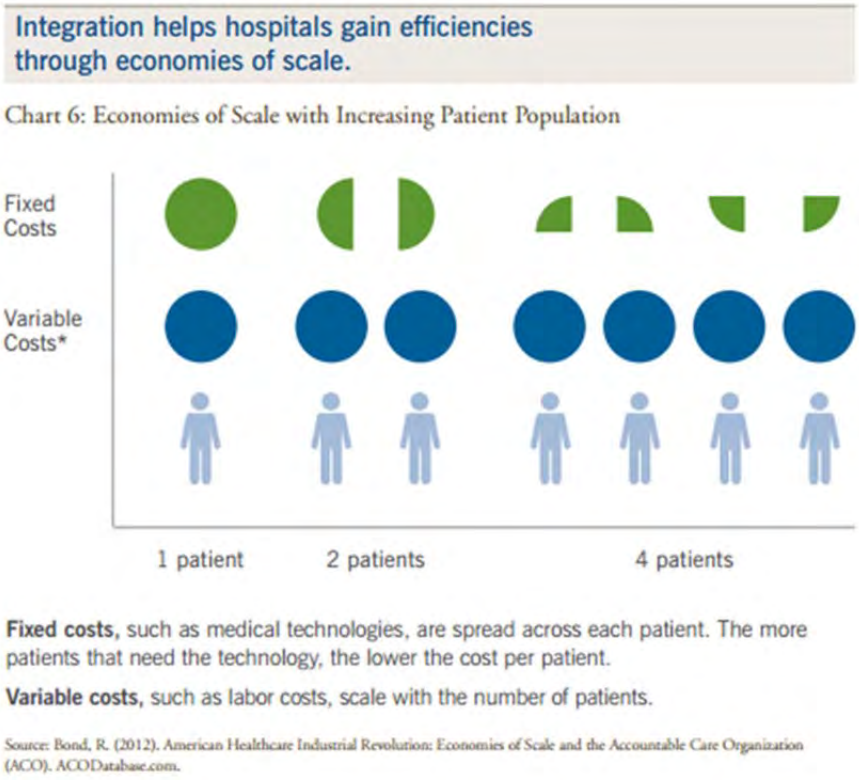

Figure 24. Integration Helps Gain Efficiencies (from Bond 2012)

Uncompensated care, bad debt, and charity care are the biggest drains on any hospitals financial stability. As previously discussed, the effects of uncompensated care are even worse during times of economic instability. The requirement for each of the hospitals to provide care regardless of means to pay has already been well established in

earlier chapters. Both nonprofit and Pubic hospitals are mandated to provide this community benefit, thus within the system of systems the community would be better served if they provided the care, leaving for-profits to invest and pursue more profitable procedures and in turn support the community thru investing in new medical technologies. It may seem callas or unsympathetic to the underserved populations, but in actuality, the payoff would be in the form of a more robust health care system, as each hospital serves a unique purpose based on their strengths.

For example, public hospitals receive their funding from government appropriations at the beginning of the fiscal year or in quarterly distributions. Hypothetically speaking, public hospitals do not have to provide care to receive their funding. This funding decision to care for some patients puts the hospitals in the unique situation of assuming a community's role of providing emergency and acute care to those under-insured or without insurance. Nonprofit and for-profit hospitals can relinquish the need within a community of providing emergency rooms (high risk to both nonprofits and for-profits) and expending assets providing care when there is a low expectation of being compensated. With public hospitals providing for those who are under or not-insured (nonprofits assisting with over-capacity), nonprofit hospitals can provide more charity care, and for-profit hospitals can pursue more profitable care. This decision space enables for-profits and nonprofits to a smaller degree, to continuously upgrade facilities and infrastructure with advancements in medical sciences that provide support to public hospitals.

Granted, with hospitals working in the hypothesized system of system does not solve the problem of rising uncompensated care cost, but it does transfer the risk to the hospitals most able to absorb the rising costs. Government's sole mission is providing for the welfare of its people, and especially the poorest. That role is the origins of the public hospital in the United States. Governments can absorb debt spending much more readily than any privately owned hospital, and therefore public hospitals are in a much better position to provide care to the poor. A mutual partnership pertains to the sharing of assets and capital investment with nonprofit and for-profit hospitals in the community with each

obtaining value for their role in network will provide for a robust, sustainable health care system of systems.

