1-1-2020

HOW DO MARKET AND ORGANIZATIONAL FACTORS AFFECT QUALITY OF CARE: MAMMOGRAPHY FOLLOW-UP RATE

Jessica Marie Escareno

HOW DO MARKET AND ORGANIZATIONAL FACTORS AFFECT QUALITY OF CARE: MAMMOGRAPHY FOLLOW-UP RATE

by

Jessica Marie Escareno

A Dissertation

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

Major: Health Systems Policy and Management

The University of Memphis

August 2020

Acknowledgments

First off, I would not be able to complete this dissertation without the praise and love I received from God.

I would like to thank the University of Memphis who gave me a home to develop my research for three years. Also, to my committee who answered every question and email with a smile. My committee supported every initiative I took and never once showed me anything but support.

To my parents, not only did they do everything possible to get me to where I am, they showed me what true love is. They never once took my dreams as something small and encouraged every venture I took. Dad, you pushed me during every step, and I would not be here without your "can do, will do" attitude. You told me an education was my key to everything, but you also showed me that a positive spirit gives you the strength to do anything. Mom, I would not have made it without your comforting voice through every struggle. You always encouraged me to try my best but prepare for the unexpected. You showed me that success is not won but earned. I dedicate this dissertation to you both.

Kathy, my dear sister, you were my motivation through each chapter of this dissertation. My motivation to succeed in life. My motivation to provide us with a stable life. Kathy, I dedicate this dissertation to you.

Christian, my fiancé, your constant support and 9-hour drives during these past 4 years have enabled me to complete my dream. I dedicate this dissertation to you.

To my grandparents who were veterans, ranchers, and homemakers, thank you. I am your wildest dream come true and you deserve all of this and more. I dedicate this dissertation to you.

Finally, to all the first-generation college students, I dedicate this dissertation to you. Let this be proof that it is possible.

Abstract

A mammogram follow-up rate investigates the rate of initial mammograms that require a follow-up visit to confirm breast cancer. The ideal mammogram follow-up rate for an organization is 10%. Rates below mean organizations are underperforming the scan and missing possible cancer cases; above means that hospitals are overdoing mammograms.

Previous research examined the problem in a micro-level approach focusing on patient and provider level factors. Open systems theory views the problem from a macro-level approach showing the components and how they interact with each other and their environments.

The objectives of this study include reviewing how open systems theory can be used to understand the components affecting hospitals' mammography follow-up rates, and examining market and organizational factors are associated with hospitals or counties meeting the recommendation, and understand how the guarantor in open systems theory changed the system between 2010 and 2016.

We merged three datasets: Centers for Medicare & Medicaid Services, Area Health Resource File, and the Healthcare Cost and Utilization Project. We performed multinomial logistic regressions to analyze what market and organizational factors affect the follow-up rate. We conducted t-tests and sign tests to provide a profile of hospitals that changed recommended meeting status between 2010 and 2016.

Our results showed that open systems theory is underutilized and has the capability to be included in future research on public health problems. Our findings showed that counties were less likely to meet the recommendation if they had more deaths per 100,000 population, more radiologists per 100,000 population, a higher percentage of screening hospitals, and higher

percent of African Americans. Organization level factors that affected quality of care included hospital ownership and region where hospitals that were private/not-for-profit, government funded, or in the Western region were more likely to meet the recommendation compared to hospitals that were for-profit or in the Northeast. The guarantor results showed no significant findings between 2010 and 2016 for organizational and market level factors.

Future research should focus on open systems and viewing the problem in a macro-level approach in market and organization level factors in relation to their effect on quality of care.

Table of Contents

List of Tables

Chapter 1. Introduction

Mammography follow-up rate: Market and Organizational factors affecting quality of care

In the United States, roughly 3.5 million women are currently treated or finished treatment for breast cancer in the United States as of January 2020. Breast cancer is the most commonly diagnosed cancer in the United States besides skin cancer and affected an estimated one in eight women ("American Cancer Society", 2020). Mammograms are the leading tool in the early detection of breast cancer, and although effective, it is not without faults, missing 13% of positive cancer cases (Nelson et al., 2009; Performance Measures, 2016). Mammograms recall or follow-up visit is when additional testing is required for false positive mammograms to test the presence of breast cancer (Brodersen & Siersma, 2013; Schwartz et al., 2000). The mammography follow-up rate is the percentage of initial diagnostic mammograms that require a follow-up visit for additional testing. Quality of care associated with mammogram follow-up rates has been researched in patient populations and according to radiologist characteristics and systemic factors. Although market and organization level factors are shown to significantly influence quality of care, none has been investigated regarding mammography follow-up rates.

Scope and composition of dissertation

This dissertation has been organized as sections from 1 to 5. Section 1 begins with the general introduction of the topic which drives the direction of the papers. Figure 1 displays the conceptual framework for the dissertation.

Section 2 contains a systematic literature review that investigates how open systems theory has been implemented in previous literature and conceptualizes how this can be implemented to review quality of care, especially mammography follow-up rates. Objectives included to

investigate previous literature on open systems theory in a variety of fields and elaborate on the potential open systems theory has to explain mammography follow-up rates. We conducted a search to identify articles where open systems theory has been used in fields to understand how it can apply to a healthcare setting, specifically. The search was completed in accordance with the Preferred Reporting Items for Systematic Reviews and comprised the components of open systems theory included input process, output, feedback, and the field and purpose of each article. In total, 11 studies met the inclusion criteria. Of the selected articles, only two fields were relevant: healthcare and education. Education studies ranged from improving continuing education programs to improving stress in a school. Health care studies focused on improving outcomes, management, productivity, and accreditation. Open systems theory has the ability to be utilized in both practice and research. In practice, healthcare facilities can utilize open systems theory to review processes and bring light to innovative solutions. Researchers can examine public health issues in greater detail using open systems theory. This theory has the ability to effectively review a systems-based approach to mammography follow-up rates.

Section 3 comprises a research paper discussing if market level factors can affect mammography follow-up rates. This paper had two specific objectives: To investigate how input, or market level factors, in Singerian inquiring organizations affect quality of care regarding mammography follow-up rates and to review the guarantor or feedback component of Singerian inquiring organizations between 2010 and 2016 on the change in healthcare quality using mammography follow-up rates as the quality indicator. The study sample included data from the Area Health Resource File and the Centers for Medicare & Medicaid Services data from the years 2010 and 2016. The mammography follow-up rate score was categorized as below, meeting, or above the recommendation of 10%. The independent variables included per capita

income, percent African American population, percent of screening hospitals, total hospitals per 100,000 population, total deaths per 100,000 population, number of uninsured per 100,000 population, and number of radiologists per 100,000 population. To compare the hospitals' profiles for 2010 and 2016, regarding the Singerian inquiring organization's replication, we performed a sign test to see the difference in variables between 2010 and 2016 within two subsets of hospitals moving from meeting in 2010 to not meeting in 2016 (MN) and vice versa (NM). The results show that in 2010 variables that were found to be significantly associated with mammography follow-uprates included total deaths, radiologists, and screening hospitals. When comparing the hospitals below the recommendation, counties with a larger number of deaths, radiologists, and screening hospitals were less likely to meet the recommendation. When comparing hospitals above the recommendation, those with a larger percentage of screening hospitals were more likely to meet the recommendation. In 2016, variables that were significantly associated with mammography follow-up rates included percent of African American population, radiologists, total hospitals, and screening hospitals. When comparing counties below the recommendation, counties with a larger number of African American or Black population and more percentage of screening hospitals were less likely to meet the recommendation while those with a larger number of total hospitals were more likely to meet the recommendation. When comparing counties above the recommendation, counties with a larger number of radiologists and percentage of screening hospitals were more likely to meet the recommendation. When reviewing the replication, all but per capita income decreased in 2016 from 2010 for both groups. All variables but screening hospitals in the NM group were significant with a p value <0.0001. Although significant, there should have been a different direction between the variables between both groups. Future research is recommended to

continue reviewing and investigating even more characteristics associated with follow-up rates and underlying factors that affect the mammography follow-up rate of a county and hospital which could be other market or organization level variables that we were not able to analyze.

Section 4 comprises a research paper discussing whether organizational level factors can affect mammography follow-up rates. This paper had two specific objectives: to investigate how processes, or organizational level factors, in Singerian inquiring organizations affect quality of care regarding mammography follow-up rates and to review the guarantor or feedback component of Singerian inquiring organizations between 2010 and 2016 on the change in healthcare quality using mammography follow-up rates as a quality indicator. The study sample consisted of data from the Healthcare Cost and Utilization Project (HCUP) and the Centers for Medicare & Medicaid Services (CMS) data from the years 2010 and 2016. The dependent variable of mammograph follow-up rates was categorized as below, meeting, or above the 10% recommended rate. The independent variables include control/ownership, size, teaching status, location, number of registered nurses (RNs) per inpatient days, and region. To review the guarantor of replication, we compared the hospital profiles from 2010 and 2016 by performing t-tests to see the difference in variables between 2010 and 2016. In 2010, none of the variables were found to be significantly associated with mammography follow-up rates. In 2016, variables that were significantly associated included hospital control and region. When comparing hospitals below the recommendation, hospitals that are private/not-for-profit were more likely to meet the recommendation compared to private/investor-owned hospitals, while hospitals located in the Northeast were less likely to meet the recommendation compared to hospitals located in the West. When comparing hospitals above the recommendation, hospitals that are government or nonfederal were more likely to meet the recommendation compared to private/investor-owned

hospitals. When investigating the feedback loop of the Singerian inquiring organizations, no variables were found to be significantly different or associated in the hospital changing from meeting to not meeting or vice versa between 2010 and 2016. Future research should continue to explore environmental or organizational factors in a macro-level approach including the guarantor factors as they affect all aspects of healthcare quality, especially mammography follow-up rates.

Section 5 provides the future directions for research and policy along with concluding remarks. References and appendices follow towards the end of the dissertation.

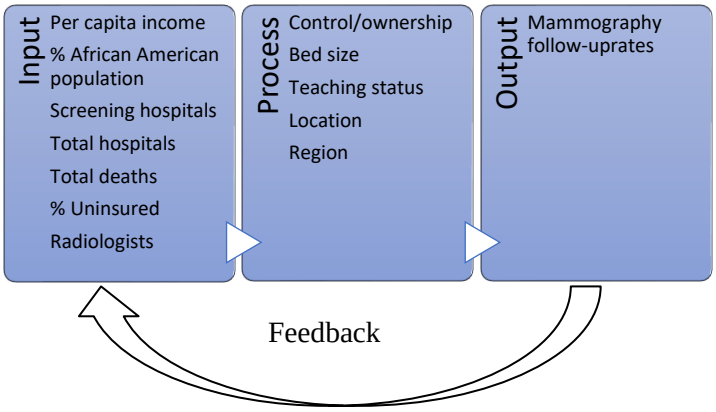

Figure 1. Mammography Follow-Up Conceptual Framework based on the Open Systems Theory

Chapter 2. The Applicability of Open Systems Theory: A PRISMA-Compliant Systematic Review

Background

Breast cancer accounts for the second greatest number of deaths among women and it is the second most common newly diagnosed cancer. An estimated 42,170 women will die of breast cancer in 2019 ("American Cancer Statistics", 2020). The United States Preventive Services Task Force (USPSTF) recommends biennial screening mammography for women aged 50 to 74 years (USPSTF, 2019). Mammography is the most common screening tool used in the United States to detect breast cancer (Jones et al., 2005). Increased use of screenings has decreased the breast cancer mortality rate in the United States by 15% in women 39 to 49 (Stout et al., 2006; Ries et al., 2006; Tabar et al., 2001; Tabar et al., 2011; Rafferty et al., 2014; Nelson et al., 2009). Breast cancer mortality has decreased in women over 50 by 1.3% per year from 2013 to 2017 ("American Cancer Statistics", 2020").

Although mammography is an effective tool to detect cancer, it is not without limitations. Mammography screening is 87% sensitive, meaning it correctly identifies around 87% of women who have breast cancer and misses 13% of positive cancer cases (Nelson et al., 2009; Performance Measures, 2016). In addition, there is an increased risk of false-positive results, where a radiologist marks a mammogram as positive when there is no cancer present. False positive tests require additional screening, such as another mammogram, which can negatively affect women's future screening participation (Brodersen, 2013; Castells et al., 2006).

A mammogram follow-up is required when a radiologist determines an examination to be positive or inconclusive and additional imaging is recommended before a final breast cancer diagnosis (Rothschild et al., 2013; Nelson et al., 2009; Yankaskas et al., 2001). False positive results lead to additional, unnecessary follow-up mammography testing to confirm the absence

of breast cancer which will more likely end up as negative than positive (Brodersen & Siersma, 2013; Schwartz et al., 2000; Brodersen et al., 2004). An estimated 70% of women have received a mammogram in the past two years where they have an estimated a 10% chance of receiving a false positive mammogram (Dabbous et al., 2017). A woman has a probability of 50-60% to obtain a false positive after ten yearly mammograms (Hubbard et al., 2011; "Independent UK," 2012). Annual screening beginning at 40 will result in 60 opportunities for a false positive result by the time they reach 70 years of age (Elmore et al., 1998).

Follow-up rates are used as a performance measure for the healthcare facility's quality of care standards (Yankaskas et al., 2011). To manage mammography, follow-up issues, the American College of Radiology and the Agency for Healthcare Research and Quality (AHRQ) have both recommended a target follow-up rate of 10% (Rothschild et al., 2013). Although market level factors and organizational factors have been shown to affect quality of care, these factors have not been investigated regarding mammogram follow-up rates. Most research on mammography measured population, radiologist, and systemic factors affecting mammography follow-up care. Patient population predictors shown to be significantly associated with a follow-up mammogram include age, breast density, hormone replacement therapy, the interval of mammograms, family history, and history of benign biopsy results (Kerlikowske et al., 1993; Fracheboud et al., 1998; Kollias et al., 1998). Radiologist characteristics that are significantly associated with increased follow-up rates include gender, fellowship training, years of work experience, and affiliation with an academic medical center (Rothschild et al., 2013). Systematic characteristics that predict mammography rates include reading volume, batch reading, double versus single reading, and computer-aided reading (Rothschild et al., 2013).

The purpose of this study is to investigate the previous literature regarding open systems theory and how to apply it to hospital-level mammography follow-up rates. The previous literature on open systems theory and mammography follow-up rates is outdated, and needs to be investigated in other areas, as the problem is timely and affects many individuals. The results of this study could provide policymakers with evidence-based information regarding what organizational and market level factors lead to a high follow-up mammogram rate, which may indicate poorer quality of care. Although previous literature has shown external factors such as market level variables and internal factors such as organizational variables influence the quality of care and delivery of healthcare services, none has been previously investigated regarding mammography follow-up rates in healthcare facilities.

An operational theory such as open systems theory can facilitate measurement of the associations among factors that affect mammogram follow-up rates. In the 1930s, biologist Von Bertalanffy developed General Systems Theory, which posited that living organizations are exchanging matter with their environments like systems acting to reach equilibrium. As organisms live within their organizations, they are both interplaying and influencing each other and their environment. Viewing the system in single parts does not provide the full picture of the phenomenon. General systems theory can view the phenomenon from a macro-level approach (Kast & Rosenzweig, 1972). Systems thinking has been an invaluable resource to explain how factors affect a system in fields such as the social sciences, biology, psychology, and recent health problems (Cordon, 2013). Systems thinking has been used to tackle and identify pathways in health system challenges as well as healthcare research including tobacco control, obesity, and tuberculosis (Mutale et al., 2014). For example, in evaluating a healthcare organization, the improvement of quality of services is the result of the improvement through mentoring, training,

and supervision of healthcare workers which leads to good clinical care and services (Mutale et al., 2014).

