

INFUSING SERVICE EXCELLENCE INTO HEALTHCARE SETTINGS

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INFUSING SERVICE EXCELLENCE INTO HEALTHCARE SETTINGS

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Although healthcare is a service-intensive industry, the quality of the service itself is infrequently studied in previous literature. In this dissertation, we look into the service aspects in healthcare settings and explore how to apply service operations strategies in healthcare settings to improve service quality, patient satisfaction, and healthcare organization performance. This dissertation is composed of three essays.

In the first essay, we explore the U.S. healthcare customers' preferences and concerns of the healthcare system, and identify potential research opportunities. Using both qualitative and quantitative research methods, we analyze a multi-year survey data with 2,400 respondents. We also conduct a thorough literature review of Healthcare Operations Management articles published in the past decade. Comparing insights generated from the above mentioned two sources, we identify potential research opportunities. The first essay serves as the stepping stone of my dissertation and points out research directions.

Leveraging insights from my first essay, I then focus on how service excellence can be achieved in more specific situations in healthcare settings. In the second essay, we explore how does Information Communication Technology in healthcare delivery impact patient perceptions of care received. Using a mix of quantitative (i.e., Generalized Linear Model with binomial distribution on a Logit link) and qualitative

(i.e., content analysis) methods, we analyze a multi-year survey data with 1,600 respondents. We find that the majority of patients hold positive opinions about ICT in healthcare delivery. Reasons why patients support or oppose ICT in healthcare delivery are also explored.

In the third essay, we examine the service practices the providers implemented to achieve service excellence. Analyzing a comprehensive data set of U.S. nursing homes, we assess the nursing home chains' standardization strategies in their service offering, service delivery, and customer mix. This study yields inspiring implications for healthcare organization chains in making within-chain standardization decisions.

BIOGRAPHICAL SKETCH

Lu Kong was born in Lanzhou, China. She attended Tianjin University of Finance and Economics and earned a Bachelor of Management degree. Later she attended Cornell University and earned a Master's degree in Hospitality Administration. After graduation, she worked for Marriott for one year. She then started her Ph.D. program at the Hotel School at Cornell University in 2015.

献给崔先生

因你陪伴在来时路的每一步，无论艰辛与欢乐

献给爸爸妈妈

因每次临行前密缝的寒衣，和渡口旁相送的孤影

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CHAPTER 1

INTRODUCTION

1 Overview

Healthcare is one of the biggest industries in the United States: its share of GDP is projected to be 19.7 percent by 2026, reaching \$5.7 trillion (CMS National Health Expenditure Projections 2017 – 2026). Due to its service-intensive nature, healthcare in the U.S. is touted as the “world’s largest service industry.” However, the quality of the service itself is infrequently discussed in the medical literature (Kenagy et al. 1999). The recent heated discussions, procedures, and policies to promote “patient-centered” care and patient experience require the healthcare providers, both organizations and individuals, to improve service quality in the care processes. However, since the healthcare industry has many stakeholders (such as patients, care providers, government regulations and policies, pharmaceutical companies, and technologies) and each plays an important role, it is not easy to achieve service improvement due to the complication of coordination among all forces. In this dissertation work, I focus on the theme “infusing service excellence into healthcare settings.” Under this theme, I explore research problems such as the alignments and mismatches of current research topics and healthcare customers’ preferences, the use of technology in healthcare settings, and the applications of operations strategies in healthcare settings.

The essence of patient-centered care and patient experience improvement relies on incorporating patient preferences, needs, and values into the care processes (Barry and Edgman-Levitan 2012). In operations theories and practices, customer focus is a well-established tool to guide the design of products and services. Thus, I devote the first essay of my dissertation to exploring the customers' needs and preferences in the U.S. healthcare system and investigate the gap between customers' concerns and current operations management research. This project serves as a foundational stepping stone for my research agenda and highlights future research directions for fellow healthcare operations researchers.

Leveraging insights from my first essay, I then focus on how service excellence can be achieved in a more specific situation in healthcare settings. Technology, for example, is playing an increasingly important role in the traditional service-intensive industries such as hotels and restaurants. Choices on "high-tech" versus "high-touch" are extensively discussed among both academic researchers and industry practitioners. Yet, not much is known on patient choices and preferences of technology use in healthcare delivery. In the second essay of my dissertation, I investigate how Information Communication Technology (ICT) changes healthcare delivery from the patient perspective. This paper reveals the level of patient acceptance of ICT, and points out directions for how to promote the benefits of ICT while avoiding its disadvantages.

After exploring the customer side of the story, I became curious about the service practices the providers implemented to achieve service excellence in healthcare. In the third essay of my dissertation, I focus on the nursing home industry, which combines lodging services and clinical care. I investigate relationships between nursing home chains' service strategies, in terms of standardization and customization, and nursing home performance outcomes. I elaborate and introduce each essay in the following subsections.

2. Essay 1: Aligning Priorities in Healthcare Operations with Customer Preferences.

Despite its substantial economic size, the U.S. healthcare industry faces issues that cannot be easily addressed, such as the high uninsured rate (27.6 million in 2016¹), high healthcare costs, and low quality in terms of the number of physicians per capita and infant mortality. In operations management, customer focus has been used as an effective tool to design a high-quality system. Thus, in an effort to provide possible solutions to those issues with operations management theories, we want to examine the healthcare customers' perspective on the U.S. healthcare system issues. We also investigate the synergies and gaps between the current research themes and customers' preferences, and use it to guide the future healthcare operations research.

This article addresses three basic questions related to healthcare operations in the U.S.:

(1) What are the most concerning issues in the U.S. healthcare system from a patient

¹ <https://www.kff.org/uninsured/fact-sheet/key-facts-about-the-uninsured-population/>

and customer perspective? (2) What factors account for these perceptions? (3) Is there alignment between customer perceptions and published research in healthcare operations? To answer the first two questions, we conduct a multi-year survey and collect data from 2,400 respondents representing the demographics of New York State. Both qualitative (content analysis) and quantitative (Generalized Estimating Equation) methods are used to analyze the data. A thorough literature review of healthcare articles in Operations Management journals is also conducted to investigate the third question.

We find that in general, customers are most concerned about (1) the cost of care, (2) access to care and coverage, and (3) quality and efficiency. These customer concerns are found to be associated with health policies, sociodemographic characteristics, and living environments. After examining customers' pressing concerns and themes of published healthcare research within the OM discipline, we call for more macro-level decision making research in addition to the papers that focus on narrowly defined problems.

This study contributes to the literature by being the first to empirically verify the "Iron Triangle of Healthcare" (Kissick 1994), which describes three issues that are of primary concern for all healthcare systems: cost, access, and quality. Furthermore, based on empirical evidence, we also point out the gap between current research themes and urgently-needed research topics for healthcare operations scholars.

3. Essay 2: Usage and Impact of Information and Communication Technologies in Healthcare Delivery.

The recent few years have witnessed significant changes in how health services are delivered to patients. These changes include shift towards a more patient-centered delivery model (Danaher and Gallan 2016); the rise of consumerism in the healthcare market (Shrank 2017, Berry 2007, Krishnan et al. 2015); and the growing role of the Information and Communication Technologies (ICT) in care delivery (Rouleau and Gagnon 2017). Patients now have access to information from many online sources regarding their symptoms and potential therapies and expect to be actively involved in their care decisions (Amante et al. 2015, Paluch and Blut 2013), and they also expect more convenient and responsive care (Shrank 2017). While ICT's use in healthcare delivery is growing, patient preferences for such technologies is becoming a critical factor for successful adoption (Deslich et al. 2013, Standing and Cripps 2015). In this paper, we investigate patients' perception of ICT in healthcare settings, and how their sociodemographic characteristics impact their usage of ICT in healthcare delivery. Multi-year data was collected through phone interviews with a sample size of 1,600 individuals. We use a mix of quantitative (Generalized Linear Model with binomial distribution on a Logit link) and qualitative (content analysis) methods to address our research questions.

We find that overall, perceived ICT benefits outweighed potential concerns, and the majority (75.9%) of the patients indicate that they are willing to use remote healthcare services in the future. This suggests that patients are welcoming and trusting the usage

of ICT in healthcare. Nevertheless, depersonalization of the interaction with care providers concerns many patients. Our results also indicate that age, together with enabling factors such as income and education, are substantial barriers to the use of remote healthcare services.

This study makes contributions to the technology acceptance model in identifying the perceived benefits and concerns of ICT in healthcare delivery from the patient perspective and estimating their likelihood of using ICT in the future. We also provide practical implications for healthcare providers on how to use ICT to promote the perceived benefits and eliminate the perceived concerns.

4. Essay 3: Chain Operators' Service Strategies: Standardization or Customization?

All chain operators of service face the decision of how unique each of their units should be. Some chains choose to provide identical services through uniform processes across all units, while other chains choose to differentiate their units. It is unclear how this decision affects the performance outcomes of chains. We investigate within a customer-recognizable chain (meaning customers can tell a unit belongs to a chain from the unit's name) how standardization and customization across chain-belonging units impact that chain's performance outcomes. We study this question in the nursing home industry. More specifically, we study the Degree of Standardization (DoS) in three operational dimensions: customer mix, service offering, and service delivery, and its impact on three nursing home outcomes: financial outcome, clinical outcome, and resident welfare.

We use a data set covering ten years (2006 – 2015) of comprehensive measurements of all nursing homes in the U.S. that are certified by the Centers for Medicare and Medicaid Services (CMS). We explore the Degree of Standardization (DoS) in three operational dimensions: customer mix, service offering, and service delivery, and we investigate the relationships between the DoS and important nursing home outcomes: financial outcome, clinical outcome, and resident welfare. We estimate these relationships using three separate yearly fixed-effect models with clustered standard errors, one for each of the three outcome measures. We find that nursing home chains need to (1) customize their service offering and customer mix to improve their financial outcome; (2) standardize their customer mix across units to decrease the number of deficiency citations in clinical areas; (3) and customize their service offering and service delivery to enhance resident welfare.

To our knowledge, this study is the first systematic multi-dimensional assessment of service firms' standardization strategies from a chain perspective. We contribute to the literature by (1) assessing standardization and customization strategies in multiple operational dimensions in nursing homes and their impact on important service outcomes; and (2) establishing a new method to identify customer-recognizable nursing home chains to account for the “spillover” effect among facilities bearing the same chain name. Our results guide nursing home chains in their (1) strategies of within-chain standardization, and (2) investment decisions in acquiring new properties. Our findings also provide guidance for policymakers in guiding nursing

home chains' (1) activities both before and after merging and acquisitions, and (2) daily operational decisions regarding standardization and customization. Broadly speaking, our results also provide managerial insights for chain operators of service in their standardization strategies and merging and acquisition activities.

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CHAPTER 2

ALIGNING PRIORITIES IN HEALTHCARE OPERATIONS WITH CUSTOMER PREFERENCES

1. Introduction

The United States healthcare system has experienced considerable turbulence in the past decade, with the passage of the Affordable Care Act (ACA) in 2010 and subsequent amendments proposed in 2017 and 2018. With this turbulence has come a substantial policy debate regarding how this system should operate, particularly in terms of how to pay for healthcare services. Even before the ACA's enactment, the U.S. system faced considerable concerns regarding access to insurance or other payment support, since having insurance often determines the extent of direct healthcare. Of particular concern to many analysts is the system's patchwork of public and private payment sources, including government funding, employer-sponsored insurance, and privately offered community-based plans. Using an operations management perspective, this paper addresses the more basic issue of what consumers seek in a healthcare system. The study includes both primary survey data and secondary data to surface the main concerns outlined by healthcare consumers. This deep dive into the healthcare industry can provide ample implications for policy makers and companies that operate in it (see, e.g., Joglekar et al. 2016). In our study, we explore the key issues which need to be addressed in this industry from healthcare customers' perspectives, and use this information (1) to assess the alignment between those key issues and current operations research themes, thus discover future research

opportunities; (2) to see whether the providers are addressing the issues brought up by consumers; and (3) to assess whether personal characteristics and living environment affect the customers' perception of the key issues of healthcare.

This study is part of a rising theme of industry-specific contextual studies, which has gradually gained interest in the operations management field. For example, Kettunen and Kwak (2018) studied contracts for public procurements from the viewpoint of the owner of procurements, and discovered the relationships between the schedule for contracting public procurements and the cost of procured services or products; Adbi et al. (2019) explored the impact of demand shock on influenza vaccine market structure in India, finding that such shocks result in a reversal of the market structure, with a decline in the market share of multinational vaccine manufactures and significant gains in the market share of domestic vaccine manufacturers; Lawson et al. (2018) achieved empirical evidence of the benefit of combining built-to-forecast and build-to-order order fulfilment strategies at a global automotive producer; and Mills et al. (2018) modeled the process of sending casualties to emergency care facilities with the restriction of capacity and different level of multi-agency coordination, under the situation of multiple-casualty incidents.

One key reason for the single-industry focus of this research is the size and importance of the U.S. healthcare industry. Healthcare is one of the biggest industries in the United States in terms of its economic value. With the recent rapid growth rate, the healthcare industry's share of GDP is projected to be 19.7 percent by 2026, reaching

\$5.7 trillion (CMS National Health Expenditure Projections 2017 – 2026). In contrast, the GDP percentage for developed countries which are known for their sound healthcare systems is around 10% (Germany, 11.3%; Canada, 10.4%; and Japan, 10.7%) (Peterson-Kaiser).

Despite its size, the U.S. healthcare system faces issues that cannot be easily addressed. For example, compared to some other developed countries such as Germany and Japan, the United States has much higher health costs but no better care quality, in terms of number of physicians per capita and infant mortality. Also, despite the improved insured rate under the Affordable Care Act, millions of American still remain uninsured (27.6 million in 2016). As is the case when choosing an operations strategy for an organization, policies and plans on how to allocate limited resources for U.S. healthcare have to be established to achieve the optimal solutions (Boyer and Verma 2009); and priorities on healthcare have to be set properly at multiple levels (Rudan et al. 2007, Durand-Bourjate 2010, Klein 1992), from overall strategy to specific budgeting for individual patients. In particular, the possibility of misplaced priorities in the healthcare system should be investigated.

An operations strategy perspective can be useful in assessing potential priority mismatches. Similar to what were recognized as “competitive priorities” in operations strategy (namely, cost, quality, delivery, and flexibility) (e.g. Boyer and Verma 2009), the healthcare system has goals that compete for resources: maximization of population health, reduction of inequities in health, and financial protection against the

costs of ill health (WTO, 2010 and 2014). To set health priorities to achieve an optimal set of solutions, policy makers have to make strategic decisions such as setting budgets for healthcare expenditures (in contrast to other spending areas such as education), emphasizing primary care versus tertiary care, deciding which diseases to alleviate, allocating resources among different population groups, and setting budget limits for individual patients (Ham 1996). Multiple stakeholders are involved in this process. In the U.S., these stakeholders include government officials, healthcare professionals, public and lay representatives, and government commissions (Sabik and Lie 2008). According to Ham (1992 and 1996), macro level decisions, such as national healthcare budgets, are usually made by politicians, whereas care providers and other healthcare professionals are responsible for micro level decisions, such as the level of intervention in individual patient care.

Researchers have pointed out, however, that policy decisions may not be based on rational processes and that the limited resources are not used to the optimal extent (Baltussen and Niessen 2006, Mitton and Donaldson 2004). The major reason is that due to the nature and complexity of the decision process, the decisions are mostly ad hoc and based on historical or political patterns (Birch and Chambers 1993, Ham 1997, Robinson 1999) rather than on current realities. For example, although research shows that strong primary care is associated with improved population health (Kringos et al. 2013) and that investing in primary care is more effective than paying for tertiary care (MOH Republic of Ghana Ministry of Health 1998), the U.S. continues to invest in specialty care and new technologies, leading to a shortage of primary care providers

(U.S. Department of Health and Human Services 2013) and rising costs of care.

Unable to apply a holistic view and neglecting many factors that influence the process, policy makers are not doing particularly well and need assistance in making those decisions (Baltussen and Niessen 2006, McDaniels et al. 1999, Bazerman 2013).

Similarly, as academic scholars, we need to set our research priorities by allocating limited time and effort to topics that are important and worth exploring. However, just like setting healthcare priorities, the decision processes regarding which criteria to address are somewhat subjective. Most of the time, we are drawn to study what we are familiar with, good at, or curious about, rather than what matters need to be explored. Thus, researchers too, need a better understand of what the issues are, from various perspectives, so that we may apply knowledge from our own disciplines to address them.

To make better choices, politicians, healthcare professionals, and healthcare researchers need to better understand the major issues of the healthcare system and concerns from various perspectives. Of crucial importance among these perspectives is that of the public, for the following reasons (Bruni et al. 2008): due to the public funds applied to the healthcare system, citizens are important stakeholders of the system (Daniels and Sabin 2002); involving the public in policy making promotes the principles of democracy (Goldman 2004); encouraging public insights in making decisions that affect individuals' lives can, in turn, improve public confidence in the healthcare system (Traulsen and Almarsdóttir 2005); and the public provides a

perspective about the values and priorities of the community that could improve the quality of priority decisions (Ham 1993).

One potentially valuable approach for setting healthcare priorities is to apply operations strategy framework. Operations strategy literature identifies four competitive objectives for organizations, which also served as performance measurements, namely, cost, quality, delivery, and performance (Hayes and Wheelwright 1984). Given limited resources, organizations are bound to improve one objective at the expense of the others (Ferdows and Meyer 1990), and they thus have to make tradeoffs and set priorities among the four goals to position themselves in the marketplace.

During the recent decade, we have seen a gradual increase in the quantity of healthcare operations management (HOM) studies. Additionally, the trend has also shifted from the analysis of single healthcare delivery organizations to a broader perspective of a healthcare ecosystem which includes multiple entities (Dai and Tayur 2019). One reason for this trend is that healthcare system stakeholders include more than just care providers and patients. Entities such as government, policy makers, and pharmaceutical companies also play important roles. As a result, the trend encourages operations management researchers to think about the interactions among entities while setting future research priorities (Dai and Tayur 2019).

Based on an operations management perspective, we conducted this study to identify consumers' perceptions of healthcare priorities with a goal of determining how consumers' perceptions are affected by external factors such as government policies, and internal factors such as individuals' sociodemographic variables and living environment. Comparing our findings with a thorough healthcare operations management literature review from several top operations management journals over the past decade, we explore the alignments between issues in healthcare consumers' perception and the topics addressed by our fellow researchers. Based on our results, we respectfully suggest future research opportunities in healthcare operations management.

2. Literature Review

To provide background information related to the theme of this paper, we arrange our review of past research as follows: first, we draw upon the theory of operations strategy, arguing for the necessity of priority setting in HOM research and for including customers' perceptions in that process. Then, we review healthcare articles published in several operations management journals within a 10-year period using the taxonomy of HOM literature established by Dai and Tayur (2019). We further develop our hypothesis by revisiting past studies on the external and internal factors that could drive people's perceptions of healthcare priorities.

2.1 Operations Strategy and Healthcare

Operations strategy is reflected by a set of competitive priorities and structural and infrastructural decisions (Verma and Boyer 2010). Business organizations need to address four competitive priorities: cost, quality, delivery, and flexibility (Hayes and Wheelwright 1984), and organizations are most successful if they focus their efforts on one or a few categories at a time (Ferdows and Meyer 1990). Although operations strategy framework described above was first generated within manufacturing settings, Roth and Velde (1991) proposed that this approach could be adopted in service delivery system design. Thus, drawing upon this well-established framework this paper attempts to provide guidance for setting public healthcare priorities.

While some published research pointed out that through targeting and segmenting customers, organizations can better match supply and demand (Davidow and Uttal 1989, Heskett 1987), others advocate focusing on the customer's definition of quality rather than executives' assumptions (Hart 1988) and delivering values as determined by the customer (Chase and Hayes 1991). This analysis extends beyond simple marketing studies. By incorporating customer insights into operating decisions, the voice of customers is integrated into product development through a Quality Function Deployment (QFD) strategy (Griffin and Hauser 1993, Hauser and Clausing 1988, Fitzsimmons 1994). Moreover, methods of empirical data collection to identify customer needs are also well studied (Griffin and Hauser 1993). Service scholars (Lovelock 1992) also proposed operations and marketing to work together to develop the thorough understanding of the four basic forces in a service business. Those are: (1) What does management want?; (2) What do employees and suppliers want?; (3)

What do customers want?; and (4) What is the organization actually capable of doing? In our paper, we surveyed healthcare customers about their perceptions of the industry regarding what issues are important and urgent, and what issues are not.

2.2 Systematic Literature Review in HOM

Although many problems in healthcare operations management are not analytically different from those in other industries, healthcare and health services have distinctive characteristics. For example, one essential attribute of healthcare is people's quality of life. However, quality of life is difficult to measure, and it is awkward to quantify this with a dollar value. Also, the healthcare system involves shared decision processes among a variety of decision makers, including physicians, nurses, patients, and administrators, and it entails complex reimbursement and payment mechanisms (Pierskalla and Brailer 1994). Thus, we used the taxonomy framework Dai and Tayur (2018 and 2019) proposed in their handbook and HOM review paper, rather than the traditional operations management topics to categorize the sampled HOM articles. In this framework, the sampled HOM articles are grouped into three levels by the scope of issues they are dealing with: macro, meso, and micro. With this framework, we reviewed seven operations management journals: *Production and Operations Management*, *Management Science*, *Manufacturing & Service Operations Management*, *Decision Analysis*, *Journal of Operations Management*, *Decision Sciences*, and *Operations Research*. The term "health care" and "healthcare" were searched in both article title and keywords, with the time span from 2007 to 2017. We found 205 articles that met these criteria.