The last item to investigate pertains to the risk management capability that a system of systems can provide. From the discussion on risk management in Chapter 2, the key steps outlined by INCOSE for Risk Management are:

1. Identify the potential sources of risk and identify risk drivers;
2. Quantify risks, including both the probability of occurrence and seriousness of impact, and assess the impacts on cost (including life cycle costs), schedule, and performance;
3. Determine the sensitivity of these risks to project, product, and process assumptions, and the degree of correlation among the risks;
4. Determine and evaluate alternative approaches to mitigate moderate and high risks;
5. Ensure that risk is factored into decisions on selection of specification requirements and design and solution alternatives; and
6. Take actions to avoid, control, assume, or transfer each risk.

For the purpose of this discussion as it pertains to hospital system of systems, steps 1 and 6 are the most important. Risk is inherent in everything and the best one can hope for is to reduce the risk to acceptable levels. The first step is to identify potential risks which with respects to most hospitals come in the form of compensation for services rendered. A second risk is investing in innovative procedures, equipment, or processes. A third and final risk for this discussion is the inability to attract new investors. Each one of these risk pertains more to one or another of the public, nonprofit, and for-profit hospitals, than it does to the others. After identifying the risk according to the principles of risk management, decisions or processes are implemented in order to “avoid, control, assume, or transfer risks.

With respect to the first risk (uncompensated care), the solution in a system of systems is to transfer the risk to the public hospitals who are funded by patient revenues and tax-payers money through government appropriations. The government has the greater capacity to increase funding to public hospitals to compensate for an increase in

individuals unable to pay than are nonprofits and for-profit hospitals in issuing tax-deferred bonds or obtaining new investors respectively.

Nonprofit hospitals have a much lower propensity to invest in new procedures, processes, and equipment than do for-profit hospitals. This is due mainly to the apprehension caused by the risk of loss association with cost of innovation. Within a system of system architecture the risk of testing new procedures, processes, and equipment can be “assumed” by for-profit hospitals. For-profit hospitals have a much higher propensity to invest, especially if there is a reasonable expectation of earning a profit or increasing the value of their shares. The for-profit hospitals in a community will serve as test beds for the nonprofit and public hospitals on all new procedures, processes, and equipment. These hospitals will work to determine the requisite technical readiness for implementation and utilization.

For-profit hospitals have a fiduciary requirement to consider the needs of their shareholders in decision making and how they conduct business. A primary objective of a for-profit hospital is to earn a profit and increase the value of their shares or dividends, so that current investors will stay and new investors will be motivated. For-profits seek to increase the amount of shareholders they have in order to increase their revenue. The risk for for-profit hospitals is providing care that is unprofitable or assuming to large a sum of the uncompensated care, bad debt and charity care that indicate their quarterly expenses are greater than their revenue. There is a significant danger that for-profits will operate for too long in the “red” (or at a loss in revenue), that investors will see the company as to large a risk for the investors’ money. If the investors sell their shares, and the for-profit hospital is unable to reverse the trend and obtain new investors, there is a strong possibility the hospital would become financially insolvent and close their doors. The value obtained through the system of system network is that for-profits can avoid unprofitable procedures and assuming debt and transfer that risk to the public and nonprofit hospitals.

By implementing a system of system architecture within a community, all hospitals receive in return value that sustains them and allows for them to continue operating and providing care for the community. Assets can be shared, risk is transferred

to the organization that, due to their taxation status, can better assume the risk, and the strength associated in each of the public, nonprofit and for-profit hospitals is capitalized upon. Public hospitals continue provide the Good Samaritan role supported by public funding and augmented by nonprofits. In return, public hospitals can enlist the service of equipment, laboratories and expertise accumulated by the nonprofit and for-profit hospitals. Nonprofit hospitals and for-profit hospitals can operate with significant reduction in losses, facilitating a cost reduction as they would no longer have to offset the losses of unprofitable procedures by inflating the cost of profitable procedures.

V. VALIDATION OF THE SYSTEM OF SYSTEMS IN IMPROVING ACCESS TO HEALTH CARE

A. MOMENTUM IS CURRENTLY TOWARDS INTEGRATION

The validation for integration and an implementation of a system of systems organizational structure rests in the fact that physicians, administrations, and management corporations are already moving in that direction and seeing significant results. The following are some examples of how physicians and hospitals have chosen to integrate and create a system of system on smaller scales. Many of these attempts at integration are relatively new and sufficient data is currently unavailable for a robust analysis, but initial indications have shown to be very positive.