Open systems theory has been used as the backbone theory for many concepts in organizational theory and management. Von Bertalanffy's (1972) definition of an open system is a system that exchanges information or energy with their environments. An open system consists of various inputs, processes, and outputs (Kast et al., 1972). Input is defined as the energy or material that will be transformed by the system. The processes or throughput is used by the system to convert the input into a product. The output is the product or service from the system's processing of the input's materials (Gillies, 1982). Health systems are open systems because they are influenced by their local and national environments along with their international and global environments (Markle et al., 2007). Viewing organizations as a system enables us to understand how humans interact with each other, their environment, and within their systems (Zakus & Bhattacharyya, 2007). Systems theory has been used to examine healthcare entities that would want to explore innovation, change, or delivery (Anaf et al., 2007; Checkland et al., 1990). This literature review investigates open systems theory to conceptualize how this can be implemented in a healthcare setting to investigate mammography follow-uprates.

Objectives

(1) Investigate previous literature on open systems theory in a variety of fields.

(2) Elaborate on the potential open systems theory has to explain mammography follow-up.

Methods

We conducted a search to identify studies of open systems theory in fields to understand how it can be applied to a healthcare setting in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement criteria (PRISMA).

Inclusion/Exclusion Criteria

Studies applying open systems theory in different fields and applications were considered for this review. Eligibility criteria included articles published in English with no publication date considered.

Search Strategy

Studies were identified using PubMed, Web of Science, Psycinfo, Cochrane, and Google Scholar. The studies were scanned according to eligibility criteria. References were then examined to gather more studies. We conducted a general literature review to determine relevant search terms. The last search was run on May 6, 2019. We used the following search terms to search all databases: Open Systems Theory, Application, Organization, Perspective, Healthcare, Health, Business, Education, Management, and Nursing. The retrieved records were screened by using the title and abstract and whether it met the eligibility criteria on applying open systems theory to understand a problem. The full text publication was always screened to identify the appropriateness of the articles. The data extraction from articles was collected by the primary author of this systematic review.

Extracted Information

Information we extracted from each paper included the components of open systems theory including input, process, output, feedback loop, and the field and purpose of the article to which open systems theory was applied. Field is defined as the focus or topic of the study. Input is defined as the required resources such as mechanical, material, financial, and human. Purpose is defined as what the article was targeting to accomplish in their research endeavor. Process is defined as the interactions of the resources with the individual and populations in need of services to maintain or improve their health status (Chuang & Inder, 2009). Output is defined as the system's improvements to outcomes. The feedback loop is defined as the adaption of the system due to its new conditions (Mele et al., 2010).

Results

Our findings indicate that although open systems theory has been established since the 1930s, articles applying this theory to our topic were scarce.

Study selection

The search provided a total of 1,541 citations. After adjusting for duplications 1,541 remained, and of these, 1,489 studies were discarded after determining that the abstracts did not meet the criteria. The full text of the remaining 52 citations were examined and 38 did not meet the inclusion criteria. In total 11 studies met the inclusion criteria and were included in the systematic review (Figure 2). No unpublished relevant studies were obtained. We focused on a qualitative synthesis for the studies due to their vastly different study designs, participants, interventions, and outcomes rather than conducting a meta-analysis.

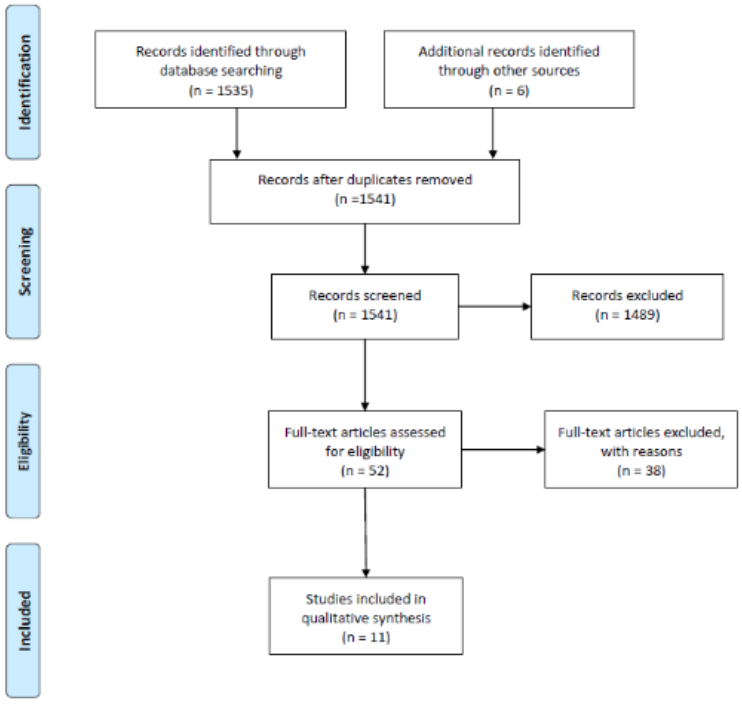

Figure 2. A flow diagram of the search process

Field

Of the selected articles that met eligibility criteria, most focused on education and health care (Table 1). Of the 11 studies, six studies were related to education and eight were health care based. In relation to education, the topics in the articles ranged from improving continuing education programs to improving stress related to academic tests. The topics in the field of health care were centered around accreditation and improving outcomes, management, and productivity.

Table 1- Study information of articles that used Open Systems Theory

Article (author, year)	Purpose	Field	Input	Process	Output	Feedback
Kessel et al., 1971	Create a vital working environment	Education	Physical facilities, financial resources, institutions regulations	Educational process	Administrative operations	Larger society
Biney, 2015	Improve adult education organizations	Education	Expand existing faculty	Review programs and courses	Attraction of more students	Readjust-ment of the program
Cohen et al., 2005	Update curriculum	Education	Patient, surgical supplies, anesthetics	Anesthesia and surgery	Stable patient	Review session
Curry et al., 2015	Improving outcomes for patients AMI and the link between hospital organization-al culture and performance	Healthcare	Organizational leadership	Promoting positive shifts in organi-zational culture	Improvement of patients with AMI	
Nguyen et al., 2019	Examine factors affecting physician system integrations	Healthcare	Health reform, market structure, competition, market demographics, regulations, technology	Hospitals physicians and payers	Physician system integration of a system in a healthcare facility	
Broskowski, 1973	Evaluate a teacher centered consultation	Education	Money, personnel, materials, pupils, community values and goals	Governing rules, normative systems, differed	Graduates along with ideas, values, attitudes, and skills	Graduates and reports from parents

Table 1- (Continued)

Article (author, year)	Purpose	Field	Input	Process	Output	Feedback
Messer et al., 1991	Review the success of the professional psychology program	Education	Applicants to program, admission process, accepted students	Didactic training, experimental training and socialization processes	Initial career path, graduation, and post-graduation career paths	Career paths of graduates
Chuang & Inder., 2009	Understand a healthcare systems relationship between interactions of subsystems	Healthcare	People, equipment, materials, procedures, and the working system environment	Process of transforming the inputs	Accreditation and measurement or reporting systems	Link from the output of the quality measure-ment to the accredita-tion system in the input
Meyer & O'Brien-Pallas, 2010	Understand nurses in a macro-level approach in large scale organizations	Healthcare	Patients, staff, material, resources, and information	Work performed by the nurses	Clinical, human, and organizational outcomes	Organiza-tional performance indicators

Theme

Although our search themes were not limited, in the initial search only two themes were identified in the studies: education and health care. Education was found to use open systems theory to facilitate change or improvement in educational programs or working environment. Educational programs were found to be the center of change. Studies strived to improve educational organizations and curriculum. Other studies investigated leadership of either university faculty or teachers and how stress affects the working environment and programs.

Health care studies were centered on organizational factors facilitating improvement of the healthcare system. The studies focused on how leadership and workforce can affect the organization and performance in productivity, performance, and outcomes. Systems theory in health care incorporates patients as input, quality as process, and output as their improvements to outcomes (Chuang & Inder, 2009).

Input

Input is defined as the energy or material that will be transformed by the system (Kast, 1972). According to the studies, input was viewed as either physical or social infrastructure where the entity will source the necessary materials. The physical structures included physical facilities or institutions, financial resources, materials or workforce, students or patients, information, time, and procedures.

Physical structures were also identified as system building blocks where the system will gather their resources, which is why most of the identified inputs are resources to drive the system to process. Kessel and Mink discuss how the system or university is surrounded by constraints in which the system must operate like physical facilities where the change will occur

(Alderfer & Brown, 1973; Kessel & Mink, 1971). Financial resources were also identified as input where money would be the driving force along with other resources (Gilson, 2012; Kessel & Mink, 1971, Broskowski,1973; Hayanjneh, 2007). Other building blocks that are needed to drive the system to process are materials and workforce which are intended to give the system it's momentum (Broskwoski,1973; Cohen et al., 2005; Gilson, 2012; Hayajneh,2007; Meyer & O'Brien-Pallas, 2010; Chaung & Inder,2009; Nguyen et al., 2019, Curry et al., 2015, Biney, 2015). Materials were identified as resources that are necessary to complete the task or purpose of the system. Workforce included personnel needed to complete the task such as patients, students, faculty, healthcare workers, including nurses and physicians, and leadership positions in the institution (Broskwoski, 1973; Cohen et al., 2005; Gilson, 2012; Hayajneh,2007; Meyer & O'Brien-Pallas, 2010; Chaung & Inder, 2009; Nguyen et al., 2019; Curry et al., 2015; Biney, 2015). In other studies, input was viewed and described as the students or patients entering the system and information from the healthcare facility needed drive the facility forward towards process (Griffith, 2004; Messer et al., 1991; Broskwoski,1973; Meyer & O'Brien-Pallas, 2010; Cohen et al., 2015; Hayajneh,2007; Gilson, 2012). Time and procedures necessary to complete the system were also viewed as input (Hayajnejh,2007; Gilson, 2012, Chaung & Inder, 2009).

Hayajneh (2007) discussed open systems theory in the view of a hospital as a system within various systems including healthcare entities, insurers, individual practitioners, hospitals, and other entities. Input was viewed as resources need to take the raw materials to complete the task (Hayajneh, 2007). Curry and colleagues (2015) aimed to use open systems theory to improve outcomes for acute myocardial infarctions. It was hypothesized that a productive exchange in the system between the environment and system would promote an improved system performance. Although Curry and colleagues' (2015) work is theoretical, qualitative and

quantitative data was collected to generate variables. Input was viewed as the materials or workforce to improve health outcomes in patients with myocardial infarction including promoting positive shifts in organizational culture which has been shown to significantly increase health outcomes (Curry et al., 2015). Cohen and colleagues (2005) used open systems theory to define and outline a system-based practice for anesthesiology. The American Association of Medical Schools approached the problem through discussions with small groups where input was identified as the materials or workforce required to complete the task such as students, patients, surgical equipment, procedures, medical records, or communication. Open systems theory was used to identify core competencies and the team integrated a systems-based approach to better understand the topic (Cohen et al., 2005). Chaung and Inder (2009) utilized open systems theory to construct a healthcare system hierarchy with interactive systems linked with control and communication. Input was viewed as materials or workforce needed to analyze healthcare systems to optimize quality of care through accreditation processes including surveyors survey methods or procedures and survey standards. Biney (2016) explored the utilization of open systems theory in adult education organizations. Although it is classified as library research, input was categorized as expanding the existing faculty of the adult education program (Biney, 2016). Meyer and O'Brien-Pallas (2010) discussed using open systems theory with nursing services delivery theory for analyzing large-scale organizations in a discussion paper where input was viewed as staff, care recipients, supplies, funding, and labor market conditions which will be used to drive the system towards the outcome. Broskowski (1973) applied process consultation and open systems theory to create a model for consultation and evaluation of a junior high school faculty. Applying open systems theory, Browksowki viewed input as physical factors such as money, personnel, materials, and pupils, along with community

values and goals. Kessel and Mink (1971) sought to explore how the outside environment can affect a university and what change can come from it. Although strictly informational, Kessel and Mink (1971) investigated input as the physical facilities or institutions along with financial resources and regulations. Nguyen and colleagues (2019) sought to identify from interviews with healthcare executives which organizational factors were effective in physician-system integration. Input was viewed as the materials or workforce including practice type, physician culture, organization mission, compensation and incentives, strategies, information technology, hospital type, patient payer mix, hospital size, and organizational leadership (Nguyen et al., 2019).

Of the 11 articles, only two were analytical in nature which were Griffith (2004) and Messer et al., (1992). Griffith (2004) proposed that schools' achievement is based on their responses to organizational stress. Following open systems theory, input was defined as internal processes such as student population and school characteristics gathered from parent, student, and principal surveys. When analyzed, schools or organizations under stress were schools having a large minority, socioeconomically disadvantaged, and non-English speaking student populations which were found to underperform on standardized tests and require more learning. When separated into clusters, high stress schools had lower levels of student achievement indicated by lower math CRT scores (660.31 vs 692.63, $p<0.008$) and reading scores (667.20 vs 684.20, $p<0.042$) compared to a low stress school. Messer and colleagues (1992) developed a model for each department and school of psychology to conduct a self-study to clarify its goals, values, and emphasis using the open systems theory. Input was defined as program applicants, screened by admissions, and accepted students. Regarding admissions, the results were significant for the criteria for judging candidates for admission ($p<0.01$) with an overall

disapproval for adding criteria to the evaluation model ($p<0.01$). A criterion or adjustment to the evaluation model is the commitment to underserved populations and commitment to public service ($p<0.01$).

Process

Process is defined as the transformation of energy necessary to meet the task requirements and optimize output within the system (Meyer and O'Brien-Pallas, 2010). According to the included studies, process was based on the overall goal of the study. For the studies that were educational, process was viewed as the educational process of learning encompassing reviewing programs, staff training, establishing rules, adaptation to stress, and promotion of programs (Kessel & Mink, 1971;Alderfer & Brown, 1973; Curry et al., 2005; Biney, 2015; Messer et al., 1991; Broskowki, 1973; Griffith, 2004). On the same note, process has also been viewed as the process of transforming the input to output (Chaung & Inder 2009). Although theoretical, Curry (2015) investigated the relationship between organizational culture and performance and viewed process as promoting positive shifts in the system which can accelerate learning and improvement of overall outcomes of care. Biney (2016), in a library research article, viewed process as reviewing programs and courses offered to improve the adult education program. In reviewing the consultation program among faculty in a junior high school, process was viewed as governing rules and roles or functions of the organization (Browskoski, 1973). When investigating how the environment affects institutions of higher learning, Kessel and Mink (1971) distinguished process as the educational process of learning when reviewing university leadership.

Examining the two analytical papers mentioned previously, Griffith defined process as the school's adaptation to stress or threats to the organizational process. Types of stress or threats

can include reduced funding, competition for resources, and numerous student populations. In the study, schools with less consensus among parents and more principal changes resulted in more stress and more internal disruption. School internal process information was gathered from a survey completed by parents, students, and principals. For school order, students responded to five items that asked how school order and discipline were maintained with responses ranging from 'strongly disagree' to 'strongly agree'. With learning supports, students responded to seven items discussing teachers' help with students' daily tasks ranging from 'strongly disagree' to 'strongly agree'. Teacher-student relationships were investigated by whether teachers treat the student fairly and listen to the student, with responses ranging from 'strongly disagree' to 'strongly agree'. Comparing Cluster 1 and Cluster 3 schools, Cluster 1 or high stress schools had the lowest z scores on internal processes including school order (2.80 vs. 2.92, $p < 0.041$), learning supports (3.44 vs. 3.50, $p < 0.038$), and teacher-student relationships (3.32 vs. 3.40, $p < 0.013$). Messer and colleagues (1992) defined process as the training and socialization process of the psychology program. Results suggested that respondents agreed with the current written comprehensive exam, core faculty did not want student input into the exam, and there was no strong consensus for specialization between core faculty and students ($p<0.01$).