We categorized all sampled articles into 21 thrusts (Dai and Tayur 2018 and 2019), as shown in Figure 1.1. Among all thrusts, the most studied are organization design (21.5%), design of delivery (17.6%), ambulatory care (15.1%), and resource allocation (10.7%). Barely 10 percent of all the articles we sampled (9.8%) touched upon macro level topics, which deal with the broad strategic directions or overarching policies, the general role of different entities, and the design and structure of the national healthcare system. Among those articles, more than half are focused on the financing of health service (3.9%) and access to health services (2.4%). None talk about health network flow topics, such as the consolidation of hospitals and payers.

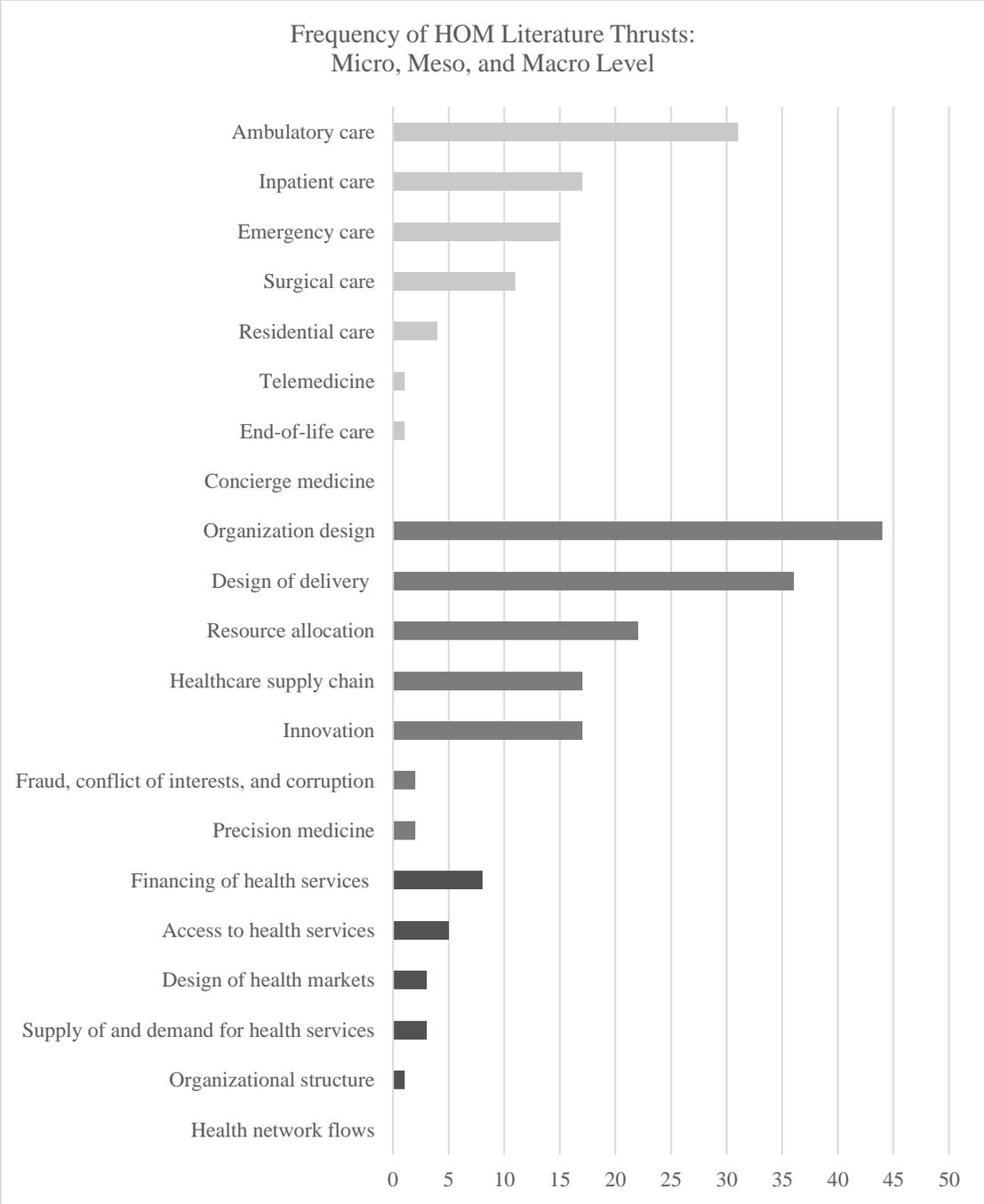


Figure 1.1 Frequency of Healthcare Operations Management Literature Thrusts

The majority (68.3%) of sampled articles explore meso level thrusts in HOM. These deal with the problems that extend beyond specific operations problems within an

organization, but are not as broad as the design of general health markets. Among those papers, many studied organization design (21.5%), for instance hospital design and service flow design, and many explored designs of delivery (10.7%), such as referral strategies, infection prevention, and treatment management. A fair number of papers studied resource allocation (10.7%), the healthcare supply chain (8.3%), and health innovations (8.3%), such as studies on electronic medical records systems.

Thirty-nine percent of sampled articles studied micro level thrusts, that is, specific problems in a single organization, such as ambulatory care (15.1%), inpatient care (8.3%), emergency care (7.3%), and surgical care (5.4%). Only a couple of papers focused on residential care, telemedicine, and end-of-life care (in total 3%), and none studied concierge medicine. Many papers falling into the micro scope studied scheduling, staffing, and capacity planning. Among all specific operations issues, scheduling is the more thoroughly studied. Some 52 papers out of 205 focus on the scheduling issue of patients or care providers.

Acknowledging the current research thrusts leads to our first research question:

RQ1: Is there alignment between current HOM research thrusts and healthcare customers' healthcare priorities?

2.3 Public / Customer Involvement in Healthcare Priority Setting

Needless to say, the public is an important stakeholder in the U.S. healthcare system. As decision makers are increasingly pressured to engage the public in the priority

setting processes (Abelson et al. 2007), many researchers have explored the involvement of the public in healthcare priority setting: the methods, the scope of public engagement, and the results.

In their review, Mitton et al. (2009) sampled 175 empirical articles and found that the majority (58%) of studies used the “middle level interactive” methods to collect public opinions. Those methods include poll and survey, referendum, consultation document, interactive websites, focus group, and study circle. About a quarter (24%) of researchers used “low level interactive” methods to gather information from the public. Those methods include traditional publicity, public hearing, and hotline. Finally, a small portion of studies involved the public with “high level interactive” methods, which include but are not limited to consensus conference, deliberative poll, and town voting meetings (Rowe and Frewer 2005).

Mullen (1999) stated that in practice, the public tends to focus on the location of health service provision along with non-medical aspects. Then, building on Lomas’s (1997) framework of scope of public engagement, Mitton et al. (2009) later summarized that the majority of studies on public involvement in health priorities engage the public in the macro level issues, which deal with the broad system design and functions, while only a small number of studies engage the public in meso and micro level issues, which deal with problems related to more specific services, programs, and populations.

Despite the increasing number of studies in this area, the results are not as satisfactory. In general, research points out that at this stage, public involvement in healthcare priority setting is relatively informal and operates on an ad hoc basis, rather than a formal approach (Mitton et al. 2009). Little research has provided evidence having produced practical guidance for policy making. Our study, building on the operations strategy framework and drawing the knowledge from both operations management literature and healthcare customer data, aim to shed the light on future research opportunities in the HOM field, and provide practical insights for decision makers based on population groups.

2.4 External Factors Affecting Consumers' Perceptions on Healthcare

Many external factors, such as government healthcare policies and general economic status, may affect people's perception of healthcare systems. Our paper focuses on government policies when examining the external impact, due to the necessity of government supervision and legislation in healthcare. For example, healthcare providers cannot deny urgent access to those who did not purchase health insurance, although such care may be limited. Also, for the free market to work, consumers must have the knowledge that choices exist in the market and have the necessary information to make choices, not let others affect their preference easily, and have the time and resources to shop for alternatives (Mor and Yip 2015). Many insurance carriers limit customer choice of healthcare providers, and it is obvious that the conditions we just cited are not satisfied in the healthcare industry. Researchers have studied the consistency between public opinion and government policy and the

potential rationale for such policy (Monroe 1998, Burstein 1998), and have argued that sociologists should review the importance of public policy when analyzing public perception.

As we indicated above, government policies have great impact on the entire healthcare system, including care providers, healthcare organizations, insurance companies, and pharmaceutical companies, not to mention the ultimate consumers of healthcare—patients. For example, on a macro level, two federal government policies enacted after World War II promoted an employer-based system of financing health insurance. First, any fringe benefits from work were exempt from price controls, and, second, fringe benefits did not count as taxable income and thus were not subject to income tax (Barr 2016). Research predicts that policy interventions, if appropriate, could significantly improve population health (Mehta et al. 2017). Even non-health-related social policies, such as receiving government housing assistance (Fenelon et al. 2017) and unemployment benefits (Cylus and Avendano 2017) can unexpectedly affect consumers' health status. On a micro level, for instance, physicians' practice behavior could be changed by policy reform. One study found that policies retracting pharmaceutical sales visits to physicians are linked to significant reductions in prescribing detailed drugs (Larkin et al. 2017).

The Patient Protection and Affordable Care Act (ACA), enacted on March 2010, introduced major changes in overarching government health policies that affect the healthcare system and population welfare. The ACA's main goals of making

affordable health insurance available to more people, expanding the Medicaid program to cover more people, and improving quality of care while lowering the costs, was believed to be the U.S. healthcare system's most significant regulatory overhaul since the passage of Medicare and Medicaid in 1965 (Vicini and Stempel 2012). For example, the Affordable Care Act revised and expanded Medicaid eligibility in 2014, under which all U.S. citizens and legal residents with income up to 133% of the poverty line would qualify for coverage in states that chose to participate. Many studies that have explored the impact of the Medicaid expansion on insurance coverage levels found that it has increased insurance coverage levels, especially in participating states (Hudson and Moriya 2017, Decker et al. 2017, McMorrow et al. 2017, Sommers et al. 2015), improved people's financial condition (Allen et al. 2017, McMorrow et al. 2017), boosted hospitals' financial situation (Blavin 2016); encouraged usage of care (Han et al. 2017), and improved quality of care (a majority of articles found Medicaid expansion is positively associated with improved quality of care) (Cole et al. 2017). As methods to constrain healthcare costs and improve quality, the Affordable Care Act also changed Medicare payment mechanisms to discourage readmissions, initiated bundled payment, and created the Accountable Care Organizations. Studies found that the bundled payment could reduce the intensity of post-acute care without affecting patient health (Huckfeldt et al. 2017); different types of hospital (i.e., in various locations, of various sizes, for-profit or non-profit) are affected differently by those policies (Thompson et al. 2017); and that hospital practice is altered to decrease the thirty-day readmission rate (McHugh et al. 2017). Lissenden and Yao (2017) find that Affordable Care Act changes to Medicare also

improved preventive care by increasing diagnoses of early stage colorectal cancer among U.S. seniors. The Affordable Care Act also established the “insurance mandate” requirement, requiring everyone to either acquire insurance coverage or pay a penalty. Research shows that the insurance mandate has improved access to variety of specialty care (Barry et al. 2017). Under the Affordable Care Act, young adults under 26 years old are allowed to be covered under parents’ insurance plan. Researchers find this change has improved young adults’ (age 19-25) self-reported health and decreased their medical costs (Chua and Sommers 2014). While seeking to decrease healthcare costs and expenditures, the current administration under President Trump has proposed to eliminate the insurance mandates under ACA, cut Medicaid spending and eligibility, and reduce tax credit for healthcare costs. Since not all of those proposals are signed into law when this paper was written, the effect of the new policy remains unclear. Under the assumption that government policies and regulations affect the healthcare system (and therefore customer care), how do customers perceive potential government healthcare policy changes? The recent change in government leadership and potential ongoing healthcare policy reform bring up our second research question:

RQ2: How do external factors, such as (potential) government policy changes, impact patient perception and concerns of healthcare?

2.5 Effect of Sociodemographic and Related Factors on Consumer Perceptions

In addition to external factors, personal characteristics and experiences can also influence people’s perceptions on healthcare. In their 2018 National Vital Statistic

Reports, the Center for Disease Control and Prevention (CDC) listed ten leading causes of death in the U.S. This list, which is led by heart disease, cancer, and accidents, gives only the primary pathophysiological conditions identified at the time of death rather than their root causes (McGinnis and Foege 1993). Each of the conditions results from a combination of internal causes (such as genetic predispositions) and external factors (such as behavioral). For example, heart disease is well known to be related to tobacco use, elevated serum cholesterol levels, hypertension, obesity, and inadequate physical activity. McGinnis and Foege (1993) and Mokdad et al. (2004) found the “actual causes” of death (including but not limited to tobacco use, diet and activity patterns, and alcohol consumption) that caused approximately half of all deaths in 1990 and 2000 in the U.S. are due more to behavior and environment than to medical care. In fact, some argue, based on the study mentioned above, that healthcare (or the lack thereof) only contributes to 10% of premature deaths, while behavioral patterns contribute to about 40%, followed by genetic predisposition (30%), social circumstances (15%), and environmental exposure (5%) (Schroeder 2007). The World Health Organization (WHO) defined social determinants of health as the “conditions in which people are born, grow, live, work, and age” (WHO website, viewed February 11, 2019). Per the request of the WHO Regional Office for Europe, a group of scholars at University College London summarized the pure evidence on the social determinants of health. They listed the social gradient, stress, early life, social exclusion, work, unemployment, social support, addiction, food, and transport as ten social determinants of health (Wilkinson and Marmot 2003).

The link between socioeconomic and health status is also well established: people with higher socioeconomic status, which is “a composite construct of income, total wealth education, emplacement, and residential neighborhood (Schroeder 2007),” are healthier than those with lower socioeconomic status, in terms of age of death and number of disability, and this is true through all social classes (Isaacs and Schroeder 2004, Adler et al. 1993, McDonough et al. 1997, Marmot 2001; Williams and Collins 1995, Minkler et al. 2006). One study found that the difference in life expectancy between the richest 1% and poorest 1% of U.S. individuals (age 40-76) is 14.6 years (Chetty et al. 2016). A possible explanation for this dichotomy is that people with lower socioeconomic states are more likely to engage in unhealthy behaviors. However, this explanation does not hold, because even when holding behavior constant, higher classes are still healthier than lower classes (Isaacs and Schroeder 2004, McDonough et al. 1997, Marmot 2001, Williams and Collins 1995).

Chetty et al. (2016) also found that the location of one’s home affects a person’s health status, especially for the poor, and this variation is significantly correlated with health behaviors such as smoking. In their report, Heiman and Artiga (2015) summarized health-related neighborhood and physical environmental factors such as housing, transportation, safety, parks, playgrounds, walkability, and geographic factors (Henry J Kaiser Family Foundation). As one’s health condition and those around him or her will likely affect his/her healthcare concerns, our third research questions is:

RQ3: Do patients' predisposing characteristics, such as age and gender, and socioeconomic characteristics, such as education and income, affect their healthcare concerns?

3. Research Design and Methodology

3.1 A Multi-year Study

As we outlined earlier, the years 2016 to 2018 witnessed dramatic changes in U.S. public health policy. Due to the changes in control of the government, some of the ACA's provisions were amended, notably the requirement to purchase some kind of health insurance. To capture these changes and their impact on health customers' perceptions, we conducted a multi-year study with the time span of 2016 through 2018. In our study, we combined two sets of data for analysis. One part is a survey data collected yearly by the Survey Research Institute at our university; the other part was secondary archival data collected through various public data sources.

3.2 Survey Data

The Survey Research Institute at our university conducts the Empire State Poll (EMP), an annual survey of New York State adult residents who are age 18 and over. The EMP is a combination of an annual core of community, economic, and social science modules, along with questions on special topics proposed by scholars. The survey sample consists of a dual-frame random-digital-dial sample, covering both cellular and land-line exchanges in New York State. Once a household is sampled, every adult has an equal chance to be included in the poll. Telephone data collection for the full study

began in February each year and ended in April. The average interview length for the all modules was 23 minutes, and only demographic and socioeconomic characteristic questions and questions relevant to our research are included in this study. Interviews were conducted in English and Spanish using a Computer Assisted Telephone Interviewing (CATI) software system. Prior to conducting each round of data, SRI conducted a pilot survey with 25 participants in January of each year after receiving the Institutional Review Board approval from the University's Office of Research and Integrity Assurance. Eight hundred valid interviews were conducted each year. Table 1.1 shows the questions we designed for our study in the EMP, and other questions we used in our study as well.

Table 1.1 List of Interview Questions and Response Choices Used in Our Study

| Construct | Interview question | Response choices |
|--|---|---|
| Most urgent healthcare issue | In your opinion, what is the MOST important problem in U.S. healthcare that needs to be urgently addressed? | Open ended |
| Rating of last visit experience | How would you rate the overall level of customer service experience during your most recent visit to the healthcare facility? | <ul style="list-style-type: none"> - Very poor - Somewhat poor - Average - Somewhat positive - Very positive |
| Metropolitan status code | Provided by MSG (Marketing System Group) | <ul style="list-style-type: none"> - In the center city of an MSA (Metropolitan Statistical Area) - Outside center city of an MSA (but inside county containing center city) - Inside a suburban county of the MSA - In an MSA that has no center city - Not in an MSA |
| New York state region (upstate/downstate) | SRI defines “downstate” as the following nine-county region: Westchester, Rockland, Bronx, New York, Richmond, Kings, Queens, Nassau and Suffolk | <ul style="list-style-type: none"> - Downstate - Upstate |
| Personal financials- Past year | We are interested in how people are getting along financially these days. Would you say that you (and your household) are better off, worse off, or just about the same financially as you were a year ago? | <ul style="list-style-type: none"> - Worse - About the same - Better - Do not know |
| Personal financials- Next year | Now looking ahead, do you think that a year from now you (and your household) will be better off financially, worse off, or just about the same as now? | <ul style="list-style-type: none"> - Worse - About the same - Better - Do not know |
| Employment status | Last week, did you do any work for either pay or profit? Include any job from which you were on vacation, temporarily absent, or on layoff | <ul style="list-style-type: none"> - Yes - No - Retired - Disabled - Unable to work |
| Social ideology | When it comes to social issues, do you usually think of yourself as: | <ul style="list-style-type: none"> - Extremely liberal - Liberal - Slightly liberal - Moderate or middle of the road - Slightly conservative - Conservative - Extremely conservative |
| Political party | Generally speaking, when it comes to political parties in the United States, how would you best describe yourself? | <ul style="list-style-type: none"> - Strong democrat - Not very strong democrat - Independent, close to Democrat - Independent, close to neither - Independent, close to Republican - Not very strong Republican - Strong republican |
| Marital status | Are you married, divorced, separated, widowed, or single? | <ul style="list-style-type: none"> - Married - Divorced - Separated - Widowed - Single |

| | | |
|--------------------------------------|--|---|
| Born in US or to an American | Were you born in the United States or in one of its territories (Puerto Rico, Guam, the Virgin Island), or abroad to an American parent? | <ul style="list-style-type: none"> - Born in the U.S. - Born abroad to an American parent - Not born in the U.S. (nor a territory) nor to an American |
| Age | What year were you born? | Age was calculated from the year of birth |
| Gender | Recorded by the interviewer | <ul style="list-style-type: none"> - Male - Female |
| Education level | What is the last grade or class that you completed in school? | <ul style="list-style-type: none"> - None, or grades 1-8 - High school incomplete (grades 9-11) - High school graduate (grade 12 or GED certificate) - Technical, trade, or vocational school after high school - Some college, no 4-year degree (including Associate degree) - College graduate (BS, BA, or other 4-year degree) - Post-graduate training or professional schooling after college |
| Hispanic or Latino | Are you, yourself, of Hispanic origin or descent, such as Mexican, Puerto Rican, Cuban, or some other Spanish background? | <ul style="list-style-type: none"> - Yes - No |
| Race | What best describes your race? Please tell me yes or no for each of the following races: white or Caucasian; black or African-American; American Indian, Aleut, Eskimo; Asian or Pacific Islander; Other. | <ul style="list-style-type: none"> - Yes - No <p>To each race question (total of 5 questions)</p> |
| Household size | How many total people in your household are adults (65 and older), adults (18-64), children (under 18). | None. Respondents indicated the number of people in each age group separately. |
| Household income before taxes | Two questions covered income. The first question asked interviewees what was their total household income in 2015 from all sources, before taxes. Follow up questions asked interviewees instead of a specific number, indicate if their total household income was under or over \$50,000 and then use a scale to indicate their income level. Best responses obtained from these questions were used to code income. | |

3.3 Archival Data

As stated above, health customers’ social-demographic characteristics and living environment have the potential to affect their healthcare perceptions and concerns. To balance possible subjectivity in the survey, we also added secondary data achieved from variety of public sources. As shown in Table 1.2, all archival data are at the county level, describing the counties’ characteristics, including physical living environment, socioeconomic facets, and healthcare facts.