1. Accountability Care Organizations (ACO)

Accountability Care Organizations (ACO) came to fruition with the passage of the Affordable Care Act in an attempt to correct inefficiencies in payment systems. The idea behind the formation of ACO's was to incentivize health care organizations to keep their patients healthy by improving the quality of care. The incentive is that ACOs will receive higher Medicare payments by increasing the volume of Medicare patients they treat, and reduce costs through the coordination of care so as to limit duplicative efforts. (Kaiser Health News 2014).

According to The Center for Medicare and Medicaid Services, ACO are "groups of doctors, hospitals, and other health care providers who come together voluntarily to give coordinated high quality care to their Medicare patients" (Center for Medicare and Medicaid Services 2014). The purpose for creating ACO is an effort to bring together all the parts of a patients expected care, instead of obtaining care individually. Therefore, by integrating the multiple components of health care into a system of systems, ACOs intend on reducing duplication of services through increased communication for the purpose of reducing costs.

The health care organizations that choose to be a part of an ACO collectively care for a group of patients e.g., Medicare, for which they are accountable to the patient and

the third-party payer. The intent is to transform the current fee-for-service payments into a value-based-payment system in which the participants collectively are responsible for the total per capita costs.

According to American Hospital Association (2014) report in *Trendwatch*, where they state that "early efforts show the potential of ACOs and other care integration efforts." The report highlights the success of Advocate Health Care that saw a 26 percent reduction in readmission rates, while a Colorado based ACO experienced a reduction of inpatient stays by 8.6 percent. Kaiser Health News reported on their website that of all 32 pioneer ACOs in 2012, "all succeeded in improving quality care…and generated a gross savings of $87.6 million." The success ACOs documented and provided here show that when individual system combine into a systems-of-systems, they obtain greater value by shared resources and increase communication.

2. Joint Ventures

Businesses entering into joint ventures in the corporate world are common and lead to financial and market advantages for both businesses involved. The ascension of privately owned nonprofit and for-profit health care organization has had dramatic impacts in reducing costs, and increasing the quality of care. Why are more nonprofits seeking joint ventures with for-profits? According to Dixon Hughes Goodman Healthcare (2014) it is because for-profits offer:

- Financial expertise and access to capital; and
- Large health care organizations benefit from more favorable bond ratings and lower borrowing costs.

Hospitals are adopting some of the best practices from the corporate world and achieving realistic and positive results. According to article by LaVerne Woods et al., (2010,1) published in the *Willamette*:

> Joint ventures between tax-exempt health care organizations and for-profit parties provide a popular approach to achieve enhanced medical operations, and increased access to—and implementation of new medical technologies.

The majority of the joint ventures have occurred between physician and hospital in attempts to streamline care and reduce costs. When physicians enter into a joint venture with hospitals, the physician has immediate access to assets in the hospital and the hospital has physicians that are available to perform necessary procedures at a known cost. An example of a successful joint venture was affiliated with Regents Medical Center.

- According to Regents surgical health website a recent joint venture with Midland Surgical Center allowed Kishwaukee Hospital to double their case load and recruit additional surgeons.

Data for hospital joint ventures was difficult to obtain, but did acquire a synopsis by J.P Harrison on a quantitative study conducted concerning the impact of nonprofit hospitals engaging in joint venture with for-profit hospitals. The outcomes of the study in the words of the author of the synopsis were:

- Hospitals that operate joint ventures have a higher occupancy rate, a higher average length of stay, more clinical services, lower long-term debt, and a greater number of managed care contracts.

- The results also appear to indicate that joint ventures have a positive financial impact on U.S. hospitals.

3. The Integration of Hospitals Shows Promise

A synopsis of the most common benefits of integration seen by the research done by American Hospital Association (2014), as reported in the *Trendwatch*.

- Improved coordination across care continuum, and increased cost efficiencies.

- Greater access to capital for smaller or financially distressed hospitals and support of risk assumption and innovation.

- Larger organizations spread the fixed costs associated with running a health care system over a greater number of patients.

- Consolidation of administrative functions, including management, and human resources.

- Greater size allows health care organizations to purchase supplies and drugs at lower costs (economy of scale).