Based on the other theme of health care, studies identified their process factors as workforce, supplies, payers, and working environment (Meyer & O'Brien-Pallas, 2010; Nguyen et al., 2019; Cohen et al., 2005; Hayaneh,2007; Gilson, 2012). Hayajneh (2007) discussed process in a hospital involving procedures, departments, units, and teams that will aid in creating the output of the system. Although theoretical, the process was viewed as productivity of the hospital to gear the system to output (Hayajneh, 2007). Cohen and colleagues (2005) integrated open systems theory theoretically to identify and implement a systems-based approach to curriculum

development regarding core competencies in the anesthesiology department. When reviewing the operating room, process was viewed as anesthesia and surgery including operating room staff, surgeons, preoperative staff, and radiology tests. Meyer and O'Brien-Pallas (2010) utilized open systems theory in nursing services delivery theory where process was discussed as the work nurses complete in a macro-level approach in a large-scale healthcare organization. Nguyen and colleagues (2019) investigated factors that would be successful for physician system integration, and found process involved hospital physicians and payers.

Output

Output is the final product that is exported to the external environment (Meyer and O'Brien-Pallas, 2010). Our studies defined output as a learning endeavor or improved outcomes of their program in their specified setting. Certain studies found improved outcomes in programs including quality of care, quality of life, financial risk protections, and student achievement. In studies with the theme of education, output was the outcome of their initial purpose such as attraction of more students, increased learning, increased graduates, and graduates' career paths. Other studies found output as the creation, integration, or accreditation of a new program.

Hayajneh discussed output as increased quality of life, health, and productivity of the healthcare facility. Although theoretical, Hayanjeh viewed output as the results of the processes of the organization such as goods or services (Hayajneh, 2007). Curry et al (2015) viewed output of the system as the learning outcomes and improvement of patient outcomes. Although methodological, Curry viewed output as the improved outcome of myocardial infarctions (i.e. lower mortality rates) in organizational structures and cultures (Curry et al., 2015). Cohen and colleagues (2005) viewed the output of the system as a stable patient after a surgery. Meyer and O'Brien-Pallas (2010) used a discussion article to combine nursing services delivery theory and

open systems to increase quality of care where output included clinical, human resource, and organizational outcomes. Clinical outcomes included clinical status, functional status, valuation, and safety. Human resource outcomes included health, safety, and profession outcomes of the system. Organizational outcomes included quality, efficiency, and resource utilization of the system.

In educational studies, output was viewed as the purpose of the investigation such as attraction of more students, improved learning outcomes, increased graduates, higher student achievement, and graduates career paths who stayed in the field (Biney, 2015; Alderfer & Brown, 1973; Browskowski, 1973; Griffith,2004; Messer et al., 1991). Other studies found output as the creation, integration, or accreditation of a new program (Nguyen et al., 2019; Chaung & Inder, 2009; Kessel & Mink, 1971). In their review of adult education programs, Biney (2016) viewed output as the attraction of more students into their education programs. Biney (2016) used open systems theory in a theoretical sense to display its usefulness in improving adults' programs in different and developing countries. In reviewing a teacher-centered consultation program, mainly theoretical and not applied, Browksoki (1973) views outputs as increased graduates, along with increased ideas, values, attitudes, and skills among students and teachers. Kessel & Mink (1971) identified the significance of how the environment affects an institution and viewed the environment as their output when developing a management information system. The overall output of the investigation in Nguyen and colleagues (2019), was the successful physician system integration in a healthcare facility.

Looking again at the two analytical studies by Griffith (2004) and Messer et al. (1992). Griffith (2004) discovered that schools having a larger minority, that were more socioeconomically disadvantaged, and had more non-English speaking students increased the

school's internal disruption reported among students, parents, and principals. When analyzing psychology programs, output was designated as post graduate career paths, graduation, and initial career path or specialization. Messer and colleagues (1992) also analyzed output as the initial career path, graduation, and post career paths of the psychology students when creating a self-evaluation concept model where the faculty adopted 85% of the written or revised recommendations of the program.

Feedback

Feedback is used as the system function to correct the device or adjust the energy of the system (Meyer and O'Brien-Pallas, 2010). Of the studies selected, feedback was viewed as a readjustment or link to the input. Feedback was viewed as a readjustment of the system using feedback evaluations, review sessions, criticism, and performance indicators (Biney,2015; Alderfer & Brown,1973; Cohen et al., 2005; Griffith,2004; Meyer & O'Brien-Pallas,2010). Feedback was also identified as factors that would adjust the system including career paths, graduates, outside environment, workers, customers, data, and quality measurement (Messer et al., 1991; Browksowki, 1973; Kessel & Mink,1971; Hayanjeh, 2007; Gilson, 2012; Chaung & Inder, 2009).

Hayajneh viewed feedback as the workers and customers. The workers as the ones performing the tasks while the customers use the systems. Although theoretical, feedback was viewed as those who perform or utilize the system (Hayajneh, 2007). Cohen and colleagues (2005) designated feedback as a review session with the team to effectively review the systems-based approach to the anesthesiology curriculum and program. Biney (2016) viewed feedback as the readjustment to the program necessary to improve the program. Meyer and O'Brien-Pallas (2010) discussed feedback as organizational performance indicators that allow adjustment to the

system. Broskowki (1973) viewed feedback as reports from parents when evaluating a teacher-centered consultation program. When reviewing university leadership in view of open systems theory, Kessel and Mink (1971) discussed feedback as push from the environment that will change or adjust the system. Messer and colleagues (1991) implemented feedback as the career paths of graduates which will correct or redirect the design of the psychology program.

Discussion

In this article we discovered that open systems theory provides a potentially useful conceptual framework for examining health care issues. Open systems theory has the applicability to assist in a variety of topics to facilitate the growth of the system, especially in health care. Our review demonstrates that this theory is underutilized and should be integrated into our understanding of healthcare quality to fully understand its scope. Our analysis resulted in a comprehensive review of 11 articles discussing how to use open systems theory to fully understand the components of systems to create a comprehensive view of the system. Two main findings were found that merit further discussion.

First, of the articles reviewed, we only identified two themes: education and health care. This is an interesting finding considering that open systems theory has the capacity to be used in various fields. Education researchers used open systems theory to fully understand the components that may affect the organization and how to improve the system. Most of the education articles focused on improving the school or program's effectiveness. The heath care articles utilized open systems theory to investigate what components are necessary to improve health care outcomes. Although education and health care themes are different, their purpose is similar, understanding that the components of the system can affect the goal.

Second, of the articles analyzed, input was viewed as physical structures by 10 of the 11 articles. Although different, education and health care had similar views on input which was viewed as physical structures including institutions, funding, and other resources necessary and whether the system will gather their energy.

Our findings are novel and have not been reviewed before. Further research should examine how open systems theory can be used in various themes and additional areas of research.

Limitations

Several limitations were present in the study including the search strategy, where it may not have captured the full scope of articles. Only three databases were used during the search which limited relevant journals although the selected databases were broadly representative of the health care field. The databases chosen could have influenced the coverage of articles that were selected. The terminology may have also been too narrow and, as a result, did not capture all relevant literature. Another limitation was that only published articles were included which may have limited the findings. A significant limitation is due to the lack of relevant research available to create a full picture of the application of open systems theory to healthcare quality.

Conclusion

In conclusion, although this is the first systematic review aimed at investigating how open systems theory can be used in fields to evaluate healthcare organizations, many important aspects came to light. Open systems theory can be utilized in practice and research. Healthcare facilities can use open systems theory to further understand their systematic processes and bring

light to innovative solutions. Researchers can also use open systems theory to examine public health issues plaguing society.

Exploring the potential for open systems theory was the purpose of this paper. This theory has been underutilized in healthcare quality research for two main reasons, we believe. One, healthcare quality research is mainly focused on patient level initiatives or research discussing factors that contribute to an organization's output and not on the macro-level aspect of factors including market and organization levels. Two, healthcare quality research has fundamental theories such as the Donabedian model where researchers tend to focus their research. Open systems theory has the ability to improve our knowledge of healthcare quality by accessing all aspects of the problem that influence the overall outcome of the system. This theory breaks down the issue into components, then reviews how these components interact with the environment and within the system. This breakdown is essential to review all aspects affecting healthcare quality initiatives and research. Open-systems theory has the potential to show which input (market level) and process (organization level) variables impact the quality of breast cancer screening using mammography follow-up rates.

Chapter 3. How do Market level factors affect Mammogram Follow-Up Rates?

Introduction

For women in the United States, breast cancer is the most common non-cutaneous cause of cancer deaths. In 2020, about 42,170 of women are expected to die from breast cancer. Currently, there are more than 3.5 million women in the US who are undergoing breast cancer treatment or have finished treatment ("American Cancer Statistics", 2020).

Mammography is the leading screening tool used to detect breast cancer in the United states which aims to reduce morality and improve quality of life (Jones et al., 2005; Gur et al., 2004; Tabar et al., 1989; Humphrey et al., 2002). Breast cancer deaths have remained steady for women under 50 but declined in women over 50, where the death rate decreased by 1.3% per year from 2013 to 2017. The decrease in deaths from breast cancer is attributed to earlier detection through screenings and treatment advances ("American Cancer Statistics", 2020). Widely disseminated in the United States, an estimated 70% of women reported receiving a mammogram within the past two years (Breen et al., 2001; Stout et al., 2006; "National Center for Health Statistics", 2017).

Although mammograms have reduced mortality by early detection of breast cancer, it is not a perfect tool. Mammography is 87% sensitive which means that it misses about 13% of positive cancer cases and also contributes to false positive results (Nelson et al., 2009; Performance Measures, 2016). Mammogram recall rates range from seven to 12 percent and, after 10 yearly screenings, the false positive rate is 50-60% (Nelson et al., 2009; Hubbard et al., 2011; "Independent UK Panel"., 2012; Nelson et al., 2016). Mammograms have a tradeoff where some women will experience a decreased likelihood of mortality and others undergo

unnecessary and additional screening at an additional cost (Brodersen, 2013; Castells et al., 2006). Additional testing required for false positive mammograms to test the presence of breast cancer is measured through the mammogram follow-up rate (Brodersen & Siersma, 2013; Schwartz et al., 2000).

The Centers for Medicare & Medicaid Services (CMS) tracks follow-up rates as a performance measure for healthcare facilities that perform mammograms. This is measured as a second diagnostic mammogram or ultrasound of the breast within 45 days of the initial screening. Mammogram follow-up rates allow CMS to investigate false positive rates occurring at the initial screening (Yankaskas et al., 2001; "ACR Radiology Coding Source," 2009).

Guidelines are established to use evidence-based medicine recommendations for better system management (Bierema, 2003). The National Cancer Institute Breast Cancer Surveillance Consortium determined that the national recall rate for facilities that conduct mammograms should be 10% based on Rosenberg et al., 2006 and Schell et al., 2007. According to the number of additional workups per additional cancer detected, the ideal target recall rates were concluded to be 10% for the first and 6.7% for all subsequent mammograms (Schell et al., 2007). Facilities with a rate closer to 0% may be missing cancer cases and those with greater than 14% may be recalling too many patients, which increases unnecessary costs ("Hospital Outpatient Quality Reporting Program," 2013).

To understand the full innerworkings of the factors that play into mammogram follow-up rates, a systematic approach is necessary. A general systems approach investigates the whole picture of the issue. Bertalanffy developed General Systems Theory to explain the phenomenon of organizations exchanging matter with their environments to reach equilibrium (Kast & Rosenzweig, 1972; Boulding, 1956). A system without proper working parts will not function

effectively (Kast & Rosenzweig, 1972; Bierema, 2003). Bertalanffy defined open systems as possessing the environment and organization where the system exchanges information with the environment consisting of inputs, processes, and outputs (Kast et al., 1972). The output of the system is the final product or service of the input's materials. The process or throughput is the converter of the input's materials to the final product or output. Input is the initial energy or material to be transformed within the system (Gillies, 1982). To view organizations as a system enables us to understand how humans interact with each other, their environment, and within their systems. Healthcare organizations have several systems that are interrelated with people, processes, structures, and the environment. To facilitate change, organizations must enable systems thinking (Cordon, 2013).

Learning organizations are inquiring systems that act as a result of knowledge (Croasdell et al., 1998; Courtney et al., 1998). The system gathers evidence, models it based on the system, then presents the valid knowledge throughout the organization (Croasdell et al., 1998; Hall et al., 2001; Courtney et al., 1998). Inquiring systems are comprised of inputs, process, and outputs along with a guarantor or feedback (Courtney et al., 1998). The output is designated as a valid or true knowledge from the system (Courtney et al., 1998). The guarantor or feedback component is used to ensure the results of true knowledge (Courtney et al., 1998; Hall et al., 2001). Internal and external factors are included in the feedback process including existing knowledge (Hall et al., 2001). Open systems theory makes changes to environmental input by looking beyond the boundaries of information (Hall et al., 2003). Churchman's inquiring systems and open systems theory both shape their environments by how the organization uses its environment for success (Hall et al., 2003). In short, Churchman's inquiring systems are based on learning organizations (Courtney., 2001).

Churchman (1971) models inquiring systems on the knowledge of influential western philosophers including Leibniz, Locke, Kant, Hegel, and Singer (Courtney et al., 1998; Hall et al., 2003; Churchman, 1971; Courtney, 2001; Courtney et al., 2000; Hall et al., 2001; Hall et al., 2001; Courtney et al., 1998). Each philosopher separately discusses their own approaches to gathering evidence, but all together, facilitate knowledge creation (Hall et al., 2003; Courtney et al., 1998; Mason & Mitroff, 1973).

The philosophers are separated into old and new thinking. Leibnzian and Lockean inquiring systems are classified as old thinking. The "Analysist" Leibnizian inquiring systems use logic and analysis to generate facts and operate in a closed system (Courtney., 2001; Ulrich, 1985; Courtney et al., 1998; Hall et al., 2003). The "Realist" Lockean inquiring systems gather external observations that are both experimental and consensual to generate empirical information (Courtney et al., 1998; Courtney., 2001; Hall et al., 2003). Kantian and Hegelian inquiring systems are classified as complex thinking. The "Idealist" Kantian inquiring system is comprised of different perspectives to solve a problem and is an extension of Leibnizian (Courtney et al., 1998; Courtney., 2001; Hall et al., 2003). The "Synthesist" Hegelian inquiring system uses two opposing viewpoints to effectively create knowledge through their debate of the problem (Hall et al., 2003; Hall et al., 2001; Courtney., 2001). Singerian is viewed as new thinking. The "Pragmatist" Singer has the capability of choosing systems to create knowledge which drives the community towards continued improvement by producing valid measurements through establishing procedures. The Singerian model is ideal to use for investigating market level factors affecting mammography follow-up rates to create new knowledge to facilitate system change (Courtney et al., 1998; Croasdell et al., 1998; Courtney et al., 1998; Courtney., 2001).

Input

Market level factors have been used in previous studies to investigate health care utilization and behaviors. Healthcare facilities can influence the mammogram follow-up rate in pursuit of quality improvement. Previous studies have indicated that market level factors influence the quality of care and delivery of healthcare services. Regarding open systems theory, market level factors would encompass input, as they are the setting or materials for the process to transform to the outcome. Although open systems theory has not been utilized to study market-level factors in an open systems approach, these factors have shown to be significant in influencing outcomes in health care ("American Cancer Society", 2020).

Market level factors play an important role in human health in addressing health-related physical, social, and economics factors. Market level factors encompass resources available to a specific location. The geographic location of the patient can influence the quality of care that the patient receives. According to Baicker et al. (2005), geographic disparities affect health care and quality of care for patients. The main differences in variation are attributable to historical practice patterns, supply of specialists, hospital capacity, and lack of technology with patient characteristics and preferences. Market level factors that were found to be associated with quality of care included uninsured population, staffing ratios or proportion of staff, metropolitan region, demographic composition, competition, and county regions (Landon et al., 2001; Reschovsky et al., 2001; Succi et al., 1997 ;Benjamins et al., 2004; Coughlin et al., 2008; Propper et al., 2004; Banaszak-Holl et al., 1996; Pfeiffer & Salancik, 2003). For example, in women under 45, breast cancer is more common in African American women than white women. Overall, African American women are more likely to die of breast cancer.