Table 1.2 Archival Data: Variables, Sources, and Descriptive Analysis

| Variables | Description and Source | Unit | Min | Max | Mean | SD |
|---|--|--------------------|------------|------------|-------------|-----------|
| Population Density/1000 | Population density per square mile of land area by county, data of 2010. Source: http://www.census.gov | Count | 0.02 | 69.47 | 15.78 | 23.22 |
| Percent Poverty | Poverty estimates by county, data of 2015. Source: http://www.census.gov | Percentage | 6.00 | 30.30 | 15.71 | 5.50 |
| Percent Uninsured | Percent without health insurance coverage by county, data of 2015. Source: http://www.census.gov | Percentage | 4.90 | 20.20 | 8.88 | 2.83 |
| Weighted Average TPS Quality Score | TPS (Total Performance Score) weighted by total number of staffed beds by each county. Archived 03/03/2018. Source: https://www.ahd.com | Score, range 0-100 | 21.04 | 64.00 | 33.71 | 6.57 |
| Sum of Total Beds | Number of total staffed beds by county. Archived 03/03/2018. Source: https://www.ahd.com | Count | 67.00 | 6150 | 2858.55 | 2199.15 |
| Length of Life | Calculated score by county, data of 2017. The lower the better health ranking. Source: http://www.countyhealthrankings.org/ | Score | -1.07 | 1.21 | -0.27 | 0.54 |
| Health Behaviors | Calculated score by county, data of 2017. The lower the better health ranking. Source: http://www.countyhealthrankings.org/ | Score | -0.52 | 0.40 | -0.10 | 0.22 |
| Clinical Care | Calculated score by county, data of 2017. The lower the better health ranking. Source: http://www.countyhealthrankings.org/ | Score | -0.24 | 0.29 | -0.02 | 0.14 |
| Physical Environment | Calculated score by county, data of 2017. The lower the better health ranking. Source: http://www.countyhealthrankings.org/ | Score | -0.07 | 0.08 | 0.01 | 0.04 |
| Monthly Premium | Monthly premiums for second lowest cost silver plans (SLCSP), by county – individual. Data of 2016, 2017, and 2018. Source: https://nystateofhealth.ny.gov/ | USD | 353.19 | 618.25 | 460.29 | 66.51 |
| Price-Adjusted Medicare Reimbursement Per Enrollee | The amount of price-adjusted Medicare reimbursements per enrollee by county. Data of 2016, 2017, and 2018. Source: http://www.countyhealthrankings.org | USD | 6796.00 | 11980.00 | 9435.29 | 1109.39 |
| Average Cost of Drugs | The average of three prices from the most common pharmacy of the particular region. 6 of top 10 prescribed drugs in the US were used for price comparison. Data of 2010. Source: https://apps.health.ny.gov/pdpw/SearchDrugs/Home.action ; https://www.medicinenet.com/top_drugs_prescribed_in_the_us/views.htm | USD | 80.00 | 340.00 | 125.76 | 33.32 |

3.4 Unstructured Data: Text Coding

The survey question that was used as dependent variable in our later analysis was in the form of open-ended question: “In your opinion, what is the MOST important problem in U.S. healthcare that needs to be urgently addressed?” Thus, qualitative analysis is necessary before any quantitative analysis: similar concepts need to be clustered into categories (Ruona 2005, Downe-Wamboldt 1992). Two of the authors and one research assistant each completed two rounds of the coding process separately. We each read through all answers, identified frequent topics, determined categories, assigned categories to each response, and then compared everyone’s coding during discussions to achieve the final coding results. This coding process produced quantitatively analyzable dummy variables associated with each topic, with “1” marked as the respondent mentioned this topic in her response, “0” otherwise. Frequency analysis is conducted on the topics, bearing in mind that each response could be assigned to more than one topic.

3.5 Generalized Estimating Equations

Generalized Estimating Equations (GEE) were used to further explore the external and internal impact factors of customer’s healthcare priority perceptions. GEE was developed as a method to extend Generalized Linear Model (GLM) by accommodating repeated measures and other models where relationships between successive measurements on the same subject are assumed to influence the estimation of model parameters (Horton and Lipsitz 1999). The assumptions to run GEE in this study are that the individuals from the same county are not independent from each

other and that each individual was equally affected by the county he or she lives in. The dataset contains repeated measurement – each individual is nested within one of 58 counties, and county is the repeated measure in all of our models. Using three separated binary logistic GEE regressions, we explored the external and internal factors that are associated with the probability that healthcare customers believe that certain specific healthcare concerns should be given the highest priority in U.S. healthcare system. The GEE function in SPSS was used to perform this analysis (Heck et al. 2013). In all models, we used estimated marginal means for different levels of categorical predictor variables to compare demographic groups. For example, in Model 1, estimated marginal means were used to understand whether males are more likely than females to perceive costs of care as the most important healthcare issue in the US. Figure 1.2 shows the process of our research design.

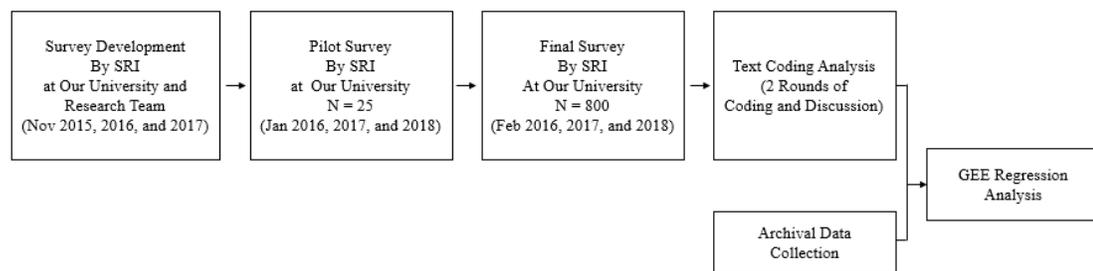


Figure 1.2 Research Design and Methodology

4. Results

4.1 Unstructured Data

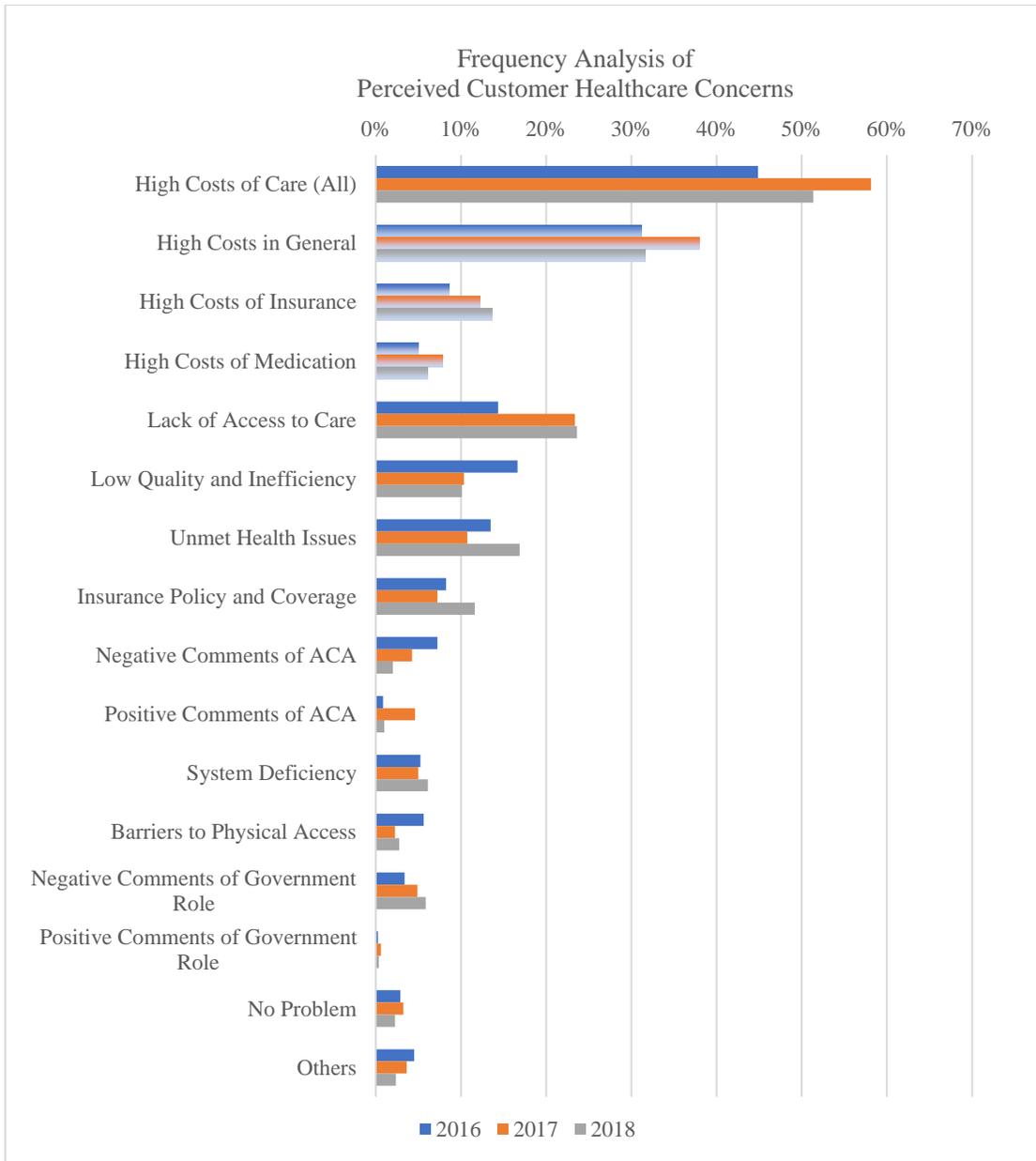
Table 1.3 shows all major categories extracted from the open-ended question and a brief description of each category, along with some example responses assigned to each category.

Table 1.3 List of Topics (Categories) of Perceived Customer Healthcare Issues

| Category | Category description | Example Responses |
|---|---|--|
| High Costs of Care | Includes concerns with costs of healthcare, such as costs in general, costs of medication, and costs of insurance | “They have to bring down the price of medicine because people are dying”; “Cost. We shouldn’t have to spend this much money to keep ourselves healthy” |
| Lack of Access to Care | Comments concerns coverage and access to healthcare of entire population and certain sub-population groups | “Affordable healthcare for all”; “Insurance for the poor”; “We need to provide more universal healthcare”; “We need a single-payer system. Healthcare is a human rights issue” |
| Low Quality and Inefficiency | Concerns regarding wait time, scheduling, resource waste, communication, clinical competency, hospital quality, healing environment | “You should not have to wait for your appointment”; “I think the quality of the healthcare needs to be improved” “They need better ways to explain the copy and stuff to customers. It is all very confusing” |
| Unmet Health Issues | Comments regarding treatment for specific diseases, special care for certain population groups, drug issues, and preventive care | “The health of the elderly”; “Maybe preventative care through healthier living”; “Heroin epidemic”; “Female troubles”; “They have to cure cancer and diabetics and all those bad diseases” |
| Insurance Policy and Coverage | Comments related to health insurance policies, such as coverage of certain items, coverage of visiting certain physicians and hospitals | “Deductibles, high premiums, and the level of coverage”; “The price or the fact that only certain insurances are only accepted in certain places” |
| Negative Comments of Affordable Care Act | Comments that express negative opinions about Affordable Care Act and mandatory insurance | “Obamacare needs to be removed”; “The conflict between taking care of people who can’t buy healthcare because of their situation and the people who are forced to buy healthcare because of regulations when it’s not right for their situation” |
| Positive Comments of Affordable Care Act | Comments that express negative opinions about Affordable Care Act, or worry about repealing Affordable Care Act without a functional plan | “Obamacare, needs to be reformed a little bit. Good for communities though”; “Preventing the appeal of the Affordable Care Act”; “We need the Affordable Care Act to remain. We need people to be covered”. |
| System deficiency | Comments concerns healthcare system abuse, the role and power of insurance and pharmaceutical companies, immigrants occupying resources | “Insurance companies, and their whole behavior towards healthcare”, “I think the most urgent problem is that people are using the emergency room as their regular doctor” |
| Barriers to Physical Access | Physical access to healthcare, such as transportation, need reference and introduction to a specialist, or not enough time with physician | “Transportation and accessibility”; “Inability to access the best doctors hard to change different doctors when you have been seen one. Cannot switch very easily”. |
| Negative Comments of Government Role | Comments about government policies, regulations, laws, and being too involved in the healthcare system | “Getting the government out of it is the biggest issue”; “Being able to sell insurance nation-wide instead of being limited to states” |
| Positive Comments of Government Role | Comments that demand more government involvement, more laws, regulations and so on | “The health insurance as a whole it needs regulation”; “The entire U.S needs to have a better government healthcare system. We can afford to have better healthcare” |
| No Problem | Respondents that do not have any issues with the current healthcare system | “No problems with healthcare”; “I am being taken care of very well” |
| Others | Other issues than stated above with frequency lower than 5 | “Racism”; “The middle class”; “There should be more employment” |

Frequency percentage of major categories was calculated and summarized in Figure

1.3.



*High Costs of Care (All) includes: High Costs in General, High Costs of Insurance, and High Costs of Medication

Figure 1.3 Frequency Analysis of Perceived Customer Healthcare Concerns

The conclusions from the qualitative analysis are as follows. First of all, the high cost of care is the issue of greatest concern for healthcare customers during the three years of the study. These costs include the expense of care in general, of medication and of insurance. Other issues of high concern are access to care, quality of service, and low

efficiency. Among all respondents, only a small portion (2.8%) believe there is no problem in U.S. healthcare that needs urgent attention.

At a closer look, among all respondents referring access as their highest priority healthcare concern, 65.7% believe the essence of the problem is the lack of availability of coverage of the population. Another 28.5% state that the problem is a lack of a single payer system or universal healthcare. When the respondents list quality and efficiency as their top concerns, 46.4% are worried about efficiency of the system and communication among stakeholders, 31.8% believe the quality of care and service needs urgent improvement, 14.2% question the competency of healthcare providers, and others believe the hospital and healing environment needs to be improved. Among all respondents who list unmet health issues as the most urgent healthcare concern, 43.9% want to prioritize developing a cure and treatment for specialized diseases such as cancer, 20.0% believe preventive care should be given a high priority, 15.8% appeal for better senior care, and 20.3% believe drug issues, such as over-prescription and legalization of marijuana, should be top priorities.

Change in frequency by year is also directly observable. In 2016, the top three healthcare priorities among the respondents were costs of care, quality and efficiency, and access to care. In 2017, more respondents worried about costs of care and access, and fewer about quality and efficiency and unmet health issues. 2018 saw an increase in the number of respondents who worried that costs of insurance continue to increase. However, that year's respondents focused less attention on general costs of care and

costs of medication. More tension rises on the availability and costs of insurance policies and coverage, and on unmet health issues, especially treatments for specialized diseases. Negative comments regarding government involvement increased over the three years, and negative comments on the ACA decreased.

4.2 Generalized Estimating Equations

We further explored what external and internal factors may affect the most frequently mentioned customer healthcare concerns. Since each year's top concerns are not exactly the same, to achieve consistency, we selected the items in the frequency ranking of year 2016, namely, costs of care, access to care and insurance coverage, and quality and efficiency of care. For each of those three health concerns, we ran a binary logistic GEE regression model, using the binary variable created from the topics as the dependent variable. For example, in model 1 "costs of care," the dependent variable is a binary variable where value "1" means the respondent indicates costs of care is the most important issue in healthcare, and "0" means the respondent does not mention costs of care in her comment.

The independent variables consist of two parts: individual level variables from our survey, and county level variables from public sources. The individual level variables include basic demographic and socio-economic characteristics of the respondents, and the county level variables are used to capture respondents' living environment. Full lists of variables included can be found in the model description tables below. For each of the three models, we first run them with only personal level survey variables,

and then we add county level variables. This process allows us to see how taking the living environment into consideration can affect the personal impact factors.

The results of Model 1, in which cost of care is the dependent variable, are shown in Table 1.4 and Table 1.5. Model 1_1 only includes individual level survey variables, while model 1_2 adds county level variables.

Table 1.4 GEE Regression Results: High Costs of Care

| Predictor (degree of freedom) | Model 1_1 Wald Chi-Square | Model 1_2 Wald Chi-Square |
|---|------------------------------|------------------------------|
| Year (2) | 7.140* | 15.749** |
| Age | 0.170 | 0.073 |
| Gender (1) | 11.842** | 6.650* |
| Number of individuals older than 65 years old in the household | 0.062 | 0.106 |
| Number of individuals between 18 and 64 years old in the household | 0.465 | 0.010 |
| Number of individuals younger than 18 years old in old in the household | 0.322 | 0.009 |
| Employ status (3) | 9.260* | 7.350 |
| Perceived personal financial – future (2) | 15.376** | 5.438 |
| Household income (1) | 14.366** Exp(B)=1.091 | 40.660** Exp(B)=1.108 |
| Born in the U.S (1) | 3.557 | 0.027 |
| Marital status (2) | 0.630 | 4.302 |
| Social ideology (2) | 7.712* | 4.717 |
| Education (3) | 8.460* | 4.416 |
| Population density/1000 | | 4.910* |
| Poverty percentage | | Exp(B)=0.995 3.472 |
| Uninsured percentage | | 5.972* |
| Weighted average TPS quality score | | Exp(B)=0.916 0.543 |
| Sum of total beds/1000 | | 0.902 |
| Length of life | | 8.597** Exp(B)=0.620 |
| Health behaviors | | 1.275 |
| Clinical care | | 4.110* |
| Physical environment | | Exp(B)=5.181 0.020 |
| Monthly premium | | 0.273 |
| Price-adjusted Medicare reimbursement per enrollee | | 7.415** Exp(B)=1.000 |
| Average cost of drugs | | 5.521* Exp(B)=0.998 |

Table 1.5 GEE Regression Results: High Costs of Care – Estimated Marginal Means for Categorical Variables

| Predictor (degree of freedom) | Model 1_1 Mean | Model 2_2 Mean |
|--|-------------------|-------------------|
| Year (1) | | |
| 2016 | 0.29 | 0.32 |
| 2017 | 0.34 | 0.40 |
| 2018 | 0.28 | 0.30 |
| Gender (1) | | |
| Male | 0.33 | 0.36 |
| Female | 0.28 | 0.31 |
| Employ status (3) | | |
| Employed | 0.35 | |
| Unemployed | 0.36 | |
| Retired | 0.29 | |
| Not able to work | 0.23 | |
| Perceived personal financial – future (2) | | |
| Worse | 0.34 | |
| About the same | 0.32 | |
| Better | 0.25 | |
| Social ideology (2) | | |
| Liberal | 0.34 | |
| Moderate | 0.30 | |
| Conservative | 0.27 | |
| Education (3) | | |
| High school graduate or below | 0.32 | |
| Non-4year degree college | 0.32 | |
| College graduate (4-year degree) | 0.27 | |
| Post-graduate training or professional schooling after college | 0.30 | |

Controlling for the repeated measure and other sociodemographic variables, Model 1_1 shows that year, gender, employment status, self-reported personal future financial status, household income, social ideology, and education level are statistically significant in explaining cost of care as the most important healthcare issue. With regard to those variables, respondents in 2017 are 17.2% more likely to be concerned with costs than in 2016; male respondents are 17.9% more likely than

females to be concerned with costs; the unemployed are most likely to worry about costs of care, while the people who are not able to work are least likely to worry; respondents who feel unconfident about their future financial status are 38.5% more likely to be concerned with cost of care than those who feel confident; liberals are 38.5% more likely than conservatives to worry about costs of care; and the relationship line between education level and probability of worrying about costs goes down and up, with people who are college graduated least likely to be concerned with costs. Counterintuitively, we found that as income level increases, the probability of worrying about costs increases as well.

After adding county level variables, as shown in model 1_2, year, gender, and household income are still significantly associated with the probability of people believing that cost is the most important issue. However, employment status, personal future financial status, and social ideology became insignificant. On the county level, population density, uninsured percentage, length of life, clinical care quality, Medicare reimbursement per enrollee, and average costs of drugs are found to be significantly associated with customer perceptions of cost of care. Whereas population density, uninsured percentage, length of life, and average costs of drugs are negatively associated with the probability of worrying about costs, clinical care quality is positively associated.

A similar analysis was performed with the dependent variable access, a dummy variable with value “1” meaning the respondent indicate “lack of access to coverage

and care” and value “0” meaning otherwise. The results of model 2 are presented in Table 1.6 and Table 1.7.

Table 1.6 GEE Regression Results: Lack of Access to Care

| Predictor (degree of freedom) | Model 2_1 Wald Chi-Square | Model 2_2 Wald Chi-Square |
|---|------------------------------|------------------------------|
| Year (2) | 10.144** | 8.732* |
| Age | 0.561 | 0.514 |
| Gender (1) | 0.075 | 0.329 |
| Number of individuals older than 65 years old in the household | 1.446 | 0.704 |
| Number of individuals between 18 and 64 years old in the household | 0.011 | 0.218 |
| Number of individuals younger than 18 years old in old in the household | 12.664** | 11.657** |
| Employ status (3) | Exp(B)=0.816 | Exp(B)=0.798 |
| Perceived personal financial – future (2) | 5.064 | 3.976 |
| Household income (1) | 1.131 | 0.253 |
| | 5.564* | 5.674* |
| Born in the U.S (1) | Exp(B)=1.069 | Exp(B)=1.077 |
| MSC(4) | 2.836 | 2.311 |
| Political Party (2) | 2.332 | 3.691 |
| Social Ideology (2) | 27.011** | 23.115** |
| Education (3) | 37.021** | 37.380** |
| Population density/1000 | 11.403* | 22.006** |
| Poverty percentage | | 1.877 |
| Uninsured percentage | | 0.073 |
| Length of life | | 1.467 |
| Health behaviors | | 0.164 |
| Clinical care | | 0.677 |
| Monthly premium | | 0.027 |
| | | 4.382* |
| Price-adjusted Medicare reimbursement per enrollee | | Exp(B)= 1.003 |
| | | 6.882** |
| Average cost of drugs | | Exp(B)=1.000 |
| | | 2.733 |

Table 1.7 GEE Regression Results: Lack of Access to Care Estimated Marginal Means for Categorical Variables

| Predictor (degree of freedom) | Model 2_1 Mean | Model 2_2 Mean |
|--|-------------------|-------------------|
| Year (1) | | |
| 2016 | 0.12 | 0.12 |
| 2017 | 0.19 | 0.19 |
| 2018 | 0.19 | 0.17 |
| Political party (2) | | |
| Democrat | 0.22 | 0.21 |
| Independent | 0.17 | 0.16 |
| Republican | 0.11 | 0.11 |
| Social ideology (2) | | |
| Liberal | 0.25 | 0.24 |
| Moderate | 0.13 | 0.12 |
| Conservative | 0.12 | 0.12 |
| Education (3) | | |
| High school graduate or below | 0.15 | 0.15 |
| Non-4year degree college | 0.18 | 0.17 |
| College graduate (4-year degree) | 0.14 | 0.13 |
| Post-graduate training or professional schooling after college | 0.18 | 0.18 |

As shown in model 2_1, controlling for the repeated measure and all other sociodemographic factors, we found that year, number of children in household, household income, political party, social ideology, and education level are statistically significant in explaining the probability of healthcare customers perceiving lack of access as the most important healthcare issue.