Integration of hospitals and other care organizations has led to significant advantages for everyone involved and has resulted in better, less expensive care for patients. Although, there is much that needs to be done to address all the issues plaguing our health care due to its complexity, the combining of systems in a good start that has resulted in success. The following statement is from the conclusion section of the American Hospital Association *Trendwatch* report that essentially sums up what system integration accomplishes for our hospitals and care providers:

> Hospitals are deploying a variety of clinical and financial integration strategies that increase coordination across the care continuum, improve care outcomes, reduce costs, enhance the availability of health care in underserved areas and improve the care experience for patients and their families. (2014, 10)

VI. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSIONS

The aim of the thesis was to show that hospitals needed to migrate away from operating as individual systems, only concerned with their internal operations and transition to a system of systems structure. Using System Engineering parlance, and methodology combined with Integration theory, the thesis was able to show that system of systems structures promoted greater stability and economic sustainability for hospitals.

The integration of the facilities and organization is the first step to creating a robust health care environment allowing greater access to capital and innovation that will sustain the existing infrastructure and allow room for growth. Bygone is the era focused on the ethicality of individuals and corporations profiting from health care in an attempt to undermine the true causes of the failing health care system. The notion of business systems working with other business systems in health care is a necessary agenda that must be examined to discern a workable arrangement in which hospitals can continue to operate and innovate to achieve the goal of increased quality care, while reducing costs.

The integration of hospitals and sharing of resources has been a growing trend over the past twenty years as administrators seek viable solutions to the most pressing problem of uncompensated care, bad debt and charity care. Hospitals are slowly migrating away from a system perspective to a system of system perspective through adopting business practices like the Accountability Care Organization and entering into joint ventures. More must be done.

The largest hurdle in the integration of hospitals is the myriad of laws and regulations that prevent public and nonprofit hospitals from fully working with for-profit hospitals. These laws and regulations were implemented to regulate the corporate world that operates very differently than hospitals. Lawmakers should take a closer look at the how hospitals truly function and understand the differences between hospitals and corporations in regard to tax status. The government may need to re-evaluate the laws concerning mergers with respect to hospitals and pass legislature that incentivizes the

types of actions that will enable many hospitals to continue to keep their doors open. The current trend show significant progress towards hospitals working collaboratively in a system of systems structure: expect the trend to continue. If the nation's hospitals are proactive and continually seek improvement, then a robust and sustainable health care system can be implemented, benefiting all those who desire quality care; which is all of us.

Based on the information gathered and the trends in health care, it is quite possible that a by-product of this integration will reveal that public hospitals will no longer be able to compete against integrated health facilities in providing quality care, or at cost without substantial infusion of tax revenue. As pressure grows for these facilities to remain on-par with integrated hospitals, laws would have to be altered allowing for the integration of public hospitals with for-profit organization. Overtime, this pressure will prove to be the crumbling of government's involvement in providing health care, relegating it back to its constitutional mandate of regulating

B. RECOMMENDATIONS FOR FURTHER STUDY

The passing of the Affordable Care Act (ACA) has left many uncertainties when it comes to the integration of hospitals and how they will operate under the new guidelines. There is speculation that under this act, many of the nonprofit hospitals will lose their tax exemption status (Whelan 2014; Cohen 2013). The passing of the act has given opponents to hospitals continuing to receive a nonprofit tax-exemption for charity care and community benefit to the poor more reason to advocate for its revocation. The influx of new laws and regulations gives an uncertain future on how hospitals will continue to operate in a rapidly changing health care environment.

A positive that may arise is the rapid decrease in hospitals absorption of uncompensated care, bad and charity debt since, in theory, every individual will now be covered in some form or another with insurance. On the other hand, there is also the expectation of an increase in government subsidized program enrollment, e.g., Medicare and Medicaid that will continue to provide partial payments to hospitals. With a significant influx of insured individuals, what will be the effects on hospitals that have

not invested in adequate Information technology systems, and incorporated Electronic Health Records?

The effects of the Afforded Care Act on hospital integration and the movements towards system of systems structure are not know and may not be known for many years to come as policies and changes are being incrementally added. In many cases the financial effects on hospitals may take many years for enough data to be obtained to see what the immediate effects of the law were.

Questions for further study:

1. What will be the effect of the ACA on the Accountability Care Organizations and Joint-Ventures between nonprofit and for-profit?
2. Will the rate of growth of uncompensated care be reduced or decline with the implementation of ACA laws and regulations?
3. Will nonprofit hospitals continue to be the preponderance of the community hospitals with the passage of the ACA, or will many of them convert to for-profit status?
4. What effects will mandatory insurance and insurance negotiated pricing of medical care have on for-profits' ability to obtain new investors?

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