Previous literature has examined mammography follow-up rates regarding patients, radiologists, and systemic factors. Predictors for patients include age, breast density, hormone replacement therapy, the interval of mammograms, family history, and history of benign biopsy results (Kerlikowske et al., 1993; Fracheboud et al., 1998; Kollias et al., 1998). Predictors for radiologists include gender, fellowship training, years of work experience, and affiliation with an academic medical center (Rothschild et al., 2013). Systemic predictors included reading volume, batch reading, double versus single reading, and computer-aided reading (Rothschild et al., 2013).

Open systems theory has been utilized to investigate healthcare utilization and will broaden the current understanding of follow-up rates. In our study, we will use the Singerian approach to identify input variables that affect mammography follow-up rates. Human and environmental considerations in Singerian inquiries provide the most comprehensive view of the problem. The Singerian approach views the problem through a holistic view where everything is connected through multiple perspectives to validate the information (Hall et al., 2003; Courtney., 2001). With a Singerian approach, the guarantor or feedback is replication to establish the validity of measures (Croasdell et al., 1998). Market-level factors are significantly associated with quality of care and delivery of healthcare services. Although they have not been studied regarding mammography follow-up rates, previous literature has justified an investigation into the association.

Purpose

The purpose of this study is to investigate what market-level factors have contributed to facilities with a high follow-up rate, which indicates overuse of services, compared to a low follow-up rate, which suggests the facility may be missing cancer cases. The research aim of this

study includes investigating and comparing the market-level factors such as region, location, competition, and county level characteristics in hospitals with high and low recall rates where all were found to be significant in affecting quality of care. Variables that significantly affect quality of care can also affect mammography follow-up rates. Factors in previous studies that were significantly associated with decreasing the quality of care included per capita income, larger African American population, less competition, higher mortality rate, and larger uninsured rate (Parchman & Culler, 1994; Snowden et al., 2012; Propper et al., 2004; McWilliams, 2009).

Methods

The study sample consisted of all non-federal hospitals with outpatient facilities in the contiguous United States. We excluded Alaska, Hawaii, and all U.S. territories due to their limited county information. For this study, the hospitals were split into three groups categorized as above, below, and meeting the recommendation of 10% follow-up mammogram rates.

This study used data from the Area Health Resource File (AHRF) and the Centers for Medicare & Medicaid Services (CMS) data from the years 2010 and 2016. Each dataset provides measures of various factors that, when merged, will provide a comprehensive view of the problem. The data was linked by zip codes. AHRF contains data on the nation's healthcare delivery system and factors that may contribute to the utilization of health care in the United States. The following variables from the AHRF were included in this model: competition, defined as total hospitals available in an area, total radiologists available, and percent of screening hospitals, per capita income, and population by race. The CMS Hospital Compare data consists of information from over 4,000 Medicare-certified hospitals and over 130 Veterans Administration Medical Centers on their quality of care. This dataset includes the mammography follow-up percent.

The dependent variable is mammography follow-up rate, categorized as below, meeting, and above the recommendation based on the research from Rosenberg et al., 2006 and Schell et al., 2007. Below the recommendation was 0 to 9.4%. Meeting the recommendation was 9.5% to 10.4%. Above the recommendation was categorized as 10.5% and above. The hospital's mammography follow-up scores for each county were averaged to match AHRF observations. The independent variables are measures of input.

The input variables we included were per capita income, percent African American population, percent of screening hospitals, total hospitals per 100,000 population, total deaths per 100,000 population, number of uninsured per 100,000 population, and number of radiologists per 100,000 population. Figure 1 displays how the variables follow the Singerian inquiring organization and Open Systems Theory Concept model. All the input variables are continuous. Per capita income is the income of the residents divided by the resident population of the area. Percent of African American population is the number of African Americans by county divided by the total population. Percent of screening hospitals was calculated by the number of screening facilities in the county divided by the total hospitals available. Total hospitals per 100,000 population was calculated by the total number of hospitals in the county divided by the total population in the county multiplied by 100,000. Total deaths per 100,000 population were calculated by the total number of deaths in the county divided by the total population in the county multiplied by 100,000. The uninsured per 100,000 population is calculated as the number of people without insurance in the county divided by the total population in the county multiplied by 100,000. The number of radiologists per 100,000 population was calculated by the number of radiologists available per county divided by the total population in the county multiplied by

100,000. We analyzed data using a multinomial logistic regression due to the dependent variable having multiple categories (Warner, 2017).

Singerian inquiring organizations and open systems theory uses replication as the feedback or guarantor of the system. The replication or feedback loop should show a favorable change in factors to drive the system toward improvement. To fulfill the theory, we added two years (2010 and 2016) to review how the market level factors were associated with hospitals changing their meeting or not meeting status of mammogram follow-up rates. Due to the small sample size, the statistical analysis performed was not able to show results when investigating the repeated measures between the subset of the outcome variables. Instead of running a repeated measures model of the 2010 and 2016 market-level factors, we provided a description of the profiles of hospitals. Since no counties stayed meeting the recommendation between 2010 and 2016, they were not included in this part of the analysis along with hospitals who stayed not meeting since that was not our main study interest. We kept the categories to hospitals that moved from meeting in 2010 to not meeting in 2016 (MN) and hospitals that did not meet in 2010 and met in 2016 (NM). To compare the profiles for 2010 and 2016, we performed a sign test to see the difference in variables between 2010 and 2016 within our two subsets MN and NM.

A p-value of less than 0.05 was used to determine a statistically significant association. SAS 9.4 was used to conduct the data analysis.

Results

In our 2010 model, only 351 counties met the recommended follow-up rate of 10% while 2,640 were below and 880 above the recommendation (see Table 2). The county level

characteristics included percent of African American population with a median of 5%, total deaths per 100,000 population with a median of 885, and percent of uninsured median of 14.53%. The competition medians for total hospitals per 100,000 population, percent of screening hospitals, and radiologists per 100,000 population were respectively 2.49,4.98, and 1.6.

Table 2-Market Level Characteristics 2010

Variable	Full Dataset	My Sample	Exclusions
Observations	**3231**	**3871**	**120**
Per capita income			
Median	$32,346.00	$35,506.00	$40,504.00
Lower Quartile	$28,713.00	$30,732.00	$34,592.00
Upper Quartile	$37,381.00	$41,664.00	$45,216.00
Std Dev	$7,810.47	$9,729.66	$9,173.97
Maximum	$111,386.00	$111,386.00	$61,270.00
% African American population			
Median	2.10%	5.00%	6.05%
Lower Quartile	0.50%	1.10%	1.50%
Upper Quartile	10.50%	14.10%	13.90%
Std Dev	14.52%	13.44%	13.40%
Maximum	85.70%	85.70%	80.00%
% Screening hospitals			
Median	4.98%	4.98%	3.10%
Lower Quartile	3.45%	3.45%	0.97%
Upper Quartile	7.54%	7.54%	3.15%
Std Dev	3.68%	3.68%	3.61%
Maximum	33.85%	33.85%	17.40%
Total hospitals per 100,000			
Median	2.88	2.49	0.00
Lower Quartile	0.98	1.43	0.00

Upper Quartile	6.16	4.96	1,054.85

Table 2- (Continued)

Variable	Full Dataset	My Sample	Exclusions
Std Dev	8.60	7.09	3,200.18
Maximum	90.29	90.29	21,879.02
Total deaths per 100,000			
Median	989.55	885.02	39,643.54
Lower Quartile	808.29	699.057	13,363.03
Upper Quartile	1166.91	1,077.34	133,701.66
Std Dev	286.54	258.92	1547,845.62
Maximum	2,712.16	2,115.03	8,841,698.84
% Uninsured			
Median	14.80%	14.53%	23.16%
Lower Quartile	11.68%	11.20%	19.45%
Upper Quartile	17.98%	17.85%	27.42%
Std Dev	4.68%	5.00%	7.26%
Maximum	39.70%	34.22%	39.71%
Number of radiologists per 100,000			
Median	0.00	1.60	0.00
Lower Quartile	0.00	0.00	0.00
Upper Quartile	1,016.26	3.54	0.00
Std Dev	1,3071.56	3.03	4,671.50
Maximum	337,172.77	48.30	34,749.03
Median score			
Below (0)	3,513 (72.99)	2640 (68.20)	83 (91.21)
Meeting (1)	364 (7.56)	351 (9.07)	
Above (2)	936 (19.45)	880 (22.73)	8 (8.79)

In our 2016 model, only 251 counties met the recommended follow-up rate with 1,978 counites below and 618 above the recommended follow-up rate of 10% (see Table 3). The

county level characteristics included percent of African American population with a median of 4.00%, total deaths per 100,000 population with a median of 982.62, and percent of uninsured median of 7.63%. The competition medians for total hospitals per 100,000 population, percent of screening hospitals, and radiologists per 100,000 population were 2.85, 5.10, and 0.00, respectively.

Table 3-Market Level Characteristics 2016

Variable	Full Dataset	Sample	Exclusions
Observations	**3278**	**2847**	**120**
Per capita income			
Median	$38,609.00	$41,425.00	$54,161.00
Lower Quartile	$33,927.00	$36,111.00	$44,880.00
Upper Quartiles	$45,025.00	$48,150.00	$61,337.00
Std Dev	$11,318.00	$11,836.00	$10,161.00
Maximum	$199,635.00	$199,635.00	$77,977.00
% African American population			
Median	2.43%	4.13%	0.93%
Lower Quartile	0.79%	1.10%	0.69%
Upper Quartiles	10.73%	12.68%	1.44%
Std Dev	14.48%	13.97%	2.22%
Maximum	85.83%	85.83%	9.98%
% Screening hospitals			
Median	5.25%	5.10%	1.87%
Lower Quartile	3.24%	3.30%	1.75%
Upper Quartiles	7.90%	8.40%	3.02%
Std Dev	4.02%	4.16%	1.25%
Maximum	30.20%	30.20%	7.50%
Total hospitals per 100,000			
Median	2.72	2.85	0.00

Table 3- (Continued)

Variable	Full Dataset	Sample	Exclusions
Lower Quartile	0.85	1.55	0.00
Upper Quartiles	6.07	5.98	2.42
Std Dev	8.91	8.78	6.21
Maximum	96.53	96.53	41.48
Total deaths per 100,000			
Median	1,026.57	982.62	624.61
Lower Quartile	852.82	800.90	464.33
Upper Quartiles	1,192.90	1,150.09	890.87
Std Dev	263.87	246.42	329.52
Maximum	2,247.70	2,247.70	1,375.32
% Uninsured			
Median	8.16%	7.63%	18.26%
Lower Quartile	5.62%	5.26%	13.06%
Upper Quartiles	10.99%	10.62%	20.08%
Std Dev	3.99%	3.91%	6.32%
Maximum	30.92%	28.00%	30.92%
Number of radiologists per 100,000			
Median	0.00	0.00	0.00
Lower Quartile	0.00	0.00	0.00
Upper Quartiles	0.89	3.19	0.00
Std Dev	2.62	3.09	1.84
Maximum	63.95	43.61	11.33
Median score			
Below (0)	3,644 (76.03%)	1,978 (69.48%)	93 (92.08)
Meeting (1)	388 (8.10%)	251 (8.82)	
Above (2)	761 (15.88%)	618 (21.70%)	8 (7.92)

Variables that were significant when comparing hospitals below the recommendation to meeting the recommendation in 2010 included total deaths, number of radiologists, and percent of screening hospitals (Table 4). For every additional death, the odds of meeting the recommendation were 0.99 times the odds of being below to meeting the recommendation (OR: 0.999; IC95%, 0.998-0.999; p =<.0001). For every additional radiologist, the odds of meeting the recommendation was 0.945 times the odds of being below to meeting the recommendation (OR: 0.945; IC95%, 0.903-0.989; p =0.0152). For every additional screening hospital, the odds of meeting the recommendation was 0.732 times the odds of being below to meeting the recommendation (OR: 0.732; IC95%, 0.702-0.764; p =<.0001). Counties with a larger number of deaths, more radiologists, and higher percentage of screening hospitals were less likely to meet the recommendation.

Table 4- Multinomial Logistic Regression of Relationship between Market Level Factors and Mammogram Follow-up Rates 2010: Adjusted Odds Ratios and 95% Confidence Intervals (a)

	Below					Above				
Predictor n=3871	**Wald's X^2 (df=1)**	**Chi-Sq**	**Odds Ratio**	**CI Lower**	**CI Upper**	**Wald's X^2 (df=1)**	**Chi-Sq**	**Odds Ratio**	**CI Lower**	**CI Upper**
Per capita income	21.193	<.001	1.000	1.000	1.000	2.094	0.148	1.000	1.000	1.000
% African American Population	0.887	0.346	1.005	0.995	1.016	2.578	0.108	1.010	0.998	1.021
% Screening hospitals * **	209.572	<.0001	0.732	0.702	0.764	98.599	<.0001	1.231	1.182	1.283
Total hospitals per 100,000	3.677	0.055	1.032	0.999	1.065	2.294	0.130	1.028	0.992	1.065
% Uninsured	0.171	0.679	0.563	0.037	8.592	10.967	0.001	161.679	7.971	>999.999
Number of radiologists per 100,000 *	5.892	0.015	0.945	0.903	0.989	1.9412	0.164	1.037	0.985	1.091

(a) *P<0.05; **P<0.01; ***P<0.001

Comparing hospitals above the recommended guidelines to meeting the recommendation in 2010, variables that were significantly associated included total deaths and percent of screening hospitals (Table 4). For every additional death, the odds of meeting the recommendation is 0.999 times the odds of being above to meeting the recommendation (OR: 0.999; IC95%, 0.998-0.999; p =<.0001). For every additional screening hospital, the odds of meeting the recommendation is 1.231 times the odds of being above to meeting the recommendation (OR: 1.231; IC95%, 1.182-1.283; p =<.0001). Counties with more total deaths were less likely to meet the recommendation while those with a larger percent of screening hospitals were more likely to meet the recommendation.

In 2016, variables below the recommendation that were significantly associated with meeting the recommendation included percent of African American population, total hospitals, and percent of screening hospitals (Table 5). For every one percent increase in the African American or Black population, the odds of meeting the recommendation is 0.211 times the odds of being below to meeting the recommendation (OR: 0.211; IC95%, 0.068-0.659; p =0.0074). For every additional hospital, the odds of meeting the recommendation is 1.059 times the odds of being below to meeting the recommendation (OR: 1.059; IC95%, 1.014-1.106; p =0.0099). For every additional screening hospital, the odds of meeting the recommendation is 0.737 times the odds of being below to meeting the recommendation (OR: 0.737; IC95%, 0.703-0.773; p =<.0001). Counties with a larger number of African American or Black population and higher percent of screening hospitals were less likely to meet the recommendation while those with a larger number of total hospitals were more likely to meet the recommendation.

While also in 2016, factors associated with meeting the recommendation among hospitals above the recommendation were percent of screening hospitals and radiologists (Table 5). For

additional radiologists, the odds of meeting the recommendation is 1.069 times the odds of being above to meeting the recommendation (OR: 1.069; IC95%, 1.008-1.133; p =0.0257). For every additional screening hospital, the odds of meeting the recommendation is 1.256 times the odds of being below to meeting the recommendation (OR: 1.256; IC95%, 1.198-1.318; p =<.0001). Counties with a larger number of radiologists and percentage of screening hospitals were more likely to meet the recommendation.

In Tables 6 and 7, we reviewed the feedback loop of the system by viewing the system from two groups of meeting and not meeting the recommendations. The number of counties that moved from meeting to not meeting (MN) was 264 and not meeting to meeting (NM) was 265 counties. Variables that decreased in 2016 from 2010 both groups (MN and NM) included all but per capita income, where per capita income in 2016 was more than 2010 in the counties. All variables but percentage of screening hospitals in the NM group were significant with a p value <0.0001.