Several variables were associated with an increase in respondents' worry levels. In years 2017 and 2018, respondents are 58.3% more likely to worry about access to care and coverage than in 2016; Democrats and liberals are more likely to be concerned

with access to care than conservative Republicans; and college graduates are most likely to worry about access to care than those with less education. Number of children in household is negatively associated with the probability of believing access should be given the highest priority among all healthcare issues, whereas household income is positively associated.

In model 2_2, after adding the county level variables, all previously significant variables remained statistically significant. On the county level, average monthly insurance premium is positively associated with the probability of perceiving lack of access as the most important healthcare issue.

Table 1.8 and table 1.9 show the results of Model 3, which use quality of care and low efficiency dummy variable as dependent variable.

Table 1.8 GEE Regression Results: Low Quality and Inefficiency

| Predictor (degree of freedom) | Model 3_1 Wald Chi-Square | Model 3_2 Wald Chi-Square |
|---|------------------------------|------------------------------|
| Year (2) | 21.136** | 3.887 |
| Age | 0.378 | 0.506 |
| Gender (1) | 6.364* | 5.011* |
| Number of individuals older than 65 years old in the household | 0.039 | 0.823 |
| Number of individuals between 18 and 64 years old in the household | 0.199 | 0.321 |
| Number of individuals younger than 18 years old in old in the household | 0.777 | 0.520 |
| Employ status (3) | 2.995 | 3.798 |
| Household income (1) | 3.281 | 4.672* Exp(B)=0.910 |
| Born in the U.S (1) | 0.356 | 0.646 |
| MSC (4) | 8.001 | 4.780 |
| Rate your last hospital visit experience (1) | 63.051** Exp(B)= 0.648 | 60.291** Exp(B) = 0.636 |
| Social ideology (2) | 13.148** | 14.083** |
| New York State region (1) | 4.606* | 1.962 |
| Education (3) | 0.356 | 1.046 |

| | |
|--|----------------|
| Population density/1000 | 0.021 |
| Poverty percentage | 5.639* |
| Uninsured percentage | Exp(B) = 1.052 |
| Weighted average TPS quality score | 0.511 |
| Sum of total beds/1000 | 0.446 |
| Length of life | 0.898 |
| Clinical care | 1.097 |
| Physical environment | 4.036* |
| Monthly premium | Exp(B) = 0.065 |
| Price-adjusted Medicare reimbursement per enrollee | 0.101 |
| Average cost of drugs | 0.055 |
| | 0.001 |
| | 2.588 |

Table 1.9 GEE Regression Results: Low Quality and Inefficiency – Estimated Marginal Means for Categorical Variables

Table 9.

| Predictor (degree of freedom) | Model 3_1 Mean | Model 3_2 Mean |
|-------------------------------------|-------------------|-------------------|
| Year (2) | | |
| 2016 | 0.15 | |
| 2017 | 0.09 | |
| 2018 | 0.09 | |
| Gender (1) | | |
| Male | 0.09 | 0.10 |
| Female | 0.13 | 0.14 |
| Metropolitan Status Code | | |
| In the center city of an MSA | | |
| Outside center city of an MSA | | |
| Inside a suburban county of the MSA | | |
| In an MSA that has no center city | | |
| Not in an MSA | | |
| Social Ideology | | |
| Liberal | 0.08 | 0.08 |
| Moderate | 0.14 | 0.16 |
| Conservative | 0.11 | 0.13 |
| New York State Region | | |
| Downstate | 0.13 | |
| Upstate | 0.09 | |

In Model 3_1, controlling for the repeated measures and all other sociodemographic characteristics, we found that year, gender, most recent hospital visit experience,

social ideology, the part of the state in which one lives, and education level are statistically significant in explaining whether healthcare customers believe that the quality of care and lack of efficiency are the most important issues in healthcare. Respondents were 66.7% more likely to be concerned with quality and efficiency in 2016 than in 2017 and 2018; female respondents are more concerned with this issue; people who are more conservative are more likely to be concerned with quality and efficiency; people who live in downstate New York are more likely to worry about quality and efficiency than those who live in upstate; and people who had a better experience during their most recent hospital visit are less likely to worry about the quality and efficiency.

After adding the county level variables, year, household income, and state region become insignificant. On the county level, poverty level is positively related to the probability of being concerned with quality of care and low efficiency, and clinical care quality is negatively related.

5. Discussion and Conclusions

Applying operations strategy framework, our paper empirically examined consumers' perspectives regarding healthcare priority setting, and compared it to operations management research thrusts for potential research opportunities. To our knowledge, our study is the first to explore customers' perceptions of healthcare issues from an operations strategy perspective, with survey data strictly stratified to represent the population. Also, the multi-year feature of the survey further validates our findings.

The time period (2016-2018) nicely captured significant changes in government health policy, thus yielding solid and inspiring results.

Another contribution of our paper is that we provided empirical evidence of the “Iron Triangle of Health Care.” This concept was first introduced in 1994 by William Kissick, the father of Medicare (Kissick 1994), describing three issues which are the primary concerns of all healthcare systems: cost, access, and quality. Those three issues compete for resources, and it was believed that when one of the three changes, the other two will be affected. Over the years, government policy makers have attempted to solve this complicated problem set, for example, by improving quality of care without increasing cost. Based on our qualitative coding and frequency analysis results, we provide seminal evidence that the three issues in the “Iron Triangle of Health Care” happen to be what worries customers the most. This finding provides confirmatory information for healthcare industry stakeholders who have been devoted to addressing those issues.

Another straightforward finding is that cost of care, access to care and coverage for all, and quality of care and system efficiency are perceived by healthcare customers as the healthcare issues that need to be most urgently addressed. This information, above all, tells us what customers want in healthcare: they want it to be affordable, they want access to insurance coverage, and they want reliable care. As a consequence, resources should be allocated accordingly. Along with rising costs, the concept “value of care” has become increasingly popular. Porter (2006) defined value as “the health outcomes

achieved per dollar spent.” In the healthcare context where the information asymmetry level is high, the issues of who should be the one to decide how much to spend on a case and where should the point be to stop treatment from the value point of view are ethically difficult to determine. Yet operations management theories on the decision making process, for both providers and patients, may shed some light. The uninsured rate has always been lower in the U.S. than in some other developed countries such as Germany and Japan. While it is the government’s responsibility to decide whether a single payer system should be adopted, the operations management field could expand the insurance coverage rate under the current system by methods such as modeling the insurance companies’ product price system and patients’ decision process of choosing an insurance product. Regarding quality of care, the recent “patient-centered care” concept emphasizes the role of patients and their participation in co-creating high quality care. Under this concept, the quality of non-clinical aspects of care, such as emotional wellbeing, is considered as important as the clinical aspect of care, including physical wellbeing. In this regard, the operations management field could build upon service operation theories and infuse service excellence into healthcare settings.

In facing resource allocation issues, those that are not important to customers are as crucial as those that are. Bearing in mind that our survey covered only New York State, we found that few respondents in our survey commented on the physical access to health service, such as lack of transportation or being too far away from any healthcare facility. Also, only several people mentioned any concern over the quality

of the hospitals, in terms of safety and cleanness. As a developed country, basic infrastructure such as healthcare facilities and transportation networks are well developed. Thus, further investments in those areas may not achieve marginal utility as high as would be true in other areas.

The results provide some inspiring directions, if not the precise answers, to our research questions. We discovered that the alignments and mismatches between current HOM research streams and customers' perceived issues are mixed. That is, fair alignments exist in some areas, as many papers are studying what customers are frequently worried about. Meanwhile, mismatches also exist when concerns that worry customers are not being addressed by research, or when research focuses on issues that are not frequently brought up by customers.

Looking more deeply into alignment issues, we note that customers' most frequently mentioned concern is cost of care, but not many HOM research articles directly address the cost issue. That said, much research studies questions that help contain or even reduce the cost of care. For example, at the micro level we found HOM papers that examined issues on ambulatory care (Cayirli and Rosen 2008, Liu and Ziya 2014, Liu 2016), inpatient care (Lemay et al. 2017), and emergency care (Batt and Terwiesch 2015) focused on scheduling and queuing of both patients and care providers, with a goal of reducing idle time and improving efficiency, thus decreasing costs in the long run. Quality remains an operations problem, and many customers brought up their concerns with quality of care and service. Likewise, many research

papers are indeed trying to solve this matter, with studies that include quality of clinical care (Anderson et al. 2014) quality of service in healthcare settings (Zheng et al. 2018, Theokary and Ren 2011), and the combination and tradeoff between the two (Senot et al. 2015).

The most noticeable mismatch in the HOM literature is access to care and coverage. This was the second most frequently cited healthcare issue of customers, but it was not explored often in HOM literature. To be clear, access does not mean the physical access to healthcare services, such as “need a referral” or “need transportation to facility” or “waitlist is too long.” Instead, this issue involves peoples’ access to insurance coverage at a macro level, such as “universal healthcare” or “everyone should be covered for healthcare.” This requires macro level decision making, and some may argue that it is more political than operational. However, when viewed as allocating healthcare resources to different population and locations on a national level, access is one of the original issues that operations management has tried to address ever since World War II (Chopra et al. 2004). Many research opportunities emerge from here, such as exploring how insurance companies could provide affordable coverage to broader population groups while still making a reasonable profit; or modeling the decision process of how customers choose whether to purchase insurance, and, if so, what kind of insurance to have. Another issue that appears more frequently in this study than in previous research is unmet health issues. Here, operations management could at least contribute to the expansion of preventive care and improve the quality of senior care. Research directions such as identifying the

optimal locations of preventive care clinics to improve coverage of the local communities, the decision process to use for offering preventive care services, the insurance policies to cover preventive care, and the application of healthcare operations methods to senior care facilities could be beneficial.

Our results also provide implications on research questions 2 and 3. The year of data collection played a statistically significant role in all three healthcare issues identified as being the greatest concerns (although after adding county level data, year becomes insignificant in explaining quality and efficiency). Specifically, in 2017, after the ACHA (BCRA) was in discussion, people report being more worried about costs of care and access to care and coverage, while paying less attention to quality and efficiency. Although the change in identified concerns cannot represent change in government policy directly, it still provides evidence of how government policy could affect respondents' concerns. The results are aligned with the predictions of the potential impact of ACHA (BCRA). If passed, it would increase the number of uninsured by 23 million within 10 years ((Kurtzleben 2017); insurance premiums would likely to increase for the old and poor (Kurtzleben 2017, Congressional Budget Office 2017); Medicaid enrollees would be decreased by 15 million in 2026, due to reductions in Medicaid funding (Congressional Budget Office 2017). Thus, as healthcare consumers interpret the policy, they would reflect on how the policy might affect their ability to pay for healthcare; thus their perceptions and concerns are affected. Research question 3 is also answered. Several demographic and social-economic characters, along with some features of the living environment, are found to

be important in explaining people's perception of the importance of healthcare issues. These findings are useful for providers, companies, and policy makers when they segment the market.

The results presented in this paper have several implications for healthcare stakeholders, including healthcare insurers, providers, and policy makers, in terms of where to allocate more resources, and where not to. For example, when non-healthcare companies move into healthcare area, such as Amazon.com, Berkshire Hathaway, and JPMorgan, they may want to contain the costs for customers and broaden the access to coverage before rushing to new incentives. Healthcare policy makers could draw upon our findings and encourage more value-based healthcare programs and policies to contain customer costs and increase value. Also, the findings regarding personal characteristics could help companies design and market their products to the fit customer segments.

6. Limitations

A substantial limitation of this study's survey data is that it comprises only New York state residents. While carefully stratified to represent the entire population in New York State, we suspect that residents of other regions of the U.S could have different priorities. To address this issue, we have conducted a national survey since 2017, and will do the same analysis to compare the results. A second limitation is that, we used just the year to represent external impacts on customers' healthcare concerns. For future research, factors such as economic status and unemployment rate should also be

taken into consideration. Finally, our findings suggest how consumers perceive the issues in the healthcare system, which is only half of the story. We have not explored how other stakeholders, such as healthcare providers, companies, and policy makers, perceive the same issue. Future studies could focus on this and combine the findings, to suggest optimal solutions.

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CHAPTER 3

USAGE AND IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN HEALTHCARE DELIVERY

1. Introduction

Healthcare expenditure accounts for a significant share of Gross Domestic Product (GDP) in many countries (for example Germany (11.3%), Canada (10.4%), Japan (10.7%) and USA 17.9% (Peterson-Kaiser²). Meanwhile, during the last few years, there have been significant changes in how health services are delivered to patients. These changes include shift towards a more patient-centered delivery model (Danaher and Gallan 2016); the rise of consumerism in the healthcare market (Shrank 2017, Berry 2007, Krishnan et al. 2015); and the growing role of information and communication technologies (ICT) in care delivery (Rouleau and Gagnon 2017). Patients now have access to information from many online sources regarding their symptoms and potential therapies and expect to be actively involved in their care decisions (Amante et al. 2015, Paluch and Blut 2013). Patients also expect more convenient and responsive care (Shrank 2017). Therefore, patient experience and satisfaction have become essential measures for healthcare in-addition to clinical outcomes such as infection rates and mortality (MacAllister et al. 2016, Jha et al. 2008).

² <https://www.healthsystemtracker.org/indicator/spending/health-expenditure-gdp/> (01/31/2019)

While the demand for responsive and convenient care is increasing, cost control of healthcare services continues to be a significant concern for both providers and patients. Furthermore rising healthcare expenditures have been, and are expected to be, at the forefront of social and political debates in the United States, as new federal policies are expected to result in profound changes in healthcare expenditure priorities and coverage (Manchikanti and Hirsch 2016, Hirsch et al. 2017). The increasing demand for timely and convenient care accessible to all citizens, on the one hand, and the need for controlling the cost of services, on the other hand, have given rise to the use of ICT in health services to support care delivery strategies that meet both patients' needs and providers' financial goals (Barrett 2017). In particular, electronic health record technologies have emerged as an integral part of providers' efforts for improving coordination of care; for reducing medical errors; for enhancing patient-provider communications; and for increasing efficiency (Jarvis et al. 2013, Chaudhry et al. 2006). The use of computers (either laptop and tablets) by physicians during clinical visits (Frankel et al. 2005) to access electronic medical records and for entering follow-up orders (e.g., prescriptions and lab work) has also increased (Hsu et al. 2005a). Moreover, electronic health record technologies, coupled with the widespread use of tablets, and smartphones by patients, have resulted in a growing interest in using telemedicine services for diagnosis and delivery of care that does not require face-to-face contact (Mehrotra et al. 2013, Wunderlich et al. 2013), or when access to care is difficult for patients (Deslich et al. 2013).

While ICT's use in healthcare delivery is growing, patient preferences for such technologies is becoming a critical factor for successful adoption (Deslich et al. 2013, Standing and Cripps 2015). Past studies have documented both negative and positive impacts of ICT on patient satisfaction (Duplaga 2015, Rolland et al. 2013, Johnson et al. 2004, Lee et al. 2015). Previous studies have explored the relationship between the adaptation of and likeliness to use ICT and user's sociodemographic characteristics (Jung et al. 2011, Houston et al. 2004). The link between the use of healthcare services and individuals' predisposing characteristics such as age and gender, and enabling resources has also been established (Anderson and Newman 1973). Our study further investigates the impact of demographic and socioeconomic status on preferences and perceptions of consumers regarding ICT application, specifically in the delivery of healthcare services.

Technology acceptance by consumers in the service industry has been extensively studied. Past research includes identification of drivers of technology acceptance (Wang et al. 2003, Ruiz Mafe et al. 2010, Ranaweera et al. 2008, Perea et al. 2004, Tandon and Sah 2016, Blut and Schoefer 2016); empirical testing of technology acceptance model (TAM) (Davis 1989) and technology readiness index (Parasuraman 2000, Dolen and Ruyter 2002, Lin and Chang 2011, Lin and Hsieh 2012, Ramkumar and Jenamani 2015, Tsikriktsis 2004, Parasuraman and Colby 2015); consumer reactions (Wirtz et al. 2018, Lanseng and Andreassen 2007, Susskind and Curry 2016, Lee et al. 2015, Wunderlich et al. 2013, Van Doorn et al. 2017); and impact on employees and consumer behaviors (Lee and Lee 2009, Bridges and Hofacker 2016,

Viswanathan et al. 2017, Tandon et al. 2017, Smith et al. 2014). Our paper attempts to make a further contribution to one specific topic area related to the above research theme. We explore the willingness to use technology in healthcare delivery settings, from a patients' perspective. We further explore the relationship between ICT use and patients' sociodemographic characteristics.

2. Background

According to Mair et al. (2007), four critical domains of healthcare affected by ICTs include management systems, communication systems, computerized decision support systems, and information systems. ICT applications in management systems, best exemplified by the use of electronic health records, allow for the acquisition, storage, and transmission of administrative or clinical activities performed in delivering care. Communication systems, such as email, mobile phones, and telemedicine services, allow more effective diagnostic, counseling, educational, and support services by facilitating communications among providers or between providers and patients. ICT applications such as decision support systems help health professionals practice within clinical guidelines by providing access to decision aid tools from computers, tablets, and mobile phones. Finally, information systems refer to the use of internet technology to access health-related information sources by providers and patients (Rouleau and Gagnon 2017).

For patients, perceived ICT benefits are reported to be faster access to less expensive care (as a result of faster appointment scheduling, shorter waiting time in the doctor's

office, and eliminating travel to the doctor's office)(Roettl and Bidmon 2016, Padman et al. 2010, Albert et al. 2011), being able to talk more openly about health issues that might be embarrassing in face-to-face meetings (Albert et al. 2011), better coordination of care among caregivers (e.g., between primary care general physician and specialists)(Mehrotra et al. 2013), and faster communication of caregivers and patients with pharmacies and laboratories (Hickson et al. 2015). On the other hand, patients' concerns include the risk of misdiagnosis because physical examination is not possible (Hickson et al. 2015, Mehrotra et al. 2013), information security and breach of privacy (Albert et al. 2011, Jung et al. 2011), lack of insurance reimbursement (Padman et al. 2010, Tang et al. 2006), and the absence of in-person interactions with caregivers (Roettl and Bidmon 2016, Katz et al. 2003).

As mentioned in the last section, we seek to understand how demographic and socioeconomic characteristics of users impact their preferences regarding the application of ICTs in healthcare delivery. Two main theoretical frameworks can help understand the ICT utilization by patients, namely, the behavioral model of access to medical care proposed by Andersen and Newman (1973) and the technology acceptance model introduced by Davis (1989).

According to Andersen and Newman, use of health services by individuals depends on their predisposing characteristics, the enabling resources which are available to them, and their need. Predisposing characteristics refer to attributes that exist before an illness occurs, including demographic characteristics such as age, gender, and

ethnicity. Enabling resources refer to personal, family, or community resources required to access health services. Finally, need refers to the illness level. Regarding the role of predisposing characteristics, studies have documented that female patients are more likely to use healthcare services involving ICT (Carrell and Ralston 2006, Mehrotra et al. 2013, Jung et al. 2011, Cohen and Stussman 2010, Nijland et al. 2009, Houston et al. 2004, North et al. 2014), while older patients were less likely to use such services (Mehrotra et al. 2013, Jung et al. 2011, Jung and Padman 2014). Race and ethnicity are also reported to impact the likelihood of using a service involving ICT, with whites being more likely to use such services than other ethnic groups (North et al. 2014, Weingart et al. 2006, Goel et al. 2011, Yamin et al. 2011).

Regarding the role of enabling resources, being employed and having health insurance (Adamson and Bachman 2010, Weingart et al. 2006), as well as higher education levels (Mehrotra et al. 2013, Roettl and Bidmon 2016, Liederman et al. 2005) enhance the use of health services involving ICT applications, while lower-income reduces the use of such services (Brodie et al. 2000, Roettl and Bidmon 2016). Care need is also found to impact the likelihood of using services involving ICT (Hsu et al. 2005b), and studies have reported that patients with more doctor visits in the prior year (Mehrotra et al. 2013) or those with more complex a conditions (indicated by the number of diagnoses and medications)(Jung et al. 2011, Houston et al. 2004) are more likely to use care services involving ICT applications.

The technology acceptance model has also been developed to understand the factors that impact the acceptance of information technology in general. According to Holden

and Karsh (2010), technology acceptance in healthcare depends on the following four factors: perceived usefulness, perceived ease of use, social influence or subjective norms (perception of essential or relevant others beliefs regarding the technology use), and perceived facilitation conditions (organizational and technological infrastructure and support). For patients, Holden and Karsh (2010) noted that all four acceptance factors are affected by individual and environmental variables. According to Or and Karsh (2009), about one-third of factors affecting ICT acceptance identified in literature have to do with sociodemographic characteristics of patients and their prior experience and exposure to computer or health technology. Regarding the role of sociodemographic characteristics, Or and Karsh (2009) reported that age is found to be negatively associated with technology acceptance in the majority of studies, while education is shown to have a positive relationship. Unlike age and education, gender was found to have no meaningful direct relationship with healthcare technology acceptance. However, previous research did not achieve consensus on how do sociodemographic characteristics impact individual acceptance and reactions on ICT. For example, while Or and Karsh (2009) found gender irrelevant to individuals' technology acceptance, Adamson and Bachman (2010) reported higher acceptance by females, which is explained by their role as the primary family caretaker. Studies have also reported that an increase in care need is associated with increased acceptance and use of services involving ICT applications (Jeannot et al. 2004, Millard and Fintak 2002).

While studies have documented the impact of age, gender, race, income, education level, and healthcare needs, the main shortcoming in existing research is that the collective and concurrent effect of sociodemographic variables on ICT preferences and choices is not confirmed. In other words, the adjusted impact of each sociodemographic variable, controlling for other variables is not fully understood. For example, while an increase in age might increase the likelihood of having a negative reaction to ICT application in healthcare, increase in care need or complexity of conditions (Jung et al. 2011, Houston et al. 2004) with age might enhance the acceptance of ICT in healthcare.

3. Hypothesis

In this study, we use data from a diverse sociodemographic group to understand the concurrent effects of predisposing characteristics, enabling resources, and care need on respondents' reactions to ICT applications in healthcare. We focus on two main dimensions of ICT application in care delivery from patients' perspective: respondents' reactions to the physicians' use of tablets or computers during visits, and respondents' willingness to use remote care services involving ICT applications.

Earlier studies of computer use by doctors have reported that patients might not have a favorable view regarding computer use by physicians for reasons such as depersonalization of the medical encounter and concerns regarding the privacy of patients' medical information (Rethans et al. 1988). However, it is not unexpected to see that as computer familiarity and literacy are increasing in the general population

(Als 1997, Frankel et al. 2005) and caregivers' skills in using such technology is improving (Duke et al. 2013), patients welcome and trust the use of computers (Lelievre and Schultz 2010, Strayer et al. 2010) or tablets (Houston et al. 2003) by caregivers during the visit. Regarding remote care service, studies conducted in the last few years suggest a growing trend toward using what is referred to as electronic office visits or eVisits (Hickson et al. 2015). In addition to innovations in smartphone technology and phone applications (Mehrotra et al. 2013, Viswanathan et al. 2017), a rise in patients' desire for electronic access to healthcare providers (Albert et al. 2011), growing popularity of home-based primary care (to avoid long wait in the physician's office or limited clinic hours) (Rust et al. 2008), and increasing access to home-based diagnostics (e.g., allergy symptoms, pregnancy tests, and tests for conditions like high blood pressure and blood glucose) (Shrank 2017) are affecting the use of electronic office visits. Many health insurance plans now cover visits that are entirely virtual (Mehrotra et al. 2013).

As for the relationships between age and the acceptance of healthcare ICT applications, while older adults might particularly benefit from the ICT applications (e.g., communicating with their caregivers or using remote care services), they might be more concerned than other age groups with the depersonalization of their encounters (Strayer et al. 2010) or breach of privacy as a result of data security issues (Dimitropoulos et al. 2011, Charness and Boot 2009). On the other hand, younger individuals might perceive less difficulty (Wallin et al. 2015) and higher social motive (as a result of social influence or perceive social norm) for using the technology

(Roettl and Bidmon 2016). In summary, we hypothesize the relationship between age and healthcare ICT use and acceptance to be negative:

- *H1: Age has a negative relationship with the use and acceptance of healthcare ICT*

Regarding gender differences, while studies suggest that women might be more likely to use services involving ICT applications as a result of their role as the primary family caretaker (Adamson and Bachman 2010), concerns regarding the security of information exchanged via ICT is reported to be higher among women than men, resulting in more resistance (Gadd and Penrod 2000). Women are also reported to experience more computer anxiety than men, as a result of higher perceived internal (e.g., ability to use the technology or perceiving that using the technology is within the individual's control) or external (e.g., the availability of resources needed to use the technology) constraints in using it (Or and Karsh 2009). In other words, from the perspective of the technology acceptance model, perceived ease of use, and perceived facilitation conditions might be lower in women than men. As a result, we hypothesize that:

- *H2: Female are less likely than male to use and accept healthcare ICT*

Consistent with the overall disparities in healthcare by race and ethnicity, studies have reported evidence of disparities in the adoption of healthcare ICTs (North et al. 2014, Weingart et al. 2006, Goel et al. 2011, Yamin et al. 2011). This disparity is attributed to the digital divide and inequality across racial and ethnic groups that still exist the United States despite the increased availability of computers and internet access

(Robinson et al. 2015, Yamin et al. 2011). Differences in computer literacy and perceived benefits of healthcare ICT are also reported to be the reason behind racial and ethnic disparities in the adoption of healthcare ICTs (Yamin et al. 2011). Thus, we hypothesize that:

- *H3: Caucasians are more likely than other race and ethnicity groups to use and accept healthcare ICT.*

Healthcare disparities and the digital divide between demographic groups in using healthcare ICTs is also reported on economic and educational lines (Brodie et al. 2000, Yamin et al. 2011). Groups with higher education and income levels usually have more prior experience and more literacy in using the technology than other groups, which enhances the perceived usefulness and perceived ease of technology use (Or and Karsh 2009). The following hypotheses are suggested regarding the relationship between education and income and healthcare ICT acceptance and use, controlling for other sociodemographic characteristics:

- *H4: Income has a positive relationship with the use and acceptance of healthcare ICT*
- *Hypothesis 4b: Income level has a positive relationship with the use of remote care services involving ICT applications.*
- *H5: Education has a positive relationship with the use and acceptance of healthcare ICT*

Finally, household size is also expected to affect the acceptance and use of healthcare ICTs. First, an increase in the number of individuals in the household can increase healthcare needs, enhancing the acceptance of care services involving ICT

applications to facilitate organizing health records, and communicating with caregivers. Second, larger household size is reported to be associated with higher use of broadband in the home (Prieger 2013), facilitating the use of healthcare ICTs. Thus, the following hypotheses are suggested for the relationship between household size and the acceptance and use of healthcare ICTs, controlling for other demographic characteristics:

- *H6: Household size has a positive relationship with the individual's use and acceptance of healthcare ICT.*

To better understand the effect of household size, we distinguished between the number of children (individuals under 18 years old), elderly (individuals older than 65 years old), and adults between 18 and 64 years old.

Figure 2.1 presents our hypotheses in a more illustrative way.

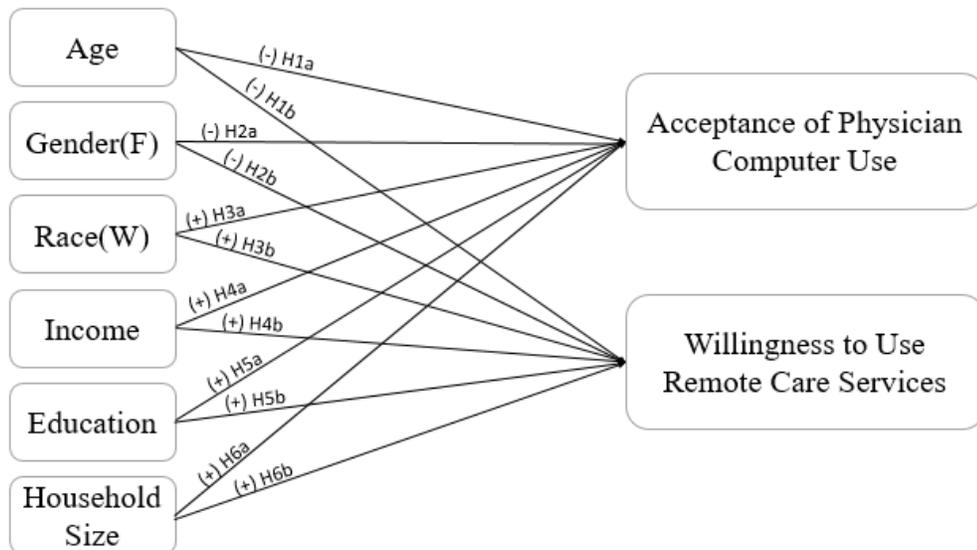


Figure 2.1 Hypotheses Illustration

Residence (residing in proximity to population centers), care need, social ideology (conservative, moderate, liberal), and rating of most recent hospital visit are also included in the analysis as control variables to control for their potential impact on healthcare ITC preferences and choices.

4. Research Methods

Multiple methods, such as field data collection (Devaraj et al 2008), survey methods (Urvashi et al 2016), meta-analysis (Blut et al 2016), and qualitative research methods such as interviews (Watanabe and Mochimaru 2017) have been used by previous research on technology usage and acceptance in service content. Among the articles we sampled, survey is one of the most widely used methods. Urvashi et al. (2016) used a survey to further extend the Unified Theory of Acceptance and Use of Technology 2, in the context of online shopping in India; Tsiriktsis (2004) sought to use survey data to extend an original theory on consumer technology readiness into a different (British) culture based on 117 customer sample. Weijters et al. (2007) conducted a survey to collect data on customers of a grocery retail chain to study their use of self-service technology; Ramkumar and Jenamani (2015) used a survey to further extend the technology acceptance model by investigating the impact of managerial interventions and user-level cognitive belief factors. In our study, we aimed to find empirical evidence of our hypothesis by studying consumers' perspective; thus survey is an appropriate method in this context. Our data sample represents the actual population distribution in the New York State, capturing people's perception of technology use in healthcare delivery.

5. Data

Data for this study were collected by the Survey Research Institute (SRI) at Cornell University as a part of its annual Empire State Poll (ESP), a general survey of adult New York State residents, age 18 and over. ESP is a combination of an annual core of the community, economic, and social science modules along with particular topical issue questions proposed by faculty members each year. In this study, data from 2016 and 2017, the fourteenth and fifteenth annual polls conducted by SRI, are used. The survey sample consisted of a dual-frame random-digit-dial telephone sample, covering both cellular and land-line exchanges for New York State. Once a household was sampled, every adult had an equal chance to be included in the poll. Table 2.1 shows a list of questions used in this study.

Table 2.1 List of interview questions and response choices used in this study

| Construct | Interview question | Response choices |
|---|---|---|
| Perceived impact of physician computer use on care ^a | Some doctors use computers in their appointments with patients. How do you think using this kind of technology during a visit impacts the care you receive? In this case, computers could include a laptop, smart phone, or tablet. | <ul style="list-style-type: none"> - Very negative impact - Somewhat negative impact - Has no impact on the healthcare I receive - Somewhat positive impact - Very positive impact - My doctor doesn't use a computer |
| Preferred levels of medical care via technology | Care for many types of medical conditions could be delivered via mobile phone or tablet in the future. This can be care for minor health issues with little impact on your daily life, moderate health issues that interrupt your normal life, or major health issues that stops you from having a normal work life. Which levels of care, if any, would you prefer to receive through such technology? | Open ended ^b |

| | | |
|---------------------------------|--|---|
| Care need and utilization | How often during the last 12 months did you, as a patient, visit a care provider for a health problem or preventative care (like checkups)? This includes physical, mental, or dental health provided in any type of healthcare facilities. | <ul style="list-style-type: none"> - Never - 1-2 Times - Once every few months - Once a month - Twice a month - Once a week - 2-3 times a week |
| Rating of last visit experience | How would you rate the overall level of customer service experience during your most recent visit to the healthcare facility? | <ul style="list-style-type: none"> - Very poor - Somewhat poor - Average - Somewhat positive - Very positive |
| Social ideology | When it comes to social issues, do you usually think of yourself as: | <ul style="list-style-type: none"> - Extremely liberal - Liberal - Slightly liberal - Moderate or middle of the road - Slightly conservative - Conservative - Extremely conservative |
| Age | What year were you born? | Age was calculated from the year of birth |
| Gender | Recorded by the interviewer | <ul style="list-style-type: none"> - Male - Female |
| Education level | What is the last grade or class that you completed in school? | <ul style="list-style-type: none"> - None, or grades 1-8 - High school incomplete (grades 9-11) - High school graduate (grade 12 or GED certificate) - Technical, trade, or vocational school after high school - Some college, no 4-year degree (including Associate degree) - College graduate (BS, BA, or other 4-year degree) - Post-graduate training or professional schooling after college |
| Hispanic or Latino | Are you, yourself, of Hispanic origin or descent, such as Mexican, Puerto Rican, Cuban, or some other Spanish background? | <ul style="list-style-type: none"> - Yes - No |
| Race | What best describes your race? Please tell me yes or no for each of the following races: white or Caucasian; black or African-American; American Indian, Aleut, Eskimo; Asian or Pacific Islander; Other. | <ul style="list-style-type: none"> - Yes - No <p>To each race question (total of 5 questions)</p> |
| Household size | How many total people in your household are adults (65 and older), adults (18-64), children (under 18). | None. Respondents indicated the number of people in each age group separately. |
| Household income before taxes | Two questions covered income. The first question asked interviewees what was their total household income in 2015 from all sources, before taxes. Follow up questions asked interviewees instead of a specific number, indicate if their total household income was under or over \$50,000 and then use a scale to indicate their income level. Best responses obtained from these questions were used to code income. | |

Notes: Rating of last visit experience and social ideology are included as control variables.

a. In 2017, a follow-up open-ended question was included in the interview asking participants to explain their response.

b. Only included in the 2017 survey.

In addition to the data on the questions listed in Table 2.1, the research team used a respondent's self-reported county to designate the region (Downstate, which includes Brooklyn, Manhattan, Staten Island, Bronx, Queens, Long Island and Rockland and Westchester counties; or upstate, which includes all other regions) where participants

live. A Metropolitan Statistical Area (MSA) consists of the central county or counties containing the core urban area, plus adjacent/outlying counties that have a high degree of social and economic integration with the central county, as measured by commutation patterns. In our study we also used sub-classification of metropolitan statistical areas to determine a respondent's proximity to geographical areas with a relatively high population density, since the health status can differ significantly between rural population to those who live in metropolitan areas, and the concepts of place and rurality may be useful on the determinants of population health (Dixon and Welch 2000).

Telephone data collection began in February of each year and was completed in April. The average interview length for all modules was 23 minutes, only demographic and socioeconomic characteristic questions and questions relevant to our research are included in this study. Interviews were conducted in English and Spanish using a computer-assisted telephone interviewing software system. Before conducting each round of data collection, SRI conducted a pilot survey with 25 participants in January of each year after receiving the Institutional Review Board approval from the Cornell University's Office of Research and Integrity Assurance.

6. Analysis

We used a mix of quantitative and qualitative methods to first statically test the relationship between sociodemographic characteristics and preferences regarding ICT applications in the delivery of care and then understand why such relationships might

exist. Table 2 shows the quantitative analysis models used in the study: Generalized linear model (GLM) with binomial distribution on a Logit link is used on the potential impact of physician computer use and willingness to use telemedicine. For preferred levels of medical care via technology, open-ended responses were coded to identify the levels of care, if any, respondents would prefer to receive remotely through a computer or tablet, then the Generalized estimation equation model with binomial distribution on a Logit link is applied.

Table 2.2 List of models used in the study

| Outcome Analyzed | Model Title | Model Outcome |
|--|---|--|
| Perceived impact of physician computer use on care | Model 1: positive impact ^a | The impact of sociodemographic characteristics on the odds of having a positive reaction versus having a negative or an impartial reaction |
| Preferred levels of medical care via technology | Model 2: willingness to use ^b | The impact of sociodemographic characteristics on the odds of being willing to receive care via computer or tablet, versus not being willing to receive such services. |
| | Model 3: preferred level of care ^c | Adjusted probability of selecting each level of care and the impact of sociodemographic characteristics on the probabilities. |

a Generalized linear model (GLM) procedure with binomial distribution on a Logit link is used. After removing individuals who reported their doctor doesn't use a computer, we grouped responses with positive connotations (very positive impact and somewhat positive impact) and responses with negative connotations (very negative impact and somewhat negative impact). A binary variable indicating the data collection year was include in the model to test if there is any difference between 2016 and 2017 responses.

b GLM procedure with binomial distribution on a Logit link is used.

c This model uses data from respondents who indicated they would be willing to receive care via computer or tablet technology. The dependent variable was the respondents' selection of each level of care (coded as a binary variable, with 1 indicating that the care level was selected and 0 indicating that it was not). In addition to sociodemographic variables, a categorical variable with three levels (minor, moderate, and major) was entered into the model as a predictor. Estimated marginal means for this categorical variable would indicate the adjusted probability of selecting each level of care. The interaction of the categorical variable with other predators would indicate the impact of sociodemographic variables on the probability of selecting each level of care. For Model 3, the Generalized estimation equation model with binomial distribution on a Logit link is used. Respondent's ID was used as the subject variable.

In all models, we used estimated marginal means for different levels of categorical predictor variables to compare demographic groups. For example, in Model 1, estimated marginal means were used to understand whether males are more likely than females to have a positive reaction to the physician's use of computers or tablets.

To better understand the results of the quantitative analysis, we used follow-up comments provided by interviewees and applied qualitative content analysis to decode data patterns and to cluster similar concepts into categories (Ruona 2005, Downe-Wamboldt 1992). Two members of the research team separately broke comments provided by each interviewee into units of information, which were then organized into categories (themes or topic domains) that emerged inductively from analyzing all responses. The initial coding and categories were evaluated by the entire research team, and then the frequency of topic domains and subdomains were calculated.

7. Results

7.1 Sample Characteristics

Eight hundred interviews were conducted each year. Table 2.3 shows the demographic characteristics of the study participants. The sample composition was almost the same in 2016 and 2017.

Table 2.3 Demographic characteristics of study participants in 2016 and 2017

| Demographic Characteristics | Number of participants or mean | | Percentage or standard deviation | |
|--|--------------------------------|-------|----------------------------------|-------|
| | 2016 | 2017 | 2016 | 2017 |
| Gender | | | | |
| Female | 392 | 394 | 49.0% | 49.3% |
| Male | 408 | 406 | 51.0% | 50.7% |
| New York State Region (control variable) ^a | | | | |
| Downstate | 400 | 400 | 50.0% | 50.0% |
| Upstate | 400 | 400 | 50.0% | 50.0% |
| Metropolitan Status Area (control variable) ^b | | | | |
| In the center city of an MSA | 318 | 507 | 39.8% | 63.4% |
| Outside center city of an MSA (but inside county containing center city) | 222 | 41 | 27.8% | 5.1% |
| Inside a suburban county of the MSA | 85 | 79 | 10.6% | 9.9% |
| In an MSA that has no center city | 99 | 94 | 12.4% | 11.8% |
| Not in an MSA | 76 | 79 | 9.5% | 9.9% |
| Care Need and Utilization (control variable) ^c | | | | |
| Never | - | 75 | - | 9.4% |
| 1-2 Times | - | 275 | - | 34.4% |
| Once every few months | - | 297 | - | 37.1% |
| Once a month | - | 74 | - | 9.3% |
| Twice a month | - | 48 | - | 6.0% |
| Once a week | - | 14 | - | 1.8% |
| 2-3 times a week | - | 15 | - | 1.9% |
| Education Level | | | | |
| None, or grades 1-8 | 11 | 14 | 1.4% | 1.8% |
| High school incomplete (grades 9-11) | 56 | 29 | 7.0% | 3.6% |
| High school graduate | 185 | 170 | 23.1% | 21.3% |
| Technical, trade, or vocational school after high school | 20 | 18 | 2.5% | 2.3% |
| Some college, no 4-year degree (including 2-year Associate degree) | 185 | 173 | 23.1% | 21.6% |
| College graduate (BS, BA, or other 4-year degree) | 192 | 226 | 24.0% | 28.3% |
| Post-graduate training or professional schooling after college | 149 | 165 | 18.6% | 20.6% |
| Hispanic or Latino | | | | |
| Yes | 105 | 111 | 13.1% | 13.9% |
| No | 695 | 686 | 86.9% | 85.8% |
| Race | | | | |
| White or Caucasian | 553 | 583 | 69.1% | 72.9% |
| Black or African-American | 171 | 144 | 21.4% | 18.0% |
| Asian or Pacific Islander | 47 | 56 | 5.9% | 7.0% |
| American Indian | 19 | 39 | 2.4% | 4.9% |
| Other races | 45 | 27 | 5.6% | 3.4% |
| Income Level | | | | |
| Less than \$10,000 | 28 | 24 | 3.5% | 3.0% |
| 10,000 to under \$20,000 | 42 | 36 | 5.3% | 4.5% |
| 20,000 to under \$30,000 | 45 | 54 | 5.6% | 6.8% |
| 30,000 to under \$40,000 | 60 | 49 | 7.5% | 6.1% |
| 40,000 to under \$50,000 | 107 | 125 | 13.4% | 15.6% |
| 50,000 to under \$75,000 | 181 | 190 | 22.6% | 23.8% |
| 75,000 to under \$100,000 | 100 | 81 | 12.5% | 10.1% |
| 100,000 to under \$150,000 | 122 | 111 | 15.3% | 13.9% |
| More than \$150,000 | 89 | 106 | 11.1% | 13.3% |
| Age | 47.34 | 47.49 | 17.18 | 17.46 |
| Number of adults 65 years or older in the household ^d | 0.26 | 0.26 | 0.53 | 0.62 |
| Number of adults between 18 and 64 years old in the household ^d | 1.13 | 1.14 | 1.16 | 1.21 |
| Number of children (under 18 years old) in the household ^d | 0.64 | 0.67 | 1.02 | 1.09 |

a Nine-county regions were designated as downstate, including Westchester, Rockland, Bronx, New York, Richmond, Kings, Queens, Nassau and Suffolk. All remaining counties were considered upstate.

b MSAs are delineated by the Office of Management and Budget and consists of a core area containing a substantial population nucleus (an urban area with at least 10,000 but less than 50,000 population), together with adjacent communities that have a high degree of economic and social integration with that core, as measured by commutation patterns.

c This question was included in 2016, but response choices were coded differently.

d Does not include the interviewee.

7.2 Descriptive Statics

Figure 2.2 shows the breakdown of responses regarding the impact of physician computer or tablet use on the quality of care.