Table 5- Multinomial Logistic Regression of Relationship between Market Level Factors and Mammogram Follow-up Rates 2016: Adjusted Odds Ratios and 95% Confidence Intervals (a)

	Below					Above				
Predictor n=2847	**Wald's X^2 (df=1)**	**Chi-Sq**	**Odds Ratio**	**CI Lower**	**CI Upper**	**Wald's X^2 (df=1)**	**Chi-Sq**	**Odds Ratio**	**CI Lower**	**CI Upper**
Per capita income	21.305	<.0001	1.000	1.000	1.000	5.657	0.017	1.000	1.000	1.000
% African American population ****	7.176	0.007	0.211	0.068	0.659	1.296	0.255	0.467	0.126	1.732
% Screening hospitals*****	158.973	<.0001	0.737	0.703	0.773	87.500	<.0001	1.256	1.198	1.318
Total hospitals per 100,000 ****	6.644	0.010	1.059	1.014	1.106	2.511	0.113	1.039	0.991	1.089
Total deaths per 100,000	1.034	0.310	1.000	0.999	1.000	2.578	0.108	0.999	0.999	1.000
% Uninsured	0.346	0.556	3.768	0.045	312.693	8.288	0.004	>999.999	10.279	>999.999
Number of radiologists per 100,000 *	0.624	0.43	0.979	0.930	1.031	4.979	0.026	1.069	1.008	1.133

(a) P<0.05; **P<0.01; ***P<0.001

Table 6: Market level factors hospitals who met in 2010 and then did not meet guidelines in 2016 (MN)

Variable	2010	2016	P-Value	Diff Median
Per capita income			<.0001	7.10E+03
Mean	$36,938.00	$44,103.00		
St Dev	$7,578	$9,799.00		
Median	$35,029.00	$41,839.00		
Minimum	$23,918.00	$27,773.00		
Maximum	$69,886.00	$920,268.00		
% African American population			<.0001	3.73E+00
Mean	8.79%	9.36%		
St Dev	11.08%	11.17%		
Median	3.80%	4.89%		
Minimum	0.10%	0.28%		
Maximum	57.10%	57.84%		
% Screening hospitals			<.0001	1.30E+00
Mean	6.80%	5.82%		
St Dev	3.12%	3.85%		
Median	6.33%	4.42%		
Minimum	1.44%	1.01%		
Maximum	20.60%	21.70%		
Total hospitals per 100,000			<.0001	3.04E+03
Mean	3.65	3.55		
St Dev	4.25	4.42		
Median	2.21	2.12		
Minimum	0.40	0.00		
Maximum	36.06	37.71		
Total deaths per 100,000			<.0001	1.15E+06
Mean	949.06	997.11		
St Dev	242.37	221.56		
Median	955.83	1012.00		
Minimum	475.24	519.29		
Maximum	1,695.00	1686.00		
% Uninsured			<.0001	1.81E+02
Mean	0.14	0.08		
St Dev	0.04	0.04		
Median	0.15	0.07		
Minimum	0.05	0.03		
Maximum	0.25	0.19		
Number of radiologists per 100,000			<.0001	3.054E+03
Mean	2.33	2.67		
St Dev	2.85	3.51		
Median	1.70	1.41		
Minimum	0.00	0.00		
Maximum	14.98	19.79		

Table 7: Market level factors hospitals who did not meet in 2010 and then met guidelines in 2016 (NM)

Variable	2010	2016	P-Value	Diff Median
Per capita income			<.0001	-811E1
Mean	$39,290.00	$48,533.00		
St Dev	$9,957.00	$13,822.00		
Median	$36,797.00	$45,839.00		
Minimum	$19,938.00	$25,246.00		
Maximum	$66,679.00	$84,101.00		
% African American population			<.0001	6.13E+00
Mean	10.62%	11.24%		
St Dev	13.07%	13.23%		
Median	6.20%	6.77%		
Minimum	0.10%	0.36%		
Maximum	54.10%	54.66%		
% Screening hospitals			0.9004	1.50E-01
Mean	6.44%	6.62%		
St Dev	3.30%	2.75%		
Median	5.90%	5.81%		
Minimum	0.40%	1.30%		
Maximum	24.00%	11.13%		
Total hospitals per 100,000			<.0001	3.10E+03
Mean	3.12	3.10		
St Dev	4.24	4.43		
Median	1.80	1.60		
Minimum	0.49	0.46		
Maximum	42.68	43.38		
Total deaths per 100,000			<.0001	1.63E+06
Mean	887.73	942.52		
St Dev	248.65	244.94		
Median	885.02	971.62		
Minimum	302.66	405.44		
Maximum	1639.00	1770.00		
% Uninsured			<.0001	2.00E+02
Mean	13.47%	7.29%		
St Dev	4.30%	3.17%		
Median	12.56%	6.46%		
Minimum	4.44%	2.18%		
Maximum	30.93%	20.59%		
Number of radiologists per 100,000			<.0001	4.13E+03
Mean	2.73	2.74		
St Dev	2.74	2.71		
Median	2.19	1.88		
Minimum	0.00	0.00		
Maximum	15.59	12.43		

Discussion

Market level factors have been used in previous studies to investigate healthcare delivery and quality of care because they play an important role in addressing health related factors. Market level factors encompass input, as they are the setting or materials for the process to transform to the outcome. Although Singerian inquiring organization Theory has not been utilized in studying market-level factors in an open systems approach, they have shown to be significant in influencing outcomes in health care.

Overall, our results were consistent with previous studies regarding the association with quality of care where competition, percent of African American population, and total deaths were found to affect mammogram follow-up rates. Competition has been shown to be significantly associated with quality of care and mammography follow-up rates specifically with percentage of screening hospitals. Competition is measured by identifying the services, who provides the services, the geographic market area, and selecting the measure of competition (Rivers & Glover, 2008). In previous literature, market competition factors were evaluated in nursing home facility healthcare delivery, where if the market is under favorable or in non-competitive environments, the organization will not feel a need to comply with the demands of the external variables (Banaszak-Holl et al., 1996). However, in a more competitive environment, or unfavorable condition, the organization will have no choice but to fall under the need to survive and share resources and allocate those across competitors (Pfeiffer & Salancik, 2003). In our study, we measured competition three ways: total hospitals available in an area, total radiologists available, and percentage of screening hospitals. In our study, all three ways of analyzing competition were found to be significantly associated with quality of care where more competition led lower quality as measured by the hospital and county not meeting the recommended mammogram follow-up rate. Demographic

composition has also been associated with quality of care and mammography follow-up rates. Previous literature has found significant associations between quality of care and African American/Hispanic populations where the greater the minority population, the lower the quality of care, which was shown to be significant in our study as well (Snowden et al., 2012).

We hypothesize that if the follow-up relationship is true, where the system should favorably change between 2010 and 2016, factors that play a role in meeting or not meeting the recommendation should have a different relationship in Tables 6 and 7. Although, the relationships between 2010 and 2016 are significant, a potentially different direction between the variables would be needed to signal significance in affecting the status of meeting the recommendation. Without ideal variable comparisons available for the market level factors, we cannot distinguish between which variables were significantly associated with meeting the recommendation of mammogram follow-up rates. Due to this, there seems to be other underlying factors that affect the mammography follow-up rate of a county and hospital which that we were not able to account for including system characteristics as batch readings of radiologists and environment characteristics as the age or breast cancer history of the women in the population.

The measurement of follow-up percentage for mammograms by the CMS hospital compare data is limited to up to 45 days after an initial mammogram. This limitation might have decreased the number of follow-up visits if the patient went in for their follow-up after 45 days. In addition, in the CMS hospital compare data, a limitation is that the patient may have received their follow-up mammogram at another institution where that was not indicated. Although CMS data limitations occurred, this is the only database that collects mammography follow-up rates in a national setting ("Timely & Effective care measures", n.d.). Another limitation includes keeping the states included in the study to the contiguous United States leaving out Puerto Rico, Virgin Islands, Hawaii, Guam,

and Alaska. This limits generalizability, but the areas left out of the study only accounted for 120 observations. A small sample size was a problem when attempting to model repeated measures, but we adjusted by analyzing the profiles of the hospitals. This is also a cross-sectional study where we studied the data at a specific point in time and therefore cannot determine causal relationships. Investigating market-level factors by merging datasets provides a broad and comprehensive view of the factors affecting mammography follow-up rates. Although limitations are present, a major strength of this study is that it provides a novel view of a problem to create further opportunities for future research.

Conclusion

Open systems theory and Singerian inquiring organizations have the ability to be implemented in more settings including health care quality which was shown to provide a different outlook on the factors affecting mammography follow-up rates.

Although novel, market level characteristics were shown to be significant in affecting mammography follow-up rates which necessitates change of focus of healthcare quality research to include market factors and their research. Competition in an area increases quality of care which was present in our study. An area wide competition initiative should be implemented nationwide to increase competition in time of hospital mergers that decrease competition.

Another aspect to review is that so few hospitals and counties changed recommended meeting status which means that they are not paying attention to the mammography follow-up guidelines. The guidelines are an important and significant factor in healthcare research. The fact that so few are paying attention or changing favorably could suggest an applied initiative is required to increase awareness of the guidelines either nationally with AHRQ or through a payer such as

CMS. Future research is recommended to continue reviewing and investigating even more characteristics associated with follow-up rates.

Chapter 4. How Organizational Factors Affect Quality of Care: Mammography Follow-Up Rates

Introduction

An estimated 3.5 million women in the United States (US) are living with a history of breast cancer including those currently being treated and finished with treatment as of January 2020. In the US, breast cancer is the most commonly diagnosed cancer besides skin cancer, with an estimated one in eight women developing breast cancer over their lifetime and an estimated of 42,170 of women expected to die from breast cancer in 2020. Death rates have remained steady in women under 50 since 2007 but have decreased by 1.3% in women over 50 from 2013 to 2017 per year. The overall decrease in mortality in women with breast cancer is the result of earlier detection through screening and advancements in treatment ("How Common is Breast Cancer", 2020).

Periodic screening aims to reduce mortality and improve quality of life through early detection of breast cancer (Gur et al., 2004; Tabar et al., 1999; Humphrey et al., 2002). Mammography was introduced in the 1980s as the foremost screening tool and nearly 70% of women in the US reported receiving a mammogram in the past two years in 2017 (Breen et al., 2001; Stout et al., 2006; "National Center for Health Statistics", 2017). Although mammograms are effective in early detection of breast cancer, it is a screening tool that is only 87% sensitive which means that it correctly identifies 87% of women but misses 13% of positive cancer cases (Nelson et al., 2009; Performance Measures, 2016).

A result of having a less than perfect testing tool is the increased rate of false positive results, where a radiologist states a mammogram is positive where no cancer is present (Elmore et al., 1998). A woman can have about 60 opportunities for a false positive result with annual screening beginning

at 40 by the time they reach 70 years of age (Elmore et al., 1998). The tradeoff of mammograms is that, although effective overall, some women will receive false positive tests and need additional and unnecessary testing which may affect future screening participation (Brodersen, 2013; Castells et al., 2006; Brodersen & Siersma, 2013; Schwartz et al., 2000).

The Centers for Medicare & Medicaid Services (CMS) investigate the possibility of false positive rates after initial screening by tracking the percent of mammograms followed with a diagnostic mammogram or ultrasound in a healthcare setting within 45 days after the initial screening ("ACR Radiology Coding Source," 2009). Based on two studies (Rosenberg et al., 2006 and Schell et al., 2007), the National Cancer Institute Breast Cancer Surveillance Consortium determined the ideal national recall rate to be 10%. The most effective or ideal target recall rates were concluded to be 10% for the first and 6.7% for subsequent mammograms based on the number of additional workups per additional cancer detected (AW/ACD) (Schell et al., 2007). If a healthcare facility has a recall rate of greater than 14%, then the facility may be recalling too many patients for a follow-up and conducting unnecessary scans. On the other hand, if the follow-up mammogram percentage is closer to 0%, then the facility may be missing cancer cases by not conducting additional and necessary scans ("Hospital Outpatient Quality Reporting Program," 2013).

After conducting a literature review, most research regarding mammography follow-uprates has determined that factors including patient population characteristics, radiologist characteristics, and systematic factors influence mammography follow-up rates. Positive patient population factors for mammogram follow-up rates included age, breast density, hormone replacement therapy, interval of mammograms, family history, and history of benign biopsy results (Kerlikowske et al., 1993; Fracheboud et al., 1998; Kollias et al., 1998). Radiologist characteristics associated with-follow-up rates included gender, fellowship training, years of work experience, and affiliation with an

academic medical center (Rothschild et al., 2013; Buist et al., 2011). Systematic characteristics known to affect mammogram follow-up rates include reading volume, batch reading, double versus single reading, and computer-aided reading (Rothschild et al., 2013; Taplin et al., 2008). Organizational factors are significantly associated with quality of care and delivery of healthcare services. Although they have not been studied regarding mammography follow-up rates, previous literature has justified an investigation on the association.

In order to adequately investigate the factors associated with mammography follow-up rates, we must examine the full picture of the healthcare system. A systems approach views the issue from a macro-level (Kast & Rosenzweig, 1972). Von Bertalanffy developed General Systems Theory in the 1930s discussing how systems would not function effectively without the various parts working properly (Bierema, 2003). Bertalanffy defined a system as open if that system exchanges information with the environment. The parts of an open system integrate inputs, processes, outputs, and a feedback loop (Kast et al., 1972). Input is defined as the energy or material that will be transformed by the system. The process or throughput is used by the system to convert the input into a product. The output is the product or service from the system's processing of the input's materials (Gillies, 1982). Health systems are open systems because they are influenced by their local and national environments along with their international and global environments (Markle et al., 2007). Systems theory has been used to examine innovation, change, and delivery of services in healthcare entities (Anaf et al., 2007; Checkland et al., 1990). Modern organizations aim to be capable of continuous learning, improving, and adapting in order to be successful in a competitive environment (Courtney et al., 1998; Hall et al., 2003). One of the main reasons for a company to fail is when the organization impedes learning or refuses to adapt (Croasdell et al., 1998). Organizations learn through relying on agents including individuals or groups able to transfer their knowledge into the

structure or memory of the organization (Croasdell et al., 1998). Organizations also need an effective learning foundation that is dynamic and accessible to multiple perspectives (Hall et al., 2003).

Organizational learning is the interpretation of the environmental variables that leads to the application of those variables to the organization's current and future or desired states where new action will be taken due to the knowledge created (Hall et al., 2001; Courtney et al., 1998). Characteristics of learning organizations must show continuous improvement to renew and include well-developed core competencies within the organization (Courtney et al., 1998). The behavior change that learning organizations facilitate leads to improved performance and value (Courtney et al., 1998).

A fundamental aspect of an inquiring organization is learning (Croasdell et al., 1998; Courtney et al., 1998). Inquiring organizations are systems that act on the result of the creation of knowledge (Croasdell et al., 1998; Courtney et al., 1998). An inquiring system or organization gathers evidence, models the evidence based on the system, and presents the results based on valid knowledge and makes it widely available throughout the organization (Croasdell et al., 1998; Hall et al., 2001; Courtney et al., 1998). Inquiring systems are composed of inputs, processes, and outputs along with a guarantor or feedback aspect (Courtney et al., 1998). The components are the same as open systems theory as an inquiring system is an open system. The guarantor or feedback is the aspect that differs. The guarantor is an aspect guaranteeing that knowledge is not false or a check and balance to ensure results are acceptable (Courtney et al., 1998; Hall et al., 2001). The feedback process scans internal and external environmental factors including existing knowledge to create new knowledge (Hall et al., 2001).

Inquiring organizations are based on learning organizations which are modelled after Churchman's inquiring systems (Courtney., 2001). Churchman (1971) views organizations as

inquiring systems or organizations that create knowledge by recasting the theories of knowledge of influential western philosophers including Leibniz, Locke, Kant, Hegel, and Singer (Courtney et al., 1998; Hall et al., 2003; Churchman, 1971; Courtney, 2001; Courtney et al., 2000; Hall et al., 2001). Churchman's models of inquiring systems provided the basis of supporting an effective learning organization to enhance the organization's ability to achieve success (Croasdell et al., 1998; Hall et al., 2003; Courtney et al., 1998). The inquiries, although separate, were discussed in an overall knowledge creation and management effort (Hall et al., 2003). Separately, each philosopher discusses the different approaches to gathering evidence to represent their views on the world (Hall et al., 2003; Courtney et al., 1998).

Churchman's inquiring systems and Open Systems Theory both discuss how the success of the organization is the product of its environment (Hall et al., 2003). The philosophers of old thinking include Leibnizian and Lockean. The "Analysist" Leibnizian inquiring systems operate in a closed system that uses logic and analysis to generate facts (Courtney., 2001; Ulrich, 1985; Courtney et al., 1998; Hall et al., 2003). The "Realist" Lockean inquiring systems use reasoning that are both experimental and consensual to gather external observations to form empirical information (Courtney et al., 1998; Courtney., 2001; Hall et al., 2003). The philosophers of complex thinking include Kant and Hegel. The "Idealist" Kantian inquiring system is an extension of Leibnizian with the addition of implementing different perspectives to solve a problem (Courtney et al., 1998; Courtney., 2001; Hall et al., 2003). The "Synthesist" Hegelian inquiring systems believe the best way to create knowledge is to view the debate of the problem between two opposing viewpoints (Hall et al., 2003; Hall et al., 2001; Courtney., 2001). The "Pragmatist" Singer is classified as new thinking and is an innovative and adaptive tool that implements multiple perspectives which is best for complex situations (Courtney., 2001; Courtney et al., 1998). A Singerian inquiry chooses

measures in a system to create and build knowledge which is useful as organizations use metrics as a performance measure and are always searching to modify models (Courtney et al., 1998). In our study, we will use the Singerian approach to identify process variables that affect mammography follow-up rates. As with every type of inquirer, the guarantor of a Singerian inquirer is replications which corroborates the validity of the established measures (Croasdell et al., 1998). Singerian organizations drive the community towards continuous improvement measures by establishing procedures to produce valid measurements (Croasdell et al., 1998; Courtney et al., 1998). This type of inquirer takes human and environmental factors into consideration to provide the most comprehensive view of the problem by incorporating multiple perspectives to validate information (Hall et al., 2003; Courtney., 2001). A Singerian inquirer views the social and managerial problems as a whole because it views the world as a holistic system where everything is connected (Courtney., 2001).

Healthcare systems incorporate input, process, and outputs where processes are the interactions of the resources with the individuals and populations in need of services to maintain or improve their health status (Chuang & Inder, 2009). Process variables may affect the quality of the initial mammogram, which will reflect the need for a follow-up mammogram. Factors that are attributable to lower quality of care include rural setting, decreased Registered Nursing (RN) staffing, larger bed size, and propriety ownership or control (Zinn & Mor, 1998; Shortell &LoGerfo, 1981; Landon et al., 2001; Kang et al., 2011; Mark, Harless and McCue, 2005; Spector & Takada, 1991; Riley & Lubitz, 1985; Kruzich et al., 1992;O'Neill et al., 2003; McFarland et al., 2017). Variables that improve quality of care include teaching status and operating in the Northeast region of the United States (Fleming, 1981; Gillies et al., 2006; Dimic et al., 2004; Allison et al., 2000).

Although open systems theory and Singerian inquiring organizations have not been used to evaluate healthcare organizational structures, previous studies have shown their involvement in transforming process factors to outcomes. The organizational setting has previously shown to be a significant influence on the quality of care (Landon et al., 2001). Organization and structural factors affect the delivery and quality of healthcare services across a variety of practice settings (Zinn & Mor, 1998). The purpose of this study is to investigate what organization level factors are associated with facilities with a high follow-up rate, which indicates overuse of services, compared to a low follow-up rate, which suggests the facility may be missing cancer cases. Open systems theory has been utilized to investigate healthcare utilization and will broaden the current understanding of follow-up rates. The major potential contribution that this study will make to existing literature is that this is the first attempt to examine what effect organization-level factors have on follow-up mammogram percentage. This study uses an operational theory of open systems theory and Singerian inquiring organizations with healthcare utilization variables, which adds to the growing body of literature on healthcare utilization at the organizational level. Figure 1 displays the concept model for our study adapting the Singerian inquiring organization and Open Systems Theory. The results of this study could provide policymakers with evidence-based information regarding what organizational factors lead to non-optimal follow-up mammogram rates.

Methods

The study sample consisted of all non-federal hospitals with outpatient facilities in the continental United States. This study used data from the Healthcare Cost and Utilization Project (HCUP) and the Centers for Medicare & Medicaid Services (CMS) data from the years 2010 and 2016 because each dataset provides a comprehensive review of a factor that, when merged, will provide a full view of the problem. The data was linked by zip codes. The HCUP database,

sponsored by the Agency for Healthcare Research and Quality, developed a national information resource on healthcare data, including cost and quality of health services, medical practice, access, and outcomes of the local market levels ("HCUP FACT SHEET", 2018). In 2016, the hospital was deidentified in HCUP. To adjust for this, we selected zip codes with only one hospital per zip code so that we may be able to correctly match the hospital with CMS data. The CMS Hospital Compare data consists of information from over 4,000 Medicare-certified hospitals and over 130 Veterans Administration Medical Centers on their quality of care. This data consists of measures that only apply to Medicare patients in hospital outpatient departments ("Timely & Effective care measures", n.d.). This dataset collects mammography follow-up percent.

The output will be mammography follow-up rate for healthcare facilities in the United States. Mammography follow-up rates have not been investigated in relation to open systems theory but meet the definition of an output. The process variables that will be investigated include control/ownership, size, teaching status, location, number of RN full-time-equivalents (FTEs) per inpatient days, and region. The feedback variable is the year before the 10% standard was established to see the difference in how the findings (output) affected organizational factors. Although the 10% mammography standard was established in 1994, two significant articles were published in 2006 and 2007 which established the effectiveness of the 1994 ruling. Due to limitations in data availability, the closest year available is 2010, which is the feedback year that will be evaluated, and 2016 which is the most recent data available at the time of analysis.

The dependent variable was coded from a continuous to a categorical variable. The outcome variable was coded as below, above, and meeting the recommendation for mammography follow-up rates. Below the recommendation was coded as 0 to 9.4%. This means that the healthcare institution has a higher chance of missing positive mammography cases. Meeting the recommendation category

was coded as a mammography follow-up rate from 9.5% to 10.4%. Above the recommendation was coded as => 10.5%, which means that organizations have a higher chance of overdoing follow-up mammograms.

HCUP categorized the independent variables which included bed size, control/ownership, location, region, and hospital registered nurse full time equivalents (RN FTEs). Hospital RN FTEs were reported as a continuous number per 1,000 adjusted inpatient days. Bed size was categorized as small, medium, or large. The actual bed size varied based on region and teaching status. Control/ownership was categorized as government/nonfederal, private/no-for-profit, and private/for-profit. Location was either rural or urban based on the Core Based Statistical Area codes. Teaching status was categorized as either nonteaching or teaching. Region was categorized as Northeast, Midwest, South, or West obtained from the AHA Annual Survey of Hospitals.

We excluded Puerto Rico, Hawaii, Alaska, Guam, and the Virgin Islands from our analysis. In order to merge HCUP and CMS, we needed to exclude zip codes that contained more than one hospital because hospitals were deidentified in HCUP in 2016. Limiting the zip codes allowed us to match the hospital in HCUP with the correct hospital in CMS data. We performed a multinomial logistic regression due to the dependent variable having multiple categories (Warner, 2017). To indicate levels of significance, a p-value of less than 0.05 was used to determine an association. SAS 9.4 was used to conduct the data analysis in this research design.

To fulfill the feedback loop or guarantor aspect of the Singerian Inquiring Organizations and Open Systems Theory, two years of data (2010 and 2016) were required to analyze the replication of the system. Due to the small sample size, when we did perform pairwise analysis between the years, no statistical analysis was able to be completed and we were not able to compare the association between of the subsets. Instead, we ran a description of the profiles of the hospitals that moved from

meeting to not meeting and vice versa. To compare the profiles for 2010 and 2016, we performed t-tests to see the difference in variables between 2010 and 2016. Since no hospitals stayed meeting the recommendation between 2010 and 2016, they were not included in the model along with hospitals who stayed not meeting since that was not our main question of interest. We kept the categories to hospitals that moved from meeting in 2010 to not meeting in 2016 (MN) and hospitals that did not meet in 2010 and met in 2016 (NM).

Results

Tables 8 and 9 show the descriptive analysis of the HCUP and CMS variables for 2010 and 2016, respectively. In 2010, the majority of hospitals were below the recommended follow-up rate (63.77%), 10% met the follow-up rate, and just over one-quarter were above the recommended follow-up rate (26.35%). The largest percentage of hospitals were classified as large bed size (37.89%), followed closely by small bed size (36.18), medium bed-size (25.93%). A majority of hospitals were private/not-for-profit (63.38%), with government/nonfederal and private/for-profit at 17.95% and 13.68%, respectively. Urban setting and nonteaching hospitals were the majority with 64.39% and 79.77%, respectively. Most of the hospitals evenly distributed among the regions including Northeast (24.79%), Midwest (23.65%), South (29.34%) and West (22.22%). Hospital RN FTEs was a continuous variable with a median of 3.3 adjusted days per 1,000.

Table 8- Organization Level Characteristics 2010

Variable	Full Dataset	My Sample	Exclusions
Observations	**1051**	**351**	**103**
Bed Size			
Small (1)	479 (46.06%)	127 (36.18%)	28 (27.18%)
Medium (2)	243 (23.37%)	91 (25.93%)	31 (30.10%)
Large (3)	318 (30.58%)	133 (37.89%)	44 (42.72%)

Table 8- (Continued)

Variable	Full Dataset	My Sample	Exclusions
Control/Ownership			
Govt, nonfederal (1)	221 (21.25%)	63 (17.95%)	21 (20.39%)
Private, not profit (2)	602 (57.88%)	240 (68.38%)	66 (64.08%)
Private, invest-own (3)	217 (20.87%)	48 (13.68%)	16 (15.53%)
Location			
Rural (0)	413 (39.71%)	125 (35.61%)	13 (12.62%)
Urban (1)	627 (60.29%)	226 (64.39%)	90 (87.38%)
Teaching Status			
Nonteaching (0)	857 (82.40%)	280 (79.77%)	59 (57.28%)
Teaching (1)	183 (17.60%)	71 (20.33%)	44 (42.72%)
Region			
Northeast (1)	131 (12.46%)	87 (24.79%)	29 (28.16%)
Midwest (2)	306 (29.12%)	83 (23.65%)	23 (22.33%)
South (3)	418 (39.77%)	103 (29.34%)	24 (23.30%)
West (4)	196 (18.65%)	78 (22.22%)	27 (26.21%)
Registered Nurse Full-time Equivalents			
Median	3.40	3.30	3.75
Lower Quartile	2.30	2.20	2.60
Upper Quartiles	4.50	4.40	5.25
Std Dev	1.76	1.65	1.60
Maximum	10.90	10.20	7.20
Score			
Below (0)	3647 (75.77%)	213 (63.77%)	65 (63.11%)
Meeting (1)	282 (5.86%)	33 (9.88%)	8 (7.77%)
Above (2)	884 (18.37%)	88 (26.35%)	30 (29.13%)

In 2016, the majority of hospitals were below the recommended follow-up rate (72.69%), 10% met the follow-up rate, and just under one-fifth were above the recommended follow-up rate (19.18%). The largest percentage of hospitals were classified as small bed size (41.63%), followed closely by large bed size (30.90%), and medium bed-size (27.47%). A majority of hospitals were private/not-for-profit 66.67% with government/nonfederal and private/for-profit at 13.95% and 20.39%, respectively. Urban setting and nonteaching hospitals were the majority with 55.65% and 83.69% compared to rural (43.35%) and teaching status (16.31%). Most of the hospitals were evenly distributed among the regions including Northeast (20.82%), Midwest (23.82%), South (28.33%) and West (27.04%). Hospital RN FTEs was a continuous variable with a median of 3.2 adjusted days per 1,000.

Table 9-Organization Level Characteristics 2016

Variable (N/%)	Full Dataset	My Sample	Exclusions
Observations	**1049**	**466**	**158**
Bed Size			
Small (1)	487(46.87%)	194(41.63%)	48(30.38%)
Medium (2)	249(23.97%)	128(27.47%)	54(34.18%)
Large (3)	303(29.16%)	144(30.90%)	56(35.44%)
Control/Ownership			
Govt, nonfederal (1)	213(20.50%)	95(20.39%)	8(5.06%)
Private, not profit (2)	604(58.13%)	306(66.67%)	120(75.95%)
Private, invest-own (3)	222(21.37%)	65(13.95%)	30(18.99%)
Location			
Rural (0)	414(39.85%)	202(43.35%)	10(6.33%)
Urban (1)	625(60.15%)	264(56.65%)	148(93.67%)
Teaching			
Nonteaching (0)	857(82.48%)	390(83.69%)	71(44.94%)
Teaching (1)	182(17.52%)	76(16.31%)	87(55.06%)
Region			

Table 9- (Continued)

Variable	Full Dataset	Sample	Exclusions
Northeast (1)	129 (12.30%)	97(20.82%)	31(19.62%)
Midwest (2)	306 (29.17%)	111(23.82%)	31(19.62%)
South (3)	417 (39.75%)	132(28.33%)	28(17.72%)
West (4)	197 (18.78%)	126(27.04%)	68(43.04%)
Registered Nurse Full-time Equivalents			
Median	3.35	3.20	4.00
Lower Quartile	2.30	2.20	3.00
Upper Quartiles	4.40	4.30	5.40
Std Dev	1.75	1.74	1.71
Maximum	10.90	10.90	9.30
Score			
Below (0)	3701(77.22%)	322 (72.69%)	129(81.65%)
Meeting (1)	283 (5.90%)	36 (8.13%)	4(2.53%)
Above (2)	809 (16.88%)	85 (19.18%)	25(15.82%)

For 2010, none of the variables was significantly associated with mammography follow-up rates (see Table 10). For 2016, variables that were significant in hospitals below the recommendation included hospital control and region (see Table 11). The odds of meeting the recommendation among private/not-for-profit hospitals are three times the odds of meeting the recommendation compared to private/for-profit hospitals (OR: 3.012; IC95%, 1.263-7.186; p =0.0129). The odds of meeting the recommendation among hospitals located in the Northeast are 0.3 times the odds of meeting the recommendation when compared to hospitals located in the West (OR: 0.294; IC95%, 0.094-0.914; p =0.0345). Hospitals that are private/not-for-profit are more likely to meet the recommendation compared to private/for-profit hospitals, while hospitals located in the Northeast were less likely to meet the recommendation compared to hospitals located in the West.