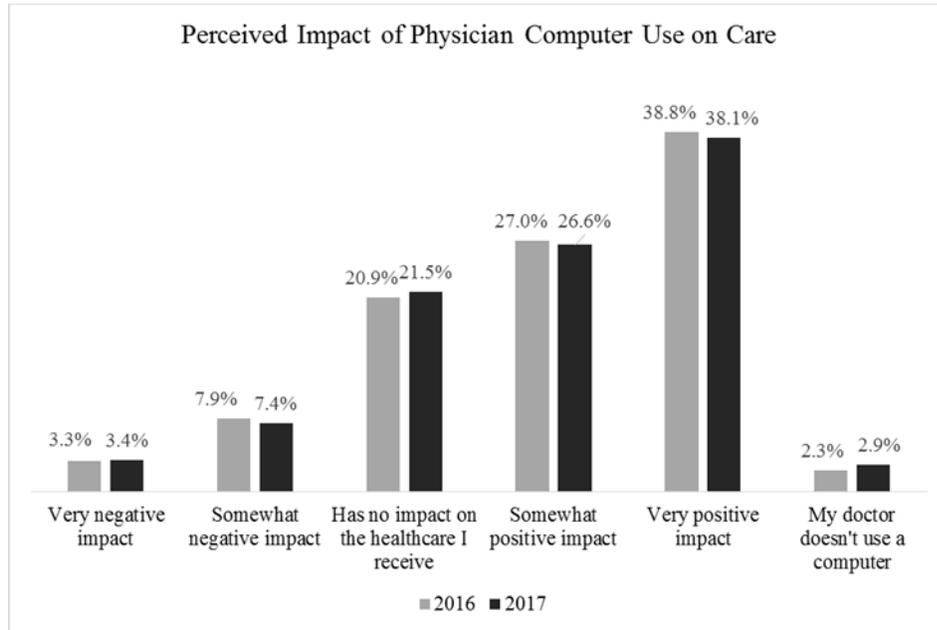


Figure 2.2 Breakdown of Responses Regarding the Perceived Impact of Physician Computer Use on Care

Figure 2.2 shows that the responses from the 2016 and 2017 samples are identical. In both years, about 65% of interviewees indicated that the use of tablets or computers by doctors during visits have a very positive or somewhat positive impact on the care they receive. Less than 11% indicated a negative impact on the quality of care.

As for receiving medical care remotely via technology, 75.9% ($n = 607$) indicated they would use remote services for receiving some level of care, and 22.5% ($n = 180$) indicated they prefer to visit a doctor in person. About 1.6% ($n = 13$) of participants did not answer this question. Among those who indicated they are willing to use

remote care services, 73.1% ($n = 444$) indicated they would use such services for minor health issues, 34.1% ($n = 207$) for moderate health issues, and 18.1% ($n = 110$) for major health issues. Respondents were able to choose more than one level of care.

7.3 Impact of Demographic Characteristics on Healthcare ICT Acceptance and Adoption

Before running the models, we ran an ordinary linear regression model and used variance inflation factors to identify potential problematic multicollinearity among predictors. Variance inflation factors for predictor variables were lower than 3, indicating that multicollinearity among predictors was not an issue in the analysis (O'Brien 2007). Table 2.4 shows the results of the analyses for each model.

Table 2.4 Likelihood ratio chi-square test statistics for model parameters

| Predictor (degree of freedom) | Model 1: Positive Impact | Model 2: willingness to use | Model 3: preferred level of care |
|---|--------------------------|-----------------------------|----------------------------------|
| Year (1) | 0.98 | n.a. ^a | n.a. ^a |
| Age | 4.35 (-0.009)* | 9.82 (-0.020)* | 3.40 |
| Gender (1) | 8.23* ^b | 0.00 | 0.02 |
| Number of individuals older than 65 years old in the household | 0.54 | 0.13 | 0.05 |
| Number of individuals between 18 and 65 years old in the household | 0.04 | 0.45 | 3.42 |
| Number of individuals younger than 18 years old in old in the household | 5.98 (-0.155)* | 0.52 (-0.065)* | 0.70 |
| Education level (4) | 4.73 | 13.26* ^c | 7.27 |
| Hispanic ethnicity (1) | 2.14 | 0.26 | 0.71 |
| Race - white (1) ^d | 0.00 | 3.39 | 0.14 |
| Race - black (1) ^d | 0.47 | 1.42 | 0.07 |
| Race - Asian (1) ^d | 0.50 | 1.25 | 0.65 |
| Race - other (1) ^d | 3.04 | 1.05 | 0.52 |
| Income level ^e | 0.58 | 4.05 (0.103)* | 0.09 |
| Metropolitan status area (4) | 3.74 | 1.91 | 2.66 |
| Care need and utilization ^{f g} | n.a. | 1.92 | 1.00 |
| Rating of last healthcare facility visit ^g | 7.22 (0.162)* | 5.65 (0.208)* | 1.47 |

| | | | |
|--|------|------|-------|
| Social ideology (6) ^g | 9.12 | 8.21 | 12.51 |
| New York state region (1) ^g | 0.98 | 3.42 | 0.32 |

For categorical variables, categories with less than 20 participants were combined with the next category. For example, the first two categories of educational level (none or grades 1-8 and high school incomplete) were merged.

Parameter estimates in this table are only interpretable for continuous and ordinal variables. For categorical variables, estimated marginal means (not shown in the table) were used to compare different demographic groups.

In Model 1 and Model 2, the likelihood ratio chi-square test indicated that the models with explanatory variables included was an improvement over the intercept-only model. Model 1: $\chi^2(28) = 52.3, p < 0.05$, Model 2: $\chi^2(28) = 68.6, p < 0.05$

In Model 1, the interaction terms of year with the other variables were included in the analysis to examine differences between 2016 and 2017 data. None of the interaction terms were statistically significant at $p < 0.05$. Results shown here represent estimates from the more parsimonious model excluding the interaction terms and with only the variables shown in the table.

In Model 3, none of the variables representing the interaction of sociodemographic variables with the categorical variable indicating care levels were significant at $p < 0.05$. The interaction terms are not shown in the table.

* Significant at $p < 0.05$. Values in parentheses shows parameter estimates (log of odds).

a Model 2 and Model 3 only used 2017 data. Year was not included in the model.

b Estimated marginal means for males and females are 0.78 and 0.70 respectively. The difference was significant at $p < 0.05$.

c Estimated marginal means for high school incomplete was 0.43, for high school graduates was 0.68, for some college degree and those after high schools was 0.70, for college graduates was 0.78, and for those with postgraduate degrees was 0.76. Pairwise comparisons indicated that only the difference between the lowest educational level (high school incomplete) and the other groups was statistically significant at $p < 0.05$.

d Interviewees were able to select more than one race. Each race was entered in the models as a binary variable.

e Income level was included in the analysis as an ordinal variable

f Response choices in the question measuring this variable were coded differently in 2016 and 2017 surveys. As a result, it was excluded from Model 1. Two separate analyses were run using 2016 and 2017 data with this variable included in the models. The parameter did not reach the significance level of $p < 0.05$ in any of the two models.

g entered in the analysis as control variables

In Model 1, controlling for all other sociodemographic characteristics, the odds of having a positive reaction to the physician's computer or tablet use during a visit becomes 1% lower with each one-year increase in age and 14% lower with the increase in the number of children in the household. Estimated marginal means also indicated that males were about 9% more likely than females to have a positive reaction. Model 1 only supported hypotheses 1a and 2a.

In Model 2, controlling for all other sociodemographic characteristics, the odds of using remote care services becomes about 2% lower with increasing age and about 6%

lower with an increase in the number of children in the household. Increases in income level increased the odds of using remote care services by about 11%. Estimated marginal means showed that individuals with the lowest level of education (those who did not complete high school) are 38% less likely than other groups to use remote care services. Only hypotheses 1b, 4b, and 5b are supported by Model 2.

Finally, Model 3 results indicated that none of the sociodemographic variables are associated with preferences of care level to be received through remote care services. Adjusted probabilities for choosing minor health issues are 0.66 (95% CI [0.52, 0.77]), for moderate health issues are 0.26 (95% CI [0.16, 0.38]), and for major health issues are 0.13 (95% CI [0.07, 0.21]). Pairwise comparison indicated that these differences were significantly different from each other at $p < 0.05$. In summary, Model 3 indicated that across all sociodemographic groups, individuals are about five times more likely to choose remote care services for addressing minor issues than major issues. They are also about 2.6 times more likely to choose such services for minor issues than moderate health issues.

7.4 Themes that emerged as Reasons behind Preferences and Choices

In 2017, 605 interviewees provided additional explanation of their responses regarding the perceived impact of physicians' use of computer technology during a health-care visit. From the content analysis of the comments, seven domains emerged covering positive aspects, and six domains emerged covering negative aspects. Table 2.5 shows the positive and negative domains and examples of quotes from the interviews.

Table 2.5 Domains and themes emerged from the content analysis of the comments covering positive and negative aspects of the technology use by physicians during visits

| Major Domains/Themes | Subdomains | Example Quotes from the Interviews |
|--|---|--|
| Enhanced efficiency and organization of medical record keeping (+) | More organized record keeping | <i>"My family doctor can record my documents in their system, where they can find my documents quickly and they can diagnose me very efficiently and professionally."</i> |
| | Less paperwork and improved efficiency | <i>"It allows him [my physician] to save information and is more efficient. We are past the paper age. Now records can be stored for years and years when we use a computer as opposed to paper."</i> |
| Improved care coordination and information access among caregivers (+) | Faster access to patient information by caregivers | <i>"All of my doctors are connected into the same system on the computer. Each provider is able to get an overall picture of our health from different offices."</i> |
| | Better communication among caregivers | <i>"I recently went to an eye doctor, and he was able to communicate with another physician about my records. It helps all doctors to work together"</i> |
| | Improved doctor access to general medical information | <i>"The physician has the ability to look up medication information and recent information on drugs that they might not know."</i> |
| Enhanced patient access to caregivers and medical records (+) | Faster appointment and visits | <i>"It's less time-consuming than taking handwritten notes. The appointments are quicker so you're in and out faster."</i> |
| | Better patient access to caregivers | <i>"My primary care physician uses an online portal, so we can communicate with each other that way, even if I'm not in her office"</i> |
| | Better access to record by patients | <i>"In terms of my medical records, doctors inputting that information gives me easier access to it. I can sign in online and access my records."</i> |
| Improved reliability and security of information (+) | Lower risk of errors and omissions | <i>"One thing that it's really good at is, the program will diagnose medical interferences. If someone's on a drug with one doctor, and the other doctor prescribes a different one, the computer will recognize that and say you can't prescribe it."</i> |
| | Enhanced information security | <i>"All of the medical information is in one place. It is very secure and you do not have to worry about others getting it."</i> |
| Contribution to healthcare modernization (+) | -- | <i>"We live in a tech era now, so a lot of doctors need that"</i> <i>"These things have come along because they have proven their value."</i> |
| Other reasons (+) | -- | <i>"It makes the process for the doctors easier for them."</i> <i>"In general it just makes the process easier and faster."</i> |
| Impersonal communication (-) | -- | <i>"Each person is not an object, they're a human being. It needs a human touch. I'm not too much on computer."</i> |
| Risk of privacy breach (-) | -- | <i>"The banks and government are being hacked. I don't think my healthcare practitioner is an expert on firewall."</i> |
| Lack of technology literacy by users (-) | -- | <i>"I'm not much of a tech person. I hate computers so I have to call my daughter to ask her to help me."</i> <i>"The doctors still struggle with the technology occasionally."</i> |
| Risk of errors in using the technology (-) | -- | <i>"They get a lot of things wrong because they are typing so fast. They got a lot of things incorrect in medical records. If one doctor gets one thing wrong, it is very hard to correct."</i> |
| Risk of technology failure (-) | -- | <i>"It should all be written down on paper. Computers can crash and stop working and then everything is gone."</i> |
| Other reasons (-) | -- | <i>"They had my records almost 50 years and on paper they have only had 5 years on the computer."</i> |

Figure 2.3 shows the frequency of topics mentioned by interviewees regarding positive and negative aspects of physician use of computer technology during visits.

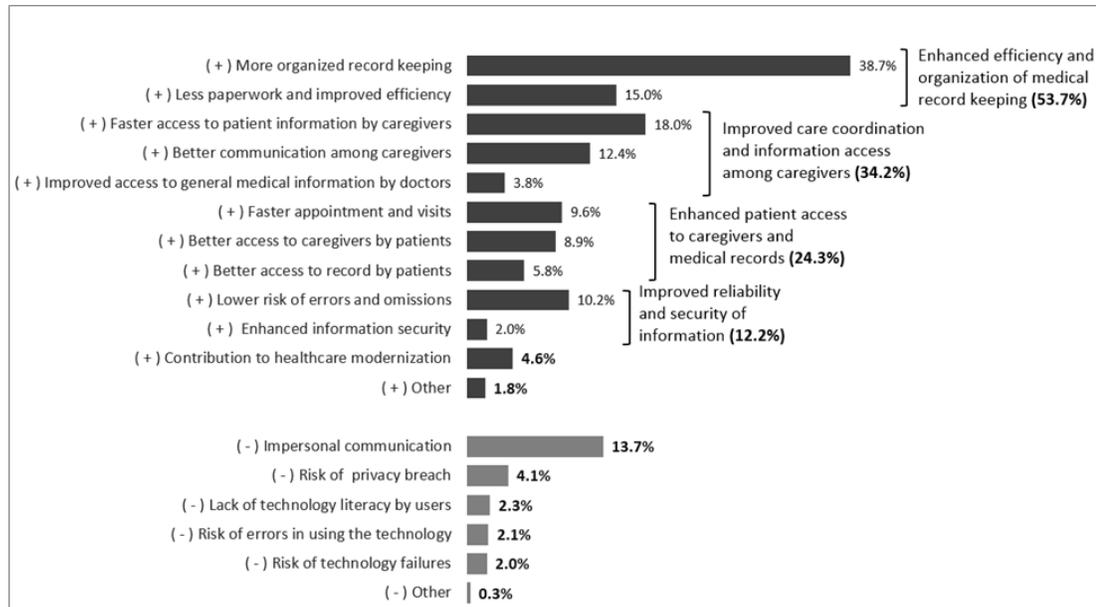


Figure 2.3 Positive and negative aspects of physician use of computer technology during visits, extracted from content analysis of interview notes

8. Discussion

This study focused on two critical aspects of the application of ICT in healthcare, the prevalence of using tablets and computers by physicians during health-care visits and the growing trend of using such technologies for receiving care remotely. In particular, the analysis explored the role of sociodemographic characteristics on patient's reactions to physicians' computer or tablet use and preferences in using remote care services involving ICTs.

Only 11% of the participants reported a negative reaction to the use of computers or tablets by physicians during a visit, with concerns mostly regarding the

depersonalization of medical encounter. Perceived benefits, including improved medical record keeping, enhanced care coordination, better access to caregivers, and improved reliability of information outweighed the negative aspects cited by interviewees. While the qualitative analysis uncovered six domains as reasons behind resistance to the acceptance of healthcare ICT, impersonal communication was by far the most frequently cited concern, expressed in about 14% of interviews, 13% higher than the percentage of individuals who had a negative reaction to the technology use by doctors. While patients are welcoming and trusting the use of ICT technology by caregivers, the main reasons behind the resistance to accepting such technology still remains the concern that 1980s studies have reported, which include impersonal communications with caregivers (Rethans et al. 1988, Cruickshank 1984) and potentially reduced confidentiality (Pringle et al. 1984).

As for the use of ICT to receive care remotely, as expected, the majority of participants, more than 75%, indicated that they would consider using mobile phones or tablets for receiving care remotely, mostly for minor health issues. Willingness to use remote care service becomes considerably lower as the severity of care needs increases. While remote care services may improve fast access to care, studies have shown that willingness to use such services for moderate and significant health issues is influenced by a complex mix of factors that dwarf fast access, as patients might still prefer to wait longer to see their doctor of choice rather than having a speedy appointment (Gerard et al. 2008).

While the majority of our study participants have a positive reaction to physician computer or tablet use during a visit and indicated their willingness to use remote care services, statistical analysis found essential differences based on sociodemographic characteristics. Among predisposing characteristics suggested by Andersen & Newman (1973), age and gender affect reactions to the physician computer or tablet use. As expected, females in our sample were less likely to have a positive reaction, and age had a negative relationship with the patient's acceptance of such technology during visits. While the analysis of comments submitted by interviewees showed no difference between males and females or among age groups in their concerns regarding the breach of privacy, we found that females are twice as concerned with the depersonalization of their encounters as are males (18.6% versus 8.9%), and individuals 50 years and older were three times more concerned with this issue than individuals between 18 and 29 years old (17.9% versus 6.7%).

In our study, age also has a negative relationship with the willingness to use remote care services. Besides the role of better skills in using the technology in younger age groups, the analysis of comments provided by interviews seems to support the notion that younger individuals have lower resistance toward using the technology because of perceived norms (Roettl and Bidmon 2016). About 28 interviewees indicated that technology had proven its benefits, and using it in healthcare is necessary to enhance the quality of care services and modernize it. While this is not even 5% of participants, the majority of these individuals who pointed to the need for adopting the technology as a norm belong to the younger age groups (11 individuals between 18 and 29 years

old and eight individuals between 30 and 49 years old). Regarding the effect of gender on using remote care services, while it was expected to see more willingness among males than females to use technology for receiving care remotely, we found no difference. This finding, while unexpected from the technology acceptance model perspective, is consistent with healthcare ICT studies noting that while perceived behavioral control in using technology might be lower among women, men and women might not be different in seeking care remotely via technology (Adamson and Bachman 2010, Jung and Padman 2014).

Regarding the role of household size, while we expected this variable to have a positive relationship with the acceptance of healthcare ICTs, only the number of children (individuals younger than 18 years old) in the household was a significant (inverse) predictor of ICT acceptance. Analyzing comments submitted by interviewees, we found that an increase in the number of children in the household has a positive correlation with the number of times that the interview participants cited the risk of privacy breach or technology failure as their concerns. The relationship between the number of children in the household and use of remote care services is not well investigated in the literature, and the number of children at home is mostly included in previous ICT studies as a control variable that often does not reach the significance levels in the statistical tests (Hambidge et al. 2011, Homko et al. 2012, Goldfarb and Prince 2008). Nevertheless, health behavior studies suggest that living in smaller households is associated with more regular check-up care visits (Arcury et al. 2005). In our study, the majority of participants will use remote care services for

minor health issues. From the health behavior perspective, it is understandable that more parenting responsibilities lower the possibility of seeking care for their minor issues. Note that our study only includes individuals older than 18 years old, asking them to indicate whether they use remote care services for their own health needs.

We found that education and income levels have a positive relationship with the likelihood of using remote care services, but care need has no impact, indicating that when it comes to the use of ICT technology, care need plays a less important role than enabling factors. First, those with lower income or education level might not have health insurance that covers remote care services. Second, from the perspective of the technology acceptance model, perceived usefulness and perceived ease of use tend to be higher in economically advantaged individuals with higher education levels and more literacy in using the technology. Commonly known as a digital divide between low-income and high-income populations, the disparity on economic and educational lines in using online resources for receiving health information has been documented and reported in previous studies (Brodie et al. 2000, Yamin et al. 2011). However, our study did not provide any evidence on the disparity based on the race or ethnicity of participants or proximity to population centers, suggesting that age, income, and education are ultimately more important barriers to using remote care services than the place of living and race.

Finally, we found no differences in the acceptance of physician computer or tablet use based on income, education level, proximity to a population center, or ethnicity of

interviewees. In other words, none of those enabling factors were significant in the presence of such essential factors as age and gender. We conclude that, unlike the adoption of ICT for receiving care remotely, in which evidence of disparity existed based on income and education levels, no such divide was found in participants' acceptance of ICT use by doctors during visits.

9. Practical Implications

While providers might be concerned that the introduction of computers or tablets into patient consultations might lead to a breakdown of patient-caregiver communications, our study found that the majority of participants had a positive reaction to physician computer or tablet use. Females, older individuals, and those with children in the household held less favorable attitudes toward the physician computer or tablet use during a health-care visit. To reduce this gap and maximize the benefits of using tablets or computers during the visit, providers serving populations with such characteristics may consider providing information to patients regarding the potential benefits of using ICT, including cost and time-saving opportunities. More important, providing training for caregivers on the proper use of computers and tablets can help providers improve patient-centered communications while using such technologies for integrating electronic health record into the medical visit (Duke et al. 2013).

Ultimately, computers and tablets are merely tools in the hand of doctors, and it is the personality of the doctor that makes him or her more or less personal to patients (Rethans et al. 1988, Levinson et al. 2010). Physicians should be trained to always explain to patients what they are doing when using such devices (McCord et al.

2009). For example, comments by our study participants and findings from previous studies indicate that using tablets or computers to show and share information regarding care and treatment with patients can enhance patient learning, efficacy, and satisfaction with care (Reychav et al. 2016). Moreover, using electronic medical records for faster access to patients' background and history can help physicians spend more time communicating with patients regarding their current health state and enhance satisfaction with care (Mwachofi et al. 2016). In contrast, if physicians spend excessive time on tablets or computers for entering and documenting records during the visit, it will negatively impact satisfaction with care.

Our study specifically showed the role of healthcare ICT as a viable tool for providing care remotely, especially for minor health issues. From a financial perspective, virtual services can help providers combat loss of revenues from the reduction of visits to physician offices or hospital clinics for minor health issues or primary care needs. Providers may consider a patient's home as an extension of the physician's offices or examination room, where a patient's history may be taken, and diagnostic tests can be performed (Saver and Peterfreund 1993). Besides home-based diagnostics such as allergy symptoms, pregnancy tests, and tests for conditions like high blood pressure and blood glucose, sinusitis and urinary tract infection are among the most common reasons patients might use remote care services (Shrank 2017). Some interviewees who provided an additional explanation regarding the type of conditions for which they prefer to receive care via technology named a skin condition, the common cold, routine check-ups or follow-ups, prescription refills, consultations with caregivers

regarding laboratory test results, and minor infections that can be alleviated using medications. However, it should be noted that patients, especially older adults whom we found to be more resistant to using remote care services, are willing to use novel methods of receiving care only when they trust their physician or care provider and have an established medical relationship with them (Husebo and Storm 2014). This is evident in our study as we found that experience of previous visits has a robust positive relationship with the acceptance and use of healthcare ICT by consumers, controlling for the effect of all sociodemographic variables. Similarly, for moderate and major health issues, patients might still prefer to wait longer to see a doctor of choice than to receive care sooner from whichever physician is available (Gerard et al. 2008).

Finally, our study found that people at lower income and educational levels probably experience more barriers to using remote care services than other groups. In other words, while the main idea behind providing such services has been to serve timely, affordable, and convenient care (Prinz et al. 2008), our study found that healthcare disparities continue on income and educational lines in the New York State. The impact of expected changes to healthcare coverage on healthcare disparities should be investigated in future studies.

10. Limitations and Future Research Directions

Our study has its limitations. While the large sample size permitted us to investigate the impact of various demographic characteristics on the choice of an outpatient care

setting and a patient's perception of physicians' computer use, our study focuses on New York State residents. While the sample was demographically and geographically diverse, the generalization of findings should be made with caution. Also, we did not have data on health insurance coverage of our study participants, and although we included self-reported income level in the analysis as a variable that would highly correlate with insurance status, it was difficult to draw accurate conclusions regarding the effect of health insurance on the willingness to use remote care services.

Lastly, one thing to be noted is that some of our findings confirmed previous research, while others are conflicted with them. Since our findings are limited to our research scope, implications may be further broadened if future study pushes the research boundary to generalize those findings.

11. Conclusions

This study highlights the growing interest in and acceptance of healthcare ICT by consumers. Perceived benefits, such as improved medical record keeping, enhanced care coordination, better access to caregivers, and improved reliability of the information, outweighed concerns that included depersonalization of interactions with caregivers. For minor health issues and primary care services, using ICTs can be a viable option for delivering convenient and timely care to a larger population and can help providers combat part of the loss of revenues from reductions in visits to physician offices or clinics. However, our analysis indicated that age, income, and education are substantial barriers to the use of remote care services by consumers,

even more important than gender, residence, race or ethnicity, and care need. As for the acceptance of ICT use by doctors during visits, no divide based on income or education was found, and the majority of participants indicated that such technology enhances the quality of care.

Nevertheless, females and older participants expressed more concerns regarding the lack of personal interactions with caregivers when ICT is used during visits. An increase in the number of children in the household seems to lead to more concerns regarding the security of information and technology failure. Providing training to caregivers in communication the nature and purpose of using computers and tablets during visits can help reduce these concerns.

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CHAPTER 4

CHAIN OPERATORS' SERVICE STRATEGIES: STANDARDIZATION OR CUSTOMIZATION?

1. Introduction

Around 70% of activities in the service sector are performed by chains rather than independent units (Gupta et al. 2015). For example, data shows that in the U.S., 33.6% of restaurants in 2018, and more than 60% of hotels in 2019 (Lock 2019, Sanford 2019), were chain-affiliated. Thus, chain operators of service, which we define as *multi-unit firms in service industries that maintain certain levels of uniformity across their belonging units*, are important analytical components of modern service industries.

Operating on a chain level, every service firm faces the decision of how unique each of its units should be, and we discover that different “across-unit standardization” strategies exist among chain operators. Some chains choose to rigidly replicate their belonging units (Winter and Szulanski 2001) and provide identical services through uniform processes across units. Using McDonald’s as an example, as a result of exceptional standardization across all units, this quick-service restaurant chain achieves high efficiency, predictability, and control (Ritzer 1983); its customers can expect a consistent dining experience at any McDonald’s restaurant. Other chains choose to differentiate among their belonging units to provide varied service experiences. An example would be the hotel chain Six Senses Resorts and Spas, which has 19 resorts across 14 countries. Although all properties convey the same philosophy of mental and physical well-being, each property is different in design to create locally-inspired experiences targeting its niche market. The structural flexibility and

uniquely localized service experiences allow Six Senses to achieve high revenue and customer satisfaction. In these two examples, McDonald's represents extreme standardization, while Six Senses is the opposite with its customization. Many chains operate in the middle of the "degree of standardization" scale.

However, it is still unclear how standardized across units a chain should be. Our research aims to investigate the relationship between the degree of standardization (DoS) across units and a chain's performance outcomes. Moreover, we argue that the DoS should be made in multiple operational dimensions according to key elements in the service value chain.³ From a service value chain perspective, a chain should first explore the demand variation across units to decide whether to target the same customer groups at the unit level. Based on potential demands, the chain then determines what services to offer in each unit and how to deliver those offerings to the customers. Thus, customer mix, service offering, and service delivery are crucial aspects to consider when making standardization decisions. Many previous studies have contributed to assessing the relationship between standardization strategies and operating outcomes (Winter and Szulanski 2001, Weaver 2005, Wang et al. 2010, Kasiri et al. 2017). However, most of these previous studies focus only on single aspects of standardization strategies, thus neglecting the trade-offs between multiple operational dimensions. In practice, the chain operators need to make a joint decision on multiple aspects simultaneously, such as standardizing across units in service offering, while customizing in service delivery. Yet, as far as we know, no existing study has conducted a comprehensive investigation to provide empirical evidence in multiple dimensions. In our research, we investigate chain operators' standardization

³ The service value chain is an operating model for the creation, delivery, and ongoing improvement of services. It outlines the key activities required to create value in response to demand, through the creation and delivery of products and services (Mathenge and Hall 2019).

strategies in three operational dimensions: customer mix, service offering, and service delivery, exploring how these dimensions impact chains' performance outcomes.

In our study, we empirically investigate the standardization in multi-unit chains in the service sector based on the nursing home context. The first reason is that in the U.S., the nursing home industry is chain-dominated. According to the Centers for Disease Control and Prevention (Harris-Kojetin et al. 2019), about 60% of the total 15,600 nursing homes are chain operated (Ritchie and Johnson 2017). Among nursing home chains, the 25 largest chains operate 19% of all facilities (IQVIA Institute for Human Data Sciences 2018), with the largest chain, Genesis, owning 56,575 beds (ProviderMagazine.com 2016). Given this context, our chain-focused study can provide valuable insights for practitioners in designing and assessing chain operational strategies. Second, nursing home operations, by nature, need to strike a balance between standardization and customization. Nursing homes are unique among service entities since they address both the clinical and long-term residential needs of the residents. On the one hand, higher degree of standardization promotes clinical quality (Chandrasekaran et al. 2012) and saves costs (Cichos et al. 2017); operating in a low margin industry (Spanko 2019b), nursing homes need the cost efficiency resulting from standardization. On the other hand, higher degree of customization can improve resident welfare by providing personalized care, thus allowing nursing homes to charge a premium. This chain-dominated industry, whose success naturally depends on the design of standardization and customization strategies, makes a perfect setting for our study.

We investigate the relationships between the DoS in three operational dimensions and important nursing home outcomes, with data including ten years (2006 – 2015) of

comprehensive measurements of all nursing homes certified by the Centers for Medicare and Medicaid Services (CMS). We establish measurements for three operational dimensions: customer mix is measured by the percentage of Medicaid residents; service offering is measured by whether or not a nursing home facility has a special care unit; and service delivery is measured by staffing ratio. The outcomes of interest are financial outcome, clinical outcome, and resident welfare. (1) Financial outcome is measured by the operating margin (Marlin et al. 1999, O'Neill et al. 2003, Park et al. 2011). (2) Clinical outcome is measured by deficiency citations in clinical areas (Lu and Lu 2016, Grabowski 2004). The number of deficiency citations reflects a nursing home facility's level of compliance to the minimum requirements of federal legislation, and is reflected in the CMS Five-Star Quality Rating System for nursing homes. CMS also refers to deficiency citations as a proxy for overall quality of care (Lu and Wedig 2013). (3) Resident welfare is measured by deficiency citations in relevant areas. Residents' quality of life is crucial for nursing homes to build a reputation and attract more customers.

We initiate a unique method to identify nursing home chains: we only select facilities that bear the same chain names. When all belonging facilities bear the same chain name, each facility's conduct will impact the chain's reputation; thus, standardization versus customization strategies are crucial for these chains. If the chain-belonging facilities do not bear the chain's name, as is the case in many nursing home chains, then the chain may not necessarily consider within-chain standardization strategies. We view "standardization" and "customization" as a continuum rather than a binary choice (Lampel and Mintzberg 1996), and establish a measure "Degree of Standardization" (DoS) to estimate where a chain is on this continuum.

We use three separate yearly fixed effect models with clustered standard errors to estimate the stated relationships, one model for each of the three outcome measures. After sample selection, 1661 nursing home facilities nested within 31 chains are included in the final analysis. When controlling property and chain size, resident acuity level and staffing level, cost, occupancy, and property type, our results show that: (1) to improve chain-belonging properties' financial outcome, nursing home chains should customize customer mix and service offering across belonging units; (2) to improve clinical outcome, nursing home chains should standardize customer mix across units; i.e., facilities belonging to the same chain should have a similar customer composite; and (3) to improve resident welfare, nursing home chains need to customize service offering and service delivery across units.

We contribute to the literature in the following two aspects: (1) To our knowledge, our study is the first systematic multi-dimensional assessment of service firms' standardization strategies from a chain perspective. Most previous studies examine the DoS in one aspect, such as product offering or production process, while neglecting the trade-offs in multiple dimensions. Our study investigates the DoS in multiple operational dimensions: customer mix, service offering, and service delivery. As the DoS in three dimensions present in the same models simultaneously, the trade-offs among them are accounted for. (2) We establish our own method to identify customer-recognizable chains. We argue that when chain-belonging facilities bear the same chain name, DoS decisions across facilities are more likely to impact customers' perception and performance outcomes. Hence, with this more accurate definition of chains, our analysis results are robust and yield more applicable implications for chains' standardization strategies.

Our study also provides crucial implications for industry practitioners and policymakers. First, nursing home chains should customize service offering and service delivery across belonging units. By doing this, chain-belonging facilities can improve their financial outcome and resident welfare without negatively impacting clinical outcome. The only operational aspect that shows the tradeoff effect is customer mix, as a more standardized customer mix will improve clinical outcome, while a more customized customer mix will enhance financial outcome. Nursing home practitioners have to prioritize the operational goals of the organization before making this decision. On the policy level, since merging and acquisition are still nursing home chains' dominate expansion methods, how to manage the newly acquired facilities becomes an issue (Banaszak-Holl et al. 2006, Paruchuri et al. 2006). Our findings can help CMS establish policies regarding post-acquisition strategies, in terms of whether to standardize or customize the new facilities' operating practices. Our findings and implications have been reviewed by several nursing home industry leaders, property owners, and practitioners. Upon recognizing the implications stated above, they also pointed out that our results provide valuable guidance for nursing home chain investment strategies: when acquiring new properties, chains will be able to rely on our findings to choose facilities that have similar or different customer mix, service offering, and service delivery strategies compared to the chain norm.

The rest of our paper is organized as follows: in Section 2, we introduce the background of our study from both the academic side, in which we review relevant prior studies, and the practical side, in which we elaborate on the operational challenges and opportunities of nursing home chains. In Section 3, we then present our data exploration and model design and develop our hypothesis. In Section 4, we

present out results. In Section 5, we highlight our contribution and discuss its implications.

2. Background and Prior Research

We briefly summarize related previous work in this section. Section 2.1 revisits work on standardization as a strategy and its relationship with different outcomes; Section 2.2 focuses on related work in healthcare settings, and Section 2.3 in nursing home settings.

2.1. Standardization as a Strategy

In the service sector, around 70% of activities are performed by chains rather than independent units (Gupta et al. 2015). Replication, defined as “the creation and operation of a large number of similar units that deliver a product or perform a service” (Winter and Szulanski 2001), has been a widely-used strategy in chains in the service sector. It is believed that the superior benefit of replication and knowledge transfer results in competitive advantage for chains (Argote et al. 2003, Argote and Ingram 2000). In the effort to explore how to successfully replicate units within a chain, two fundamental and interrelated questions emerge: should a chain standardize or customize its practices across its units? Which aspects should be standardized, which customized?

2.1.1. Whether to Standardize or Customize Should a chain allow each unit to adapt to its own operating environment, or should the chain follow an established template and “copy exactly” for every unit (Winter et al. 2012)? Many researchers believe that chains should allow units to adapt their practices to “fit the salient characteristics of

host environments to maximize unit effectiveness” (Williams 2007, Winter et al. 2012). The principle of Ockham’s razor (Smart 1984), stated as “entities should not be multiplied without necessity,” suggests that each chain unit reaches its optimal outcome when it alters from the chain norm by the right amount contingent to its local context. In the extreme case, with uniform units, a chain is incapable of adapting to local variations, hence losing the ability to reach its optimal performance. Other scholars argue that by modifying complex templates, chains are risking overwhelming the benefits of local adaptation; thus practices should be strictly standardized (Jensen and Szulanski 2007).

2.1.2. What to Standardize, What to Customize When extending design practices to individual units, which attributes are replicable and worth replicating? Essentially, what should be standardized across units, and what should be customized? Winter and Szulanski (2001) argue that instead of rigidly standardizing overall operation aspects, standardization should be focused on the replicable traits of a business model. The commonly accepted conclusion is that the chain should be neither completely customized nor strictly copied.

We contribute to the literature and augment replication strategy theories by providing empirical answers to the following questions: (1) to what degree should multi-unit service firms standardize/customize across units in multiple operational aspects? And (2) how does this decision impact firms’ operational outcomes?

The application of the replication strategy is discussed in many contexts, such as the coffee (Yaniv and Brock 2008), banking (Winter and Szulanski 2001), and cruise industries (Weaver 2005). Wang et al. (2010) investigate relationships between

standardized and customized service offerings and customer satisfaction, concluding that a mix of standardization and customization in service offering negatively affects customer satisfaction in the auto repair industry. Kasiri et al. (2017) study the impacts of standardized and customized service offerings on customer satisfaction and loyalty (hotel, healthcare, and education), finding that a balance of standardization and customization is crucial to improve customer satisfaction (opposed to Wang et al.'s finding in another industry). Ding and Keh (2016) study the impact on customer satisfaction, customer perceived risk, and customer perceived control in hotels and fitness clubs. Often enough, in the service sector, a standardized strategy is associated with high-level efficiency and control (Sandoff 2005, Winter and Szulanski 2001), brand consistency and predictability (Winter and Szulanski 2001), decreased variations, errors, and wastes (Leape 1994, Gawande 2010), reduced coordination costs (Shapiro and Varian 1999), and faster inter-organizational learning (Ingram and Baum 2001). In contrast, a customized strategy empowers each unit to adjust its practice to fit with its local contexts, such as local demand, resources, and competition. Customization is also positively linked with perceived service quality, customer satisfaction, and customer loyalty (Coelho and Henseler 2012). However, most research focuses on standardization and customization in only one operational dimension while neglecting the whole picture. We contribute to this research by investigating multiple dimensions simultaneously.

Based on the service value chain theory (Alter 2008), our research uses target customer mix, service offering, and service delivery as critical operational dimensions in which to examine standardization strategies. For example, to target local demands, large chains can customize customer mix across units, or they can serve the same customer group without introducing extra staff training and adjustment costs.

Standardizing service offering enables a chain to establish production procedures for units to follow, thus decreasing variation and error; yet customizing service offering will satisfy a broader range of demand, thus increasing customer satisfaction, hence revenue. When service delivery methods are customized, customers may achieve a personalized experience (Coelho and Henseler 2012). But standardizing service delivery satisfies customers who expect consistency and predictability. In this study, we examine DoS decisions in each of these three dimensions, controlling to discern the impact of each on performance outcomes in relation to the other two.

2.2. Standardization in Healthcare Settings

Since a substantial part of a nursing home's daily operations is to provide clinical care for residents, it is necessary to discuss standardization and customization strategies in healthcare settings.

Strategies of standardization are also widely applied in clinical care. The Institute of Medicine's (IOM) 1999 report, *To Err Is Human*, pointed out that a large number of people are injured or die due to preventable medical errors in U.S. hospitals (Donaldson et al. 2000). In response to this alarming fact, several scientifically proven protocols have been developed for common conditions to decrease medical errors (Pronovost et al. 2006). For example, CMS and the Joint Commission developed a set of core process measures for common and serious medical conditions, such as heart failure, pneumonia, and children's asthma (Chandrasekaran et al. 2012, Senot et al. 2016). If a patient is admitted to the hospital for children's asthma, CMS requires providers to follow a three-step measure to treat the eligible patient. As Leape (1994) points out, standardization of procedures can reduce errors by "reinforcing the pattern recognition that humans do well"; thus the variation in providers' judgment can be

minimized (Chandrasekaran et al. 2012). Data shows that hospitals have significantly improved the quality of care following these steps (The Joint Commission 2010). When providers follow these standard procedures, patients' health outcomes are improved (Chassin et al. 2010), and hospital readmission rates are decreased (Senot et al. 2015). Some even argue that decreasing performance variance is a reasonable goal for the hospital Intensive Care Unit (ICU) (Tucker et al. 2007). Process and procedure are not the only dimensions healthcare organizations can standardize. For example, Shouldice Hernia Hospital strictly standardizes its patients' conditions, resulting in significantly lower recurrences (Malik et al. 2016).

However, as standardized as procedures could be, healthcare is also personal, case by case, and thus subject to variations. Due to the varied conditions in each medical case, clinical care also requires certain degrees of customization (Goodney et al. 2015, Frandsen et al. 2015). In non-clinical aspects of healthcare, the recent emphasis on patient-centered care focuses on "how" care was delivered to and perceived by patients (Chandrasekaran et al. 2012). This emphasis uses the patients' perspective to argue for interpersonal communication among providers and patients (Epstein and Peters 2009). Research shows that efforts made to respond to patients' unique personal needs can improve patient satisfaction (Rubin et al. 2001, Vuori 1991) and clinical outcomes (Senot et al. 2015, Boulding et al. 2011, Bechel et al. 2000). Thus, customization in healthcare settings can also be beneficial and even necessary.

2.3. Nursing Home Studies

The operations of U.S. nursing homes impose unique challenges and opportunities for standardization and customization strategies. On the one hand, nursing homes are the long-term home for many residents. Each resident has unique needs that require

differentiated care. For example, long-term residents may gradually develop various types of chronic diseases, such as dementia, stroke, heart failure, Parkinson's disease, osteoarthritis, and diabetes mellitus (Van Rensbergen and Nawrot 2010), which require different daily care and services from providers. The variance among personal characteristics in residents also calls for more individualized care. Facing the wave of aging baby boomers, who are more "independent and educated, and ethnically, racially and economically diverse" (Siberski and Siberski 2018) than previous generations, long-term care facilities need to allow more flexibility in care, as boomers will want to be more involved in choosing the care they receive. Living in a strictly standardized environment, residents can easily find it both constraining and dehumanizing (Fiveash 1998); the quality of life decreases with extensive standardization (Kamimura et al. 2007).

However, on the other hand, as the third-largest segment in the U.S. healthcare industry (Gray et al. 1986), nursing homes operate at a surprisingly low profit margin: the average nursing home in the United States lost four cents per patient per day in 2017 (Spanko 2019a). Since it has been proved that more personalized treatment and care will drive up the cost (Senot et al. 2015), too much customization is not a feasible approach for nursing homes. Significant multi-plant economies exist in large nursing home chains (Fizel and Nunnikhoven 1993, McKay 1991), suggesting standardization can offer cost reduction. Also, as mentioned before, clinical care is a very important component in nursing home operations, and standardization in clinical care is proven to reduce errors and improve efficiency, which in the long run reduces costs. Thus, exactly how nursing home chains can achieve the balance between standardization and customization, and find the optimal degree to standardize the operations of all chain-belonging facilities, is an issue that urgently needs to be addressed.

Not many nursing home studies have looked into within-chain standardization and customization. Banaszak-Holl et al. (2018) explore within-chain standardization in staffing nursing home chains, finding that very large for-profit chain nursing homes are more likely to standardize in staff hours per resident day. In this study, the authors use self-reported chain ownership to identify nursing home chains, and they did not investigate the impact of standardization and customization on nursing home outcomes. In our research, we aim to uncover the relationship between the DoS in multiple operational dimensions and nursing home chains' performance outcomes.

3. Research Design and Hypothesis Development

In this section, we begin by introducing our data, followed by the sample selection process. Then, we establish the measurements of customer mix, service offering, and service delivery. Based on our initial data exploration and established measurements, we quantitatively define the explanatory variables: the DoS in customer mix, service offering, and service delivery. We then establish the measurements of our outcome variables (financial outcome, clinical outcome, and resident welfare) and develop our hypotheses.

3.1. Data and Sample Selection

Our raw data has ten years of measures from more than 15,000 nursing home facilities in the U.S., and our final usable sample includes ten years of measures from 1661 nursing home facilities that belong to 31 chains. In this section, we introduce our data and sample selection process in detail.

3.1.1. Data Most of our data is publicly available at LTC focus, a product of the Shaping Long-Term Care in America Project being conducted at the Brown University Center for Gerontology and Healthcare Research and supported, in part, by the National Institute on Aging.⁴ All U.S. nursing homes certified by CMS are included in this data set. We combine this data set with other nursing home data obtained directly from CMS, including deficiency citation information and nursing homes' financial variables, such as annual cost and operating margin. Thus, our data contains detailed yearly information on each nursing home's (1) facility characteristics, such as whether the facility is hospital-based, and whether the facility has any kind of special care units; (2) resident health status and acuity level, such as average Activities of Daily Living (ADL) and the proportion of long-stay residents with pressure ulcers; (3) resident demographic information, such as average age; (4) resident admission information, such as race and gender; (5) staffing level information, such as Registered Nurse (RN) hours per resident day, and Certified Nursing Assistant (CNA) hours per resident day; (6) number of deficiency citations issued to the nursing home in each inspection area; and (7) nursing home financial credentials such as cost and operating margin. The period of our study covers a decade, from 2006 to 2015, and the data set contains information from more than 15,000 nursing homes in the U.S.