Table 10- Multinomial Logistic Regression of Relationship between Organization Level Factors and Mammogram Follow-up Rates 2010: Adjusted Odds Ratios and 95% Confidence Intervals (a)

	Below (0)					Above (1)				
Predictor n=334	**Wald's X^2 (df=1)**	**Chi -Sq**	**Odds Ratio**	**CI Lower**	**CI Upper**	**Wald's X^2 (df=1)**	**Chi-Sq**	**Odds Ratio**	**CI Lower**	**CI Upper**
Bed Size										
Small (1)	0.154	0.695	1195.000	0.492	2.900	0.126	0.723	1.193	0.451	3.153
Medium (2)	0.688	0.407	1.514	0.568	4.035	0.344	0.558	1.376	0.473	3.999
Large (3)	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Control/Ownership										
Govt, nonfederal (1)	0.295	0.587	1.586	0.300	8.383	1.849	0.174	3.437	0.580	20.368
Private, not profit (2)	0.761	0.222	2.609	0.058	3.085	0.056	0.813	1.176	0.306	4.521
Private (3)	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Location										
Rural (0)	1.319	0.251	1.697	0.697	3.987	0.676	0.411	0.664	0.251	1.760
Urban (1)	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Teaching Status										
Nonteaching (0)	0.037	0.849	1.101	0.411	2.944	0.765	0.382	1.622	0.549	4.795
Teaching (1)	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Region										
Northeast (1)	0.004	0.949	0.961	0.286	3.229	0.071	0.789	1.200	0.319	4.490
Midwest (2)	0.101	0.751	0.825	0.251	2.708	0.125	0.724	0.789	0.212	2.938
South (3)	0.022	0.883	0.916	0.285	2.945	0.344	0.558	1.458	0.413	5.148
West (4)	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Registered Nurse Full-time Equivalents	0.282	0.596	1.076	0.822	1.407	0.405	0.525	1.100	0.820	1.476

(a) *P<0.05; **P<0.01; ***P<0.001

Table 11- Multinomial Logistic Regression of Relationship between Organization Level Factors and Mammogram Follow-up Rates 2016: Adjusted Odds Ratios and 95% Confidence Intervals (a)

	Below					Above				
Predictor n=443	**Wald's X^2 (df=1)**	**Chi-Sq**	**Odds Ratio**	**CI lower**	**CI Upper**	**Wald's X^2 (df=1)**	**Chi-Sq**	**Odds Ratio**	**CI lower**	**CI Upper**
Bed Size										
Small (1)	0.067	0.796	1.118	0.481	2.598	1.574	0.210	0.543	0.209	1.410
Medium (2)	0.533	0.465	1.429	0.548	3.730	0.030	0.862	0.911	0.316	2.623
Large (3)	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Control/Ownership*										
Govt, nonfederal (1)	2.967	0.085	2.918	0.863	9.871	6.347	0.012	5.986	1.488	24.082
Private, not profit (2)	6.181	0.013	3.012	1.263	7.186	3.738	0.053	2.833	0.986	8.143
Private (3)	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Location										
Rural (0)	0.876	0.349	0.682	0.306	1.520	0.024	0.876	0.930	0.376	2.305
Urban (1)	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Teaching										
Nonteaching (0)	0.028	0.868	0.912	0.309	2.690	0.275	0.600	0.730	0.225	2.368
Teaching (1)	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Region*										
Northeast (1)	4.471	0.035	0.294	0.094	0.914	0.157	0.692	1.297	0.358	4.690
Midwest (2)	0.664	0.415	0.614	0.190	1.984	0.095	0.758	0.807	0.206	3.161
South (3)	1.496	0.221	0.513	0.176	1.495	0.029	0.864	1.113	0.328	3.776
West (4)	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
Registered Nurse Full-time Equivalents	0.908	0.341	0.902	0.729	1.116	0.053	0.819	0.972	0.759	1.244

(a) *P<0.05; **P<0.01; ***P<0.001

In 2016, hospital control was a significant variable in hospitals above the recommendation. The odds of meeting the recommendation among government or nonfederal hospitals are six times the odds of meeting compared to hospitals that are private/for-profit (OR: 5.986; IC95%, 1.488-24.082; p =0.0118). Hospitals that are government or nonfederal are more likely to meet the recommendation compared to private/for-profit hospitals.

In Tables 12 and 13, the feedback loop or guarantor of the two groups was reviewed from meeting to not meeting and vice versa. A total of 89 hospitals were present in both 2010 and 2016 in our study. Six hospitals moved from meeting in 2010 to not meeting in 2016, while seven hospitals moved from not meeting in 2010 to meeting in 2016. A total of 76 hospitals did not meet in either 2010 or 2016. These were not included in the analysis. When investigating the feedback loop of the Singerian inquiring organizations, no variables were found to be significantly different or associated in the hospital changing from meeting to not meeting or vice versa between 2010 and 2016.

Table 12: Organizational factors hospitals who met in 2010 and then did not meet guidelines in 2016 (MN)

Variable	2010 N (%)	2016 N (%)	P-Value (spearman)
Bed Size			1
Small (1)	3 (50.00%)	3 (50.00%)	
Medium (2)	2 (33.33%)	2 (33.33%)	
Large (3)	1 (16.67%)	1 (16.67%)	
Control/Ownership			1
Govt, nonfederal (1)	0 (0.00%)	0 (0.00%)	
Private, not profit (2)	6(100%)	6 (100%)	
Private, invest-own (3)	0 (0.00%)	0 (0.00%)	
Location			-
Rural (0)	1(16.67%)	1(16.67%)	
Urban (1)	5(83.33%)	5(83.33%)	
Teaching Status			-
Nonteaching (0)	5(83.33%)	5(83.33%)	
Teaching (1)	1(16.67%)	1(16.67%)	
Region			1

Table 12- (Continued)

Variable	2010 N (%)	2016 N (%)	P-Value (spearman)
Northeast (1)	4 (66.67%)	4 (66.67%)	
Midwest (2)	1(16.665%)	1(16.665%)	
South (3)	0 (0.00%)	0 (0.00%)	
West (4)	1(16.665%)	1(16.665%)	
HOSP_RNFTE			0.65
Mean	2.60	3.20	
Std Dev	0.80	2.20	
Median	3.70	4.40	
Min	1.35	1.34	
Max	3.70	4.90	

Table 13: Organizational factors hospitals who did not meet in 2010 and then met guidelines in 2016 (NM)

Variable	2010	2016	P-Value
Bed Size	3 (42.86%)	3 (42.86%)	1
Small (1)	2 (28.57%)	2 (28.57%)	
Medium (2)	2 (28.57%)	2 (28.57%)	
Large (3)			
Control/Ownership			1
Govt, nonfederal (1)	2 (28.57%)	2 (28.57%)	
Private, not profit (2)	4 (57.14%)	4 (57.14%)	
Private, invest-own (3)	1 (14.29)	1 (14.29)	
Location			-
Rural (0)	3 (23.08%)	3 (23.08%)	
Urban (1)	4 (30.77%)	4 (30.77%)	
Teaching Status			-
Nonteaching (0)	7 (100%)	7 (100%)	
Teaching (1)	0 (0.00%)	0 (0.00%)	
Region			1
Northeast (1)	2 (28.57%)	2 (28.57%)	
Midwest (2)	2 (28.57%)	2 (28.57%)	
South (3)	3 (42.86%)	3 (42.86%)	
West (4)	0 (0.00%)	0 (0.00%)	
HOSP_RNFTE			0.95
Mean	2.6	2.5	
Std Dev	0.8	0.8	
Median	3.7	3.7	
Min	1.35	1.48	
Max	3.7	4.2	

Discussion

Although organization and structural factors affect the delivery and quality of healthcare services across a variety of practice settings, none have been investigated regarding mammography follow-up rates (Zinn & Mor, 1998). Control/ownership and region were both found to be significantly associated with meeting mammography follow-up rates, which matches previous literature examining quality of care. Investor owned or for-profit hospitals have been shown to provide less quality of care compared to not-fo- profit or public organizations (Harrington et al., 2001). Gillies et al., (2006) investigated the clinal performance measures where the Northeast region scored higher on all but one of the performance measures.

When investigating the feedback loop or guarantor of the system, the hospital variables from 2010 and 2016 hardly changed, but their outcome or status of meeting the recommendation did. Due to this, we hypothesize that the measured predictors do not have a significant bearing on changing the follow-up rate between 2010 and 2016.

The measurement of follow-up percentage for mammograms by the CMS hospital compare data is limited to up to 45 days after an initial mammogram. This limitation might have decreased the number of follow-up visits if the patient went in for their follow-up after 45 days. In addition, in the CMS hospital compare data, a limitation is that the patient may have received their follow-up mammogram at another institution where that was not indicated. Although CMS data limitations occurred, this is the only database that collects mammography follow-up rates in a national setting ("Timely & Effective care measures", n.d.). Another limitation includes keeping the states included in the study to the contiguous United States, leaving out Puerto Rico, Virgin Islands, Hawaii, Guam, and Alaska, which was limiting, but the exclusions only amounted to 120 observations. The small sample size of the feedback loop analysis limited the type of analysis we were able to perform, but

the profile nonetheless fulfills the guarantor analysis. This is also a cross-sectional study where we modeled the data at a specific point in time and therefore cannot determine causal relationships. Although limitations are present, a major strength of this study is the ability to provide a novel view of a problem to improve both the accuracy of mammograms and mammography follow-up rates.

Conclusion

This study shows that organizational factors are significantly associated with mammography follow-up rates. We draw two important implications from our results.

First, hospital ownership was a strong indicator of quality of care and meeting the recommendation of mammogram follow-up rates. The type of ownership predicted if the hospital met the guidelines. Private or not for profit hospitals were below the recommendation which means that this ownership is underdoing their scans. Government/nonfederal hospitals were above the guidelines for follow-up rates which means that this ownership was overdoing the scans. For profit hospitals were found to not be associated with meeting the guidelines. In an effort to understand the intricacies of healthcare quality, initiatives and research should be focused on ownership and their effects on populations.

Second, the fact that few hospitals moved from meeting to not meeting or vice versa could indicate that hospitals are not paying attention to the recommendations published by AHRQ. This is a novel study providing evidence-based information which showed that control/ownership and region of the hospital were significant predictors of mammography follow-up rates. Future research should continue to research environmental or organizational factors in a macro-level approach because they affect all aspects of healthcare quality, especially mammography follow-up rates.

Chapter 5 Conclusions

The aim of this dissertation is to advance empirical research on how market level and organizational factors affect quality of care with mammogram follow-up rates. Previous research has uncovered some factors affecting follow-up rates, but market and organizational factors have not been investigated, although both affect quality of care. This research provides additional insight on how an organization's environment and their own available resources affect the quality of screening. This concluding chapter discusses this dissertation's findings and their implications on the significance of mammogram follow-up rates.

5.1 Dissertation Implications

In section 1, I summarize the lack of available research regarding my two main interests: Open Systems Theory and mammogram follow-up rates. In section 2, although Open Systems Theory could be applied to multiple settings and was established in the 1930s, only two settings were found: education and health care. Open systems theory has the ability to provide a novel approach to solving problems by viewing them as components that make up systems and are interacting with each other and their environments. This is ideal for future policy initiatives to aid in future interpretations of public health problems.

Although mammography follow-up rates have affected millions of people, literature on factors affecting mammography follow-up rates is lacking. Not all the factors that are relevant in affecting health care quality have been investigated with recall rates, and they should be. This dissertation fills the gap in open systems and recall rate literature with providing empirical evidence and examining the impact of the policy by looking at two years of data (2010 & 2016).

In section 3, market level factors that were significant regarding mammography follow-up rates included total deaths, number of radiologists, percent of screening hospitals, total hospitals, and percent of the African American population. Counties were less likely to meet the recommendation if they had more deaths per 100,000 population, more radiologists per 100,000 population, a higher percentage of screening hospitals, and higher percent of African Americans. These findings matched previous literature discussing quality of care and market level factors. Also, counties with a larger percentage of screening hospitals and more total hospitals were more likely to meet the recommendation. More resources available in the area along with competition was associated with more counites and hospitals meeting the recommendation. Due to this, increased competition through more hospital and physician competition should be encouraged. Five out of the seven market-level variables were significant, which shows justification to continue research on market level factors and their influence on quality of care. Future initiatives should focus on how the organization's environment affects quality of care. Policy initiatives should focus on market-level area changes that could improve quality of care and, ultimately, health outcomes. Although market area factors are difficult to change, initiatives similar to recruiting medical professionals in an area can increase competition and quality of care.

In section 4, organization level factors that were found to be significant in mammography follow-up rates included hospital control and region. Hospital control or ownership of the hospital determined if the hospital met the recommended guidelines. Depending on the type of ownership, the mammography follow-up rate was either below (private or not-for=-profit) or above (Government/nonfederal) or not meeting (for-profit). Initiatives should focus on targeting communication to the ownership of hospitals where resources and payment can be tied to performance on follow-up visits. Future research and policy initiatives should focus on ownership

and their effects on quality of care and health of the population. Region was also an important indicator showing that there may be other factors playing a role regionally including demographics, income, or environment that we were not able to study.

The replication guarantor of both studies researching market and organizational level factors did not show any significant findings. We conclude that there are other underlying factors affecting the status change in some hospitals/counties between meeting or not meeting the recommended guidelines. Most hospitals and counties stayed not meeting for both years which shows that hospitals and counties are not adhering to the guidelines established to increase quality of care. To increase adherence and awareness, future policy and research initiatives should focus on a payment connection to performance to provide an incentive for hospitals to meet the recommendation.

5.2 Future Research Directions

The first study of open systems theory had a few limitations regarding lack of available articles, databases, and narrow search criteria. Future research should focus on understanding how each article used the components of the open systems theory to evaluate their systems.

Limitations in the market and organization level studies included only states in the contiguous United States, zip codes with one hospital, and patients insured by CMS. Future research should focus on other payers and their mammography follow-up rates, along with increasing the amount or types of data available regarding market and organization level variables as they were all shown to significantly affect the quality of care a patient and area will receive.

The guarantor analysis limitation for both studies was the small sample size of hospitals and counties that moved meeting status which limited our analysis type that we could conduct. Future studies should research how the feedback loop of the theory can favorably change the organization

by taking an active role in sharing the information with the county, hospital, or area. The lack of hospitals/counties moving status shows that there is a gap in communication that must be bridged to bring awareness to their low quality of care.

5.3 Conclusion

This dissertation showed three important and significant facts. One, there is a lack of counites and hospitals following mammography follow-up rate standards. Two, viewing the problem through a macro-level approach with an open systems theory, such as Singerian inquiring organization, can shine a light on the gaps in the literature of factors that play a role in a system. Three, market and organization level variables should be evaluated with every future quality of care initiative because they are significantly associated with the quality of care the patient will receive.

.

References

Allison, J. J., Kiefe, C. I., Weissman, N. W., Person, S. D., Rousculp, M., Canto, J. G., ... & Centor, R. M. (2000). Relationship of hospital teaching status with quality of care and mortality for Medicare patients with acute MI. *Jama*, *284*(10), 1256-1262.

American Cancer Society: Cancer Facts and Figures 2019. Atlanta, Ga: American Cancer Society, 2019. Available online. Last accessed September 29, 2019.

Anaf, S., Drummond, C., & Sheppard, L. A. (2007). Combining case study research and systems theory as a heuristic model. *Qualitative Health Research*, *17*(10), 1309-1315.

Area health resources files. (n.d.).Retrieved from https://datawarehouse.hrsa.gov/topics/ahrf.aspx

Baicker, K., Chandra, A., & Skinner, J. (2005). Geographic variation in health care and the problem of measuring racial disparities. *Perspectives in biology and medicine*, *48*(1), 42 S53.

Banaszak-Holl, J., Zinn, J. S., & Mor, V. (1996). The impact of market and organizational characteristics on nursing care facility service innovation: A resource dependency perspective. *Health Services Research, 31*(1), 97-117. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/8617612

Benjamins, M. R., Kirby, J. B., & Huie, S. A. B. (2004). County characteristics and racial and ethnic disparities in the use of preventive services. *Preventive medicine*, *39*(4), 704-712.

Bierema, L. L. (2003). Systems thinking: A new lens for old problems. *Journal of Continuing Education in the Health Professions*, *23*(S1), S27-S33.

Biney, I. K. (2015). Exploring the Usefulness of Open Systems Theory in Adult Education Organisations: The SCDE in Perspective.

Boulding, K. E. (1956). General systems theory—the skeleton of science. *Management science*, *2*(3), 197-208.

Breen, N., Wagener, D. K., Brown, M. L., Davis, W. W., & Ballard-Barbash, R. (2001). Progress in cancer screening over a decade: results of cancer screening from the 1987, 1992, and 1998 National Health Interview Surveys. *Journal of the National Cancer Institute*, *93*(22), 1704-1713.

Brodersen, J., Thorsen, H., & Cockburn, J. (2004). The adequacy of measurement of short and long-term consequences of false-positive screening mammography. *Journal of medical screening*, *11*(1), 39-44.

Brodersen, J., & Siersma, V. D. (2013). Long-term psychosocial consequences of false positive screening mammography. *The Annals of Family Medicine*, *11*(2), 106-115.

Broskowski, A. (1973). Concepts of teacher-centered consultation. Professional Psychology, 4(1), 50.

Buist, D. S., Anderson, M. L., Haneuse, S. J., Sickles, E. A., Smith, R. A., Carney, P. A., ... & Monsees, B. S. (2011). Influence of annual interpretive volume on screening mammography performance in the United States. *Radiology*, *259*(1), 72-84.

Castells, X., Molins, E., & Macià, F. (2006). Cumulative false positive recall rate and association with participant related factors in a population based breast cancer screening programme. *Journal of Epidemiology & Community Health*, *60*(4), 316-321.

Checkland, P., Scholes, J., & Checkland, P. (1990). *Soft systems methodology in action* (Vol. 7). Chichester: Wiley

Chuang, S., & Inder, K. (2009). An effectiveness analysis of healthcare systems using a systems theoretic approach. BMC Health Services Research, 9(1), 195.

Churchman, C.W., The Design of Inquiring Systems: Basic Concepts of Systems and Organizations, New York, NY: Basic Books, Inc., 1971.

Cohen, I. T., Souter, K., & Tebich, S. (2005). Systems-Based Practice and Anesthesiology Residency: Report from the SEA Task Force on the ACGME Core Competencies. The journal of education in perioperative medicine: JEPM, 7(2).

Cordon, C. P. (2013). System theories: An overview of various system theories and its application in healthcare. *American Journal of Systems Science*, *2*(1), 13-22.

Coughlin, S. S., Leadbetter, S., Richards, T., & Sabatino, S. A. (2008). Contextual analysis of breast and cervical cancer screening and factors associated with health care access among United States women, 2002. *Social science & medicine*, *66*(2), 260-275.

Courtney, J. F. (2001). Decision making and knowledge management in inquiring organizations: toward a new decision-making paradigm for DSS. *Decision support systems*, *31*(1), 17-38.

Courtney, J.F., B. Chae, and D.J. Hall, "Developing Inquiring Organizations," Knowledge and Innovation: Journal of the KMCI, 2000, 1:1, pp. 132-145.

Courtney, J., Croasdell, D., & Paradice, D. (1998). Inquiring Organisations. *Australasian Journal of Information Systems*, *6*(1).

Croasdell, D., Paradice, D., & Courtney, J. (1998). Singerian inquiring organizations: guiding principles and design guidelines for learning organizations. *AMCIS 1998 Proceedings*, 277.

Curry, L. A., Linnander, E. L., Brewster, A. L., Ting, H., Krumholz, H. M., & Bradley, E. H. (2015). Organizational culture change in US hospitals: a mixed methods longitudinal intervention study. Implementation Science, 10(1), 29.

Dimick, J. B., Cowan Jr, J. A., Colletti, L. M., & Upchurch Jr, G. R. (2004). Hospital teaching status and outcomes of complex surgical procedures in the United States. *Archives of surgery*, *139*(2), 137-141.

Elmore, J. G., Miglioretti, D. L., Reisch, L. M., Barton, M. B., Kreuter, W.,

Final Recommendation Statement: Breast Cancer: Screening. U.S. Preventive Services Task Force. May 2019.

https://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/breast-cancer-screening1

Fleming, G. V. (1981). Hospital structure and consumer satisfaction. *Health Services Research*, *16*(1), 43.

Fracheboud, J., de Koning, H. J., Beemsterboer, P. M., Boer, R., Hendriks, J. H., Verbeek, A. L., ... & van der Maas, P. J. (1998). Nation-wide breast cancer screening in The Netherlands: Results of initial and subsequent screening 1990–1995. *International journal of cancer*, *75*(5), 694-698.

Gillies, R. R., Chenok, K. E., Shortell, S. M., Pawlson, G., & Wimbush, J. J. (2006). The impact of health plan delivery system organization on clinical quality and patient satisfaction. *Health services research*, *41*(4p1), 1181-1191.

Gilson, L., & World Health Organization. (2012). *Health policy and systems research: a methodology reader*. Geneva: World Health Organization.

Griffith, J. (2004). Ineffective schools as organizational reactions to stress. Social Psychology of Education, 7(3), 257-287.

Gur, D., Sumkin, J. H., Rockette, H. E., Ganott, M., Hakim, C., Hardesty, L., ... & Wallace, L. (2004). Changes in breast cancer detection and mammography recall rates after the introduction of a computer-aided detection system. *Journal of the National Cancer Institute*, *96*(3), 185-190.

Hall, D., Paradice, D., & Courtney, J. F. (2003). Building a theoretical foundation for a learning-oriented knowledge management system. *Journal of Information Technology Theory and Application (JITTA)*, *5*(2),

Hall, D. J., Paradice, D. B., & Courtney, J. F. (2001, January). Creating feedback loops to support organizational learning and knowledge management in inquiring organizations. In *Proceedings of the 34th Annual Hawaii International Conference on System Sciences* (pp. 10-pp). IEEE.

Hayajneh, Y.A. (2007). Management for Health Care Professionals Series Systems & Systems Theory.

Harrington, C., Woolhandler, S., Mullan, J., Carrillo, H., & Himmelstein, D. U. (2001). Does investor ownership of nursing homes compromise the quality of care?. *American journal of public health*, *91*(9), 1452-1455.

HCUP FACT SHEET. (2018). Hcup fact sheet 2018 Retrieved from https://www.hcup-us.ahrq.gov/news/exhibit_booth/HCUPFactSheet.pdf

Hospital Out-Patient Imaging Efficiency Measures. (2013, November 26). Retrieved November 09, 2017, from https://www.acr.org/Advocacy/Economics-Health Policy/Billing-Coding/Coding-Source-List/2009/May-Jun-2009/Hospital-Out-Patient Imaging-Efficiency-Measures

How Common Is Breast Cancer? Breast Cancer Statistics https://www.cancer.org/cancer/breast-cancer/about/how-common-is-breast-cancer.html

Hubbard, R. A., Kerlikowske, K., Flowers, C. I., Yankaskas, B. C., Zhu, W., & Miglioretti, D. L. (2011). Cumulative Probability of False-Positive Recall or Biopsy Recommendation After 10 Years of Screening MammographyA Cohort Study. *Annals of internal medicine*, *155*(8), 481-492.

Humphrey, L. L., Helfand, M., Chan, B. K., & Woolf, S. H. (2002). Breast cancer screening: a summary of the evidence for the US Preventive Services Task Force. *Annals of internal medicine*, *137*(5_Part_1), 347-360.

Independent UK Panel on Breast Cancer Screening. (2012). The benefits and harms of breast cancer screening: an independent review. *The Lancet*, *380*(9855), 1778-1786.

Jones, B. A., Dailey, A., Calvocoressi, L., Reams, K., Kasl, S. V., Lee, C., & Hsu, H. (2005). Inadequate follow-up of abnormal screening mammograms: findings from the race differences in screening mammography process study (United States). *Cancer Causes & Control*, *16*(7), 809-821.

Kast, F. E., & Rosenzweig, J. E. (1972). General systems theory: Applications for organization and management. *Academy of management journal*, *15*(4), 447-465.

Kerlikowske, K. (1997). Efficacy of screening mammography among women aged 40 to 49 years and 50 to 69 years: comparison of relative and absolute benefit. *JNCI Monographs*, *1997*(22), 79-86.

Kerlikowske, K., Grady, D., Rubin, S. M., Sandrock, C., & Ernster, V. L. (1995). Efficacy of screening mammography: a meta-analysis. *Jama*, *273*(2), 149-154.

Kerlikowske, K., Grady, D., Barclay, J., Sickles, E. A., Eaton, A., & Ernster, V. (1993). Positive predictive value of screening mammography by age and family history of breast cancer. *Jama*, *270*(20), 2444-2450.

Kessel, V., & Mink, O. G. (1971). The Application of Open Systems Theory and Organization Development to Higher Education: A Position.

Kollias, J., Sibbering, D. M., Blamey, R. W., Holland, P. A. M., Obuszko, Z., Wilson, A. R. M., ... & Elston, C. W. (1998). Screening women aged less than 50 years with a family history of breast cancer. *European Journal of Cancer*, *34*(6), 878-883.

Kruzich, J. M., Clinton, J. F., & Kelber, S. T. (1992). Personal and environmental influences on nursing home satisfaction. *The Gerontologist*, *32*(3), 342-350.

Landon, B. E., Reschovsky, J., Reed, M., & Blumenthal, D. (2001). Personal, organizational, and market level influences on physicians' practice patterns: results of a national survey of primary care physicians. *Medical care*, 889-905.

O'Neill, C., Harrington, C., Kitchener, M., & Saliba, D. (2003). Quality of care in nursing homes: An analysis of relationships among profit, quality, and ownership. *Medical care*, 1318-1330.

Parchman, M. L., & Culler, S. (1994). Primary care physicians and avoidable hospitalizations. *Journal of Family Practice*, *39*(2), 123-128.

Performance Measures for 1,838,372 Screening Mammography Examinations1 from 2004 to 2008 by Age -- based on BCSC data through 2009. (2016, June). Retrieved November 09, 2017, from http://breastscreening.cancer.gov/data/performance/screening/2009/perf_age.htm

Pfeffer, J., & Salancik, G. R. (2003). *The external control of organizations: A resource dependence perspective* Stanford University Press.

PRISMA (Preferred Reporting Items for Systematic Reviews and MetaAnalyses) statement criteria. [http://www.prisma-statement.org].

Propper, C., Burgess, S., & Green, K. (2004). Does competition between hospitals improve the quality of care? Hospital death rates and the NHS internal market. *Journal of Public Economics*, *88*(7-8), 1247-1272.

Markle, W. H., & Fisher, M. A. (2007). Understanding global health. McGraw Hill Professional.

Mark, B. A., Harless, D. W., & McCue, M. (2005). The impact of HMO penetration on the relationship between nurse staffing and quality. *Health economics*, *14*(7), 737-753.

Mason, R. O., & Mitroff, I. I. (1973). A program for research on management information systems. *Management science*, *19*(5), 475-487.

McFarland, D. C., Shen, M. J., Parker, P., Meyerson, S., & Holcombe, R. F. (2017). Does hospital size affect patient satisfaction? *Quality management in health care*, *26*(4), 205-209.

McWilliams J. M. (2009). Health consequences of uninsurance among adults in the United States: recent evidence and implications. *The Milbank quarterly*, *87*(2), 443–494. https://doi.org/10.1111/j.1468-0009.2009.00564.x

Messer, S. B., Fishman, D. B., & McCrady, B. S. (1991). Conducting a self-study in a professional psychology program. Professional Psychology: Research and Practice, 22(5), 405.

Meyer, R. M., & O'Brien-Pallas, L. L. (2010). Nursing services delivery theory: an open system approach. Journal of Advanced Nursing, 66(12), 2828-2838.

Mutale, W., Balabanova, D., Chintu, N., Mwanamwenge, M. T., & Ayles, H. (2016). Application of system thinking concepts in health system strengthening in low-income settings: a proposed conceptual framework for the evaluation of a complex health system intervention: the case of the BHOMA intervention in Zambia. *Journal of evaluation in clinical practice*, *22*(1), 112-121.

National Center for Health Statistics. (2017, May 03). Retrieved November 6, 2018, from https://www.cdc.gov/nchs/fastats/mammography.htm

Nelson, H. D., Pappas, M., Cantor, A., Griffin, J., Daeges, M., & Humphrey, L. (2016). Harms of breast cancer screening: systematic review to update the 2009 US preventive services task force recommendation harms of breast cancer screening. Annals of internal medicine, 164(4), 256-267.

Nelson HD, Fu R, Cantor A, Pappas M, Daeges M, Humphrey L. Effectiveness of breast cancer screening: systematic review and meta-analysis to update the 2009 U.S. Preventive Services Task Force Recommendation. Ann Intern Med. 164(4):244-55, 2016.

Nelson, H. D., Tyne, K., Naik, A., Bougatsos, C., Chan, B. K., & Humphrey, L. (2009). Screening for breast cancer: an update for the US Preventive Services Task Force. *Annals of internal medicine*, *151*(10), 727-737.

Nguyen, A. M., Johnson, C. E., Wood, S. J., & Dowling, W. L. (2019). Organizational factors affecting successful physician-system integration: A qualitative study of Washington State health executives. Health care management review.

Rafferty, E. A., Park, J. M., Philpotts, L. E., Poplack, S. P., Sumkin, J. H., Halpern, E. F., & Niklason, L. T. (2014). Diagnostic accuracy and recall rates for digital mammography and digital mammography combined with one-view and two-view tomosynthesis: results of an enriched reader study. *American Journal of Roentgenology*, *202*(2), 273-281.

Ries, L. A., Harkins, D., Krapcho, M., Mariotto, A., Miller, B. A., Feuer, E. J., ... & Hayat, M. (2006). SEER cancer statistics review, 1975-2003.

Reschovsky, J., Reed, M., Blumenthal, D., & Landon, B. (2001). Physicians' assessments of their ability to provide high-quality care in a changing health care system. *Medical Care*, 254-269.

Riley, G., & Lubitz, J. (1985). Outcomes of surgery among the Medicare aged: surgical volume and mortality. *Health Care Financing Review*, *7*(1), 37.

Rothschild, J., Lourenco, A. P., & Mainiero, M. B. (2013). Screening mammography recall rate: does practice site matter?. *Radiology*, *269*(2), 348-353.

Schell, M. J., Yankaskas, B. C., Ballard-Barbash, R., Qaqish, B. F., Barlow, W. E., Rosenberg, R. D., & Smith-Bindman, R. (2007). Evidence-based target recall rates for screening mammography. Radiology, 243(3), 681-689.

Schwartz, L. M., Woloshin, S., Sox, H. C., Fischhoff, B., & Welch, H. G. (2000). US women's attitudes to false positive mammography results and detection of ductal carcinoma in situ: cross sectional survey. *Bmj*, *320*(7250), 1635-1640.

Shortell, S. M., & LoGerfo, J. P. (1981). Hospital medical staff organization and quality of care: results for myocardial infarction and appendectomy. *Medical care*, 1041-1055.

Spector, W. D., & Takada, H. A. (1991). Characteristics of nursing homes that affect resident outcomes. *Journal of Aging and Health*, *3*(4), 427-454.

Snowden, L. R. (2012). Health and mental health policies' role in better understanding and closing African American–White American disparities in treatment access and quality of care. *American Psychologist*, *67*(7), 524.

Stout, N. K., Rosenberg, M. A., Trentham-Dietz, A., Smith, M. A., Robinson, S. M., & Fryback, D. G. (2006). Retrospective cost-effectiveness analysis of screening mammography. *Journal of the National Cancer Institute*, *98*(11), 774-782.

Succi, M. J., Lee, S. Y., & Alexander, J. A. (1997). Effects of market position and competition on rural hospital closures. *Health Services Research*, *31*(6), 679.

Tabár, L., Duffy, S. W., Vitak, B., Chen, H. H., & Prevost, T. C. (1999). The natural history of breast carcinoma: what have we learned from screening? *Cancer*, *86*(3), 449-462.

Tabár, L., Vitak, B., Chen, T. H. H., Yen, A. M. F., Cohen, A., Tot, T., ... & Fohlin, H. (2011). Swedish two-county trial: impact of mammographic screening on breast cancer mortality during 3 decades. *Radiology*, *260*(3), 658-663.

Taplin, S., Abraham, L., Barlow, W. E., Fenton, J. J., Berns, E. A., Carney, P. A., ... & Elmore, J.G. (2008). Mammography facility characteristics associated with interpretive accuracy of screening mammography. *Journal of the National Cancer Institute*, *100*(12), 876-887.

Timely & effective care measures n.d.; Retrieved from https://www.medicare.gov/hospitalcompare/Data/Measures.html

Ulrich, W. (1985). The way of inquiring systems. *Journal of the Operational Research Society*, *36*(9), 873-876.

Yankaskas, B. C., Cleveland, R. J., Schell, M. J., & Kozar, R. (2001). Association of recall rates with sensitivity and positive predictive values of screening mammography. *American Journal of Roentgenology*, *177*(3), 543-549.

Zakus, D., Bhattacharyya, O. (2007). Health systems, management, and organization in low- and middle-income countries.

Zinn, J. S., & Mor, V. (1998). Organizational structure and the delivery of primary care to older Americans. *Health services research*, *33*(2 Pt 2), 354.