3.1.2. Sample Selection Since our research focuses on chain-level standardization and customization, only chain-operated nursing homes are included for the final analysis. As mentioned before, we want to identify customer-recognizable chain names. When customers can associate a property with a chain by recognizing the chain's key words (such as "Marriott-Courtyard"), then all properties sharing the same chain key words

⁴ <http://lctfocus.org/1/about-us>

in their name are linked: they are bound together for good or ill repute. Thus, the chain needs to delicately apply standardization strategies to build the chain image.

Two pieces of information are available to identify nursing home chains: property owner names and facility names. One owner may own facilities that belong to different chains and carry different brand names; meanwhile, facilities with similar naming patterns may belong to different chains and brands. To identify big, customer-recognizable, and mostly single-owner chains, we design our own method, which utilizes both owner and facility names. This method is a four-step process:

Step 1: We identify qualified owners. To ensure a large enough sample size to calculate variance, we only select owners with 10 continuous years of data and more than 10 facilities in each year. Based on these criteria, 100 owners are identified.

Step 2: We identify naming patterns of customer-recognizable chains. Within a customer-recognizable chain, one facility's reputation can impact the other facilities. Thus, we explore high-standardization and high-customization strategies in chains whose facilities bear the same name. Within each big owner, we extract similar naming patterns using text analysis and then use those naming patterns to identify chains. For example, within one owner, multiple facilities have the word "Kindred" in their names; thus "Kindred" is one of the chain brands identified.

Step 3: We verify the naming pattern of each chain to see if this pattern mostly exists under one owner. If a naming pattern frequently appears, but is generic and exists across many different owners, such as "Nursing and Rehabilitation," we omit it from

the chains. By the above standards, 65 chains are identified. The identified chains are then verified by nursing home practitioners.

Step 4: We select chains with enough multi-year, multi-facility observations for experiments: only chains with more than 2 years of data and more than 10 facilities each year are selected. We also focus on (1) for-profit chains due to their motivation to maximize profit and competitiveness; (2) chains that are large enough to have a fair economic scale (chains that have more than 1000 beds each year); and (3) chains that have a fair number of competitors (remove outlying chains with more than 1000 local competitors state-wide). After the selection process, our usable sample size for analysis contains 1661 nursing homes belonged to 31 chains, from the year 2006 to the year 2015. The unit of analysis in our study is each nursing home nested within a chain.

3.2. Research Design

In Sections 3.2.1, 3.2.2, and 3.2.3, we establish our measures for our explanatory variables, outcome variables, and control variables, respectively. In Section 3.3, we develop our hypotheses on the relationships between the DoS in multiple operational dimensions and nursing homes' performance outcomes.

3.2.1. Measure Development for Explanatory Variables According to the Service Value Chain Framework (Alter 2008), a chain needs to first explore the demand variation among different units and decide whether to target the same customer groups in all units. Based on the demand, the chain can then decide what services to offer and how to deliver these services. Thus, in our study, we estimate the impact on nursing

home outcomes of the DoS in three dimensions: customer mix (CM), service offering (SO), and service delivery (SD).

Customer Mix (CM) is measured by the percentage of residents whose primary financial support was Medicaid in each nursing home facility in each year, because it contains information on payment source, resident acuity level, and care needed. This percentage of Medicaid residents first represents the payment source structure in the nursing home. Second, it implies the residents' acuity level. Studies (Lewis et al. 1985, Weissert and Scanlon 1985) show that Medicaid residents are associated with poorer health status. Third, it implies the types of care needed. In the U.S., Medicare and most forms of private health insurance cover skilled nursing stays following a recent hospitalization only up to 100 days. Medicaid, on the other hand, pays for the largest share (54% in 2016 (Colello 2018)) of long-term care services. The daily care needed by long-term residents is very different from the care needed by residents recently discharged from a hospital. A facility can decide whether it accepts Medicaid residents and how many it accepts; thus the measure of the percentage of Medicaid residents ranges from 0 to 1. For Facility i in Chain j in Year t , the Customer Mix is defined as:

$$Customer\ Mix_{ijt} = \left(\frac{Number\ of\ Medicaid\ Residents_{ijt}}{Total\ Number\ of\ Residents_{ijt}} \right) * 100\%, \quad (1)$$

Service Offering (SO) is measured by the representative offering in nursing homes of a Special Care Unit (SCU). A binary variable with value 1 indicates the nursing home facility has an SCU, while 0 means the opposite, and the unit level is each facility in each year. An SCU is a critical service offering in skilled nursing facilities and is often found to be linked with nursing home performance. In 2006, about 29% of nursing

homes reported having an SCU. A study found that providing SCUs, such as a dementia and Alzheimer’s care unit, is associated with better resident health in certain aspects (Cadigan et al. 2012). Opening SCUs positively impacts the overall occupancy and private-pay occupancy of a facility (Castle 2008). Evidence also suggests that chain affiliations promote the growth of Alzheimer’s disease SCUs (Blackburn et al. 2018). A facility can decide whether and what kind of SCUs to offer its residents. Recent changes in how healthcare is paid have resulted in a boost in the post-acute continuum of non-hospital-based services. It has been proved that certain nursing homes (nursing homes with fewer Medicare patients and nursing homes located in markets with a large HMO population and greater hospital supply) are more likely to have SCUs (Banaszak-Holl et al. 1996), but it is unclear whether a nursing home chain should provide SCUs in a uniform manner. For Facility i in Chain j in Year t , the Service Offering is defined as:

$$\begin{aligned}
 & \textit{Service Offering}_{ijt} \\
 & = \begin{cases} 1, & \textit{if Facility } i \textit{ in Chain } j \textit{ provides any SCU during Year } t \\ 0, & \textit{if Facility } i \textit{ in Chain } j \textit{ provides no SCU during Year } t \end{cases} \quad (2)
 \end{aligned}$$

Service Delivery (SD) is estimated by the staffing ratio of each facility in each year. It is calculated by the registered nurse hours per resident day divided by total nurse hours per resident day, including registered nurse hours, licensed practical nurse hours, and certified nursing assistant hours. The staffing ratio is one of the crucial quality measures of nursing homes. Evidence suggests many U.S. nursing homes’ serious quality problems are, in part, due to inadequate staffing levels (Harrington et al. 2016). Federal law and regulations have minimum requirements for skilled nursing facilities’ staffing levels; however, studies show that these requirements are often not adequate to ensure a safe workplace (Wofford 2019). The staffing ratio represents the

clinical competency of a nursing home and also suggests its service delivery strategies. Higher staffing ratios are often linked to better quality since the residents are cared for by more professional staff members, but if the ratio is higher than necessary, it also means wasted staffing costs. For Facility i in Chain j in Year t , the Service Delivery is defined as:

$$Service\ Delivery_{ijt} = \frac{RNhr_{sijt}}{RNhr_{sijt} + LPNhr_{sijt} + CNAhr_{sijt}}, \quad (3)$$

Our initial data exploration validates our measurements of variables and our research question. Figure 3.1 shows different standardization strategies taken by different chains. The X-axis represents the customer mix (percentage of Medicaid residents) in nursing home facilities, and the Y-axis represents the service delivery (staffing ratio). Each figure illustrates one nursing home chain, and each bubble represents a facility. These figures demonstrate a clear pattern that in some chains, such as Chain A, each facility is unique in terms of customer mix and service delivery – the facilities of Chain A are scattered in a large range along both the X-axis and Y-axis – whereas facilities in some other chains, such as Chain B, are similar to each other in terms of service delivery but are differentiated in terms of customer mix. Then there are chains whose facilities are very similar to each other in both dimensions, such as Chain C. Inspired by these revealed patterns and a previous study (Banaszak-Holl et al. 2002), we measure the DoS by the distance between each focal facility and the mean of its belonging chain.

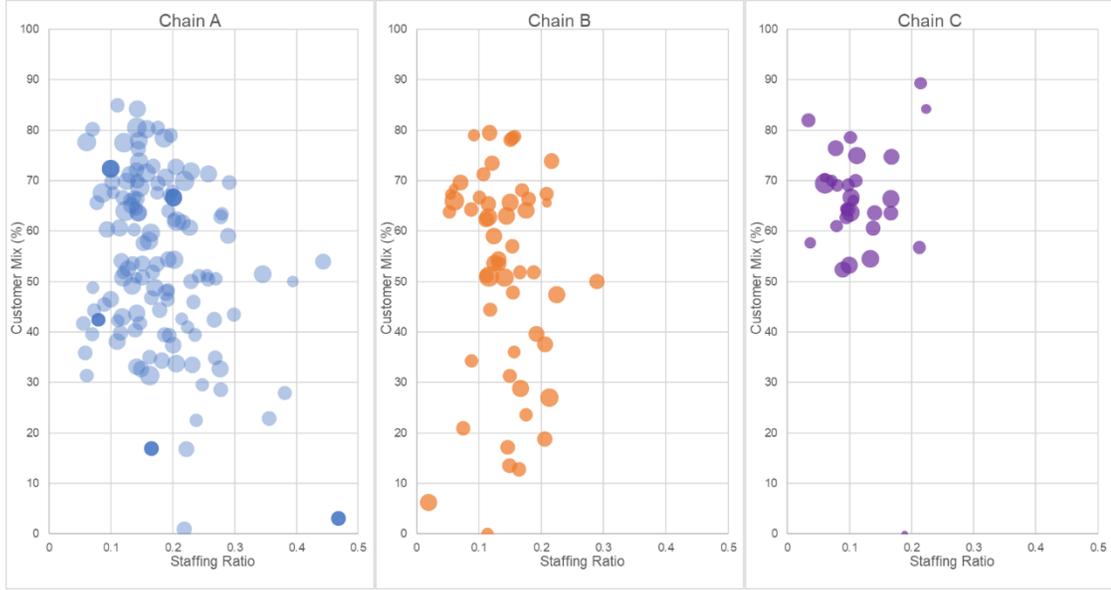


Figure 3.1 Chain A: Customized in both dimensions; Chain B: Standardized in one dimension while customized in another dimension; Chain C: Standardized in both dimensions.

For the operational dimensions – customer mix, service offering, and service delivery – we first calculate the chain yearly average on each dimension, then calculate the absolute value of the difference between each facility and the chain yearly average, then use this value divided by yearly chain average to get focal-normalized value. Since this is a measure of distance, the bigger the value, the more customized the focal facility. Thus, we take the negative of this value to estimate the degree of standardization: the bigger the value, the more standardized the focal facility. For Facility i in Chain j in Year t :

$$\begin{aligned}
 \text{Degree of Standardization in Customer Mix}'_{ijt} &= -\frac{\Delta(CM_{ijt})}{\overline{CM}_{.jt}} \\
 &= -\frac{|CM_{ijt} - \overline{CM}_{.jt}|}{\overline{CM}_{.jt}}, \quad (4)
 \end{aligned}$$

$$\begin{aligned}
\text{Degree of Standardization in Service Offering}'_{ijt} &= -\frac{\Delta(SO_{ijt})}{\overline{SO}_{.jt}} \\
&= -\frac{|SO_{ijt} - \overline{SO}_{.jt}|}{\overline{SO}_{.jt}}, \tag{5}
\end{aligned}$$

$$\begin{aligned}
\text{Degree of Standardization in Service Delivery}'_{ijt} &= -\frac{\Delta(SD_{ijt})}{\overline{SD}_{.jt}} \\
&= -\frac{|SD_{ijt} - \overline{SD}_{.jt}|}{\overline{SD}_{.jt}}, \tag{6}
\end{aligned}$$

3.2.2. *Measure Development for Outcome Variables* We study nursing home facilities' performance in three aspects: financial outcome, clinical outcome, and resident welfare; each is estimated with a separate model.

Financial Outcome is measured by the operating margin of each facility in each year. Operating margin is the ratio of operating income over revenue, and it is a validated indicator of the financial ability and risk of a firm (Marlin et al. 1999, O'Neill et al. 2003, Park et al. 2011). In 2013, CMS established the Medicare Bundled Payment for Care Improvement (BPCI). Both for-profit and non-profit nursing homes are pressured to provide higher quality care with less financial resources to secure Medicare reimbursement. For Facility i in Chain j in Year t , Operating Margin is:

$$\text{Operating Margin}_{ijt} = \frac{\text{Operating Income}_{ijt}}{\text{Total Revenue}_{ijt}}, \tag{7}$$

Clinical Outcome is measured using the weighted number of deficiency citations in clinical areas, including infection control, pharmacy services, dental services,

specialized services, physician services, and nursing services, in each facility in each year. Many CMS nursing home quality measures are, in fact, clinical measures, such as re-hospitalization rate, percentage of residents with pressured ulcers, and percentage of residents with severe pain (CMS.gov 2020). CMS conducts yearly nursing home surveys following survey protocols and federal requirements to determine whether a non-compliance citation is appropriate. If any of the inspected areas contain quality indicators that are judged substandard by the inspection team, a deficiency citation will be issued for that indicator. Multiple citations can be issued on one indicator. Deficiency citations are often used as a nursing home quality measure (Lu and Lu 2016, Grabowski 2004); the validity of this measure can be found in Lu and Wedig (2013). For Facility i in Chain j in Year t , the clinical outcome is equal to the number of deficiency citations in clinical areas divided by total occupied beds.

$$Clinical\ Outcome_{ijt} = \frac{\sum(Clinical\ Citations)}{Occupancy_{ijt} * Total\ Beds_{ijt}}, \quad (8)$$

Resident Welfare is estimated by the weighted⁵ total number of deficiency citations in resident welfare areas, including dietary services, quality of care, resident assessment, quality of life, resident behavior and facility practices, admission, transfer, and discharge rights, and resident rights, in each facility in each year. To our knowledge, ours is the first study to use deficiency citations as the indicator of general living conditions for nursing home residents. Other widely used measures are the resident self-reported quality of life scales (Kane et al. 2003, Degenholtz et al. 2008) and satisfaction scales (Cook 1998). However, due to some residents' cognitive ability issues, selection bias may skew self-reported surveys. Thus, the "check-list" method is

⁵ Resident Welfare is partially weighted. Deficiency citations on dietary services, quality of care, resident assessment, and quality of life are weighted by the total occupied beds, while citations on resident behavior and facility practices, admission, transfer, and discharge rights, and resident rights are not weighted.

more objective and less biased than self-reported information. For Facility i in Chain j in Year t :

$$Resident\ Welfare_{ijt} = \frac{\sum(Resident\ Welfare\ Citations)}{Occupancy_{ijt} * Total\ Beds_{ijt}}, \quad (9)$$

3.2.3. Control Variables We control the following factors in our models due to their potential impact on nursing home operational outcomes:

(1) Size: the number of facilities in a chain and the number of beds in a facility in each year. The structure of organizations is often contingent on size (Child 1973, Blau (1972)). Size is also associated with performance outcomes (Gottesman 1974, Curry and Ratliff 1973).

(2) Resident acuity level: resident average Activities of Daily Living (ADL) score and the average Resource Utilization Group Nursing Case Mix Index (RUGCMI) in each facility in each year. The average acuity level of residents affects the average level of care needed, and thus can be associated with clinical outcomes.

(3) Staffing level: Registered Nurse hours per resident day (Harrington et al. 2000) in each facility in each year. Staffing level is proven to be associated with clinical outcomes (Harrington et al. 2016) and nursing home costs.

(4) Costs and occupancy: total costs and occupancy of each facility in each year. Costs and occupancy can be associated with operating margins.

(5) Local competitors: the total number of nursing homes in the state each year. The number of local competitors can also influence decisions about organization structures and performance outcomes (Brickley et al. 2015, Castle et al. 2007).

(7) Property type: whether the focal facility is profit-based or hospital-based. Property types can impact the quality of nursing homes (Comondore et al. 2009).

(8) Chain norm: the chain yearly average DoS in service offering, customer mix, and service delivery. These variables account for the effects of average chain procedures.

(9) Time: the yearly fixed effect is added to capture unobservable effects over time.

3.3. Hypothesis Development

In this section, we develop our hypotheses of the relationships between DoS in customer mix, service offering, and service delivery, and nursing homes' performance outcomes.

3.3.1. Standardization and Customization in Customer Mix For a chain operating in multiple locations, the potential customer groups may vary by many local factors, such as the poverty level and natural environment of the location, and the demographic profiles of the local residents. Under this circumstance, to increase revenue, a nursing home chain may choose to customize customer mix and attract different customer groups in each facility according to local demographic profiles. Thus, we hypothesize that customization in customer mix can improve chain-belonging facilities' financial outcome.

The receivers of clinical care crucially impact clinical results. Thus, whether to standardize or customize customer mix across belonging facilities can significantly impact a nursing home chain's clinical outcome. Standardization in customer mix may further enable standardization in clinical procedures by reducing procedure complexity and knowledge transfer, thus reducing errors, which leads to fewer citations. Thus, we hypothesize that standardization in customer mix is positively associated with chain-belonging facilities' clinical outcome.

Improving resident welfare requires certain investments, such as hiring and training more employees and purchasing better amenities. If a nursing home improves its financial status, then it will have more resources to improve resident welfare. Linking to our previous argument, we hypothesize that customization in customer mix can improve chain-belonging facilities' resident welfare.

HYPOTHESIS 1A. Within a nursing home chain, customization across facilities in customer mix positively impacts nursing homes' financial outcome;

HYPOTHESIS 1B. Within a nursing home chain, standardization across facilities in customer mix positively impacts nursing homes' clinical outcome;

HYPOTHESIS 1C. Within a nursing home chain, customization across facilities in customer mix positively impacts nursing homes' resident welfare.

3.3.2. Standardization and Customization in Service Offering Healthcare is regional, and diseases such as Alzheimer's can be geographically patterned. The demand for particular specialty care could vary dramatically from one location to another due to local disease profiles. Thus, nursing home chains may choose to provide SCUs only where demand is high, to reduce unnecessary costs while capturing revenue from

customers with such needs. Thus, we hypothesize that customization in service offering across chain-belonging facilities will positively impact their financial outcome.

We hypothesize that clinical outcome benefits from standardization across facilities in service offering. When all facilities offer (or do not offer) SCUs, it is easier for the chain to establish standard procedures and employee training programs to tackle clinical care needs in all facilities.

When nursing home chains have some facilities with SCUs and some without, residents can choose facilities according to their needs. If residents gradually develop needs for SCUs, they can be transferred between facilities. Thus, we hypothesize that customization in service offering can positively impact resident welfare.

HYPOTHESIS 2A. Within a nursing home chain, customization across belonging facilities in service offering is positively associated with belonging facilities' financial outcome;

HYPOTHESIS 2B. Within a nursing home chain, standardization across belonging facilities in service offering is positively associated with belonging facilities' clinical outcome;

HYPOTHESIS 2C. Within a nursing home chain, customization across belonging facilities in service offering is positively associated with belonging facilities' resident welfare.

3.3.3. Standardization and Customization in Service Delivery In the U.S., each state has established its own legislation on minimum staffing requirements in nursing

homes. However, each facility within a chain may operate in a different market environment with varied labor costs. As each nursing home facility aims to both meet the minimum staffing requirements and maintain an adequate staffing level to care for its residents' needs, we hypothesize that nursing home chains need to customize across facilities to achieve a better financial outcome.

In each nursing home facility, residents may develop different kinds of chronic diseases, thus needing varied levels and types of clinical care. Thus, we argue that nursing home chains should customize service delivery across facilities to improve clinical outcome.

Similarly, as residents at each facility have varied personalities and health profiles, a "one-for-all" staffing ratio cannot suit all chain-belongs facilities. Each facility needs to staff the property according to its residents' needs.

HYPOTHESIS 3A. Within a nursing home chain, customization across belonging facilities in service delivery is positively associated with belonging facilities' financial outcome;

HYPOTHESIS 3B. Within a nursing home chain, customization across belonging facilities in service delivery is positively associated with belonging facilities' clinical outcome;

HYPOTHESIS 3C. Within a nursing home chain, customization across belonging facilities in service delivery is positively associated with belonging facilities' resident welfare.

4. Analysis and Results

In Section 4.1, we show the correlation analysis of included variables and rule out any potential multicollinearity issues. We establish our models and clarify model specifications in Section 4.2. We then test our hypotheses and present the model results in Section 4.3.

4.1. Correlation Analysis

Table 3.1 shows the correlations of candidate variables to be included in our models. The largest observed correlations are *Cost with Registered Nurse Hours per Patient Day* (0.70) and *Cost with Operating Margin* (-0.66), which are expected. Since multicollinearity does not present significantly, we will use all variables in Table 3.1.

Table 3.1 Correlations of Variables Used in Models

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|-----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|------|
| 1.Operating Margin | 1.00 | | | | | | | | | | | | | | | | | | |
| 2.Clinical Outcome | -0.30 | 1.00 | | | | | | | | | | | | | | | | | |
| 3.Resident Welfare | -0.02 | 0.21 | 1.00 | | | | | | | | | | | | | | | | |
| 4.DoS in Service Offering | -0.01 | 0.04 | 0.02 | 1.00 | | | | | | | | | | | | | | | |
| 5.DoS in Service Delivery | 0.04 | -0.04 | 0.01 | 0.00 | 1.00 | | | | | | | | | | | | | | |
| 6.DoS in Customer Mix | 0.08 | -0.04 | -0.01 | -0.02 | 0.05 | 1.00 | | | | | | | | | | | | | |
| 7.Number of facilities in Chain | 0.00 | 0.04 | -0.01 | 0.03 | -0.03 | 0.15 | 1.00 | | | | | | | | | | | | |
| 8.Average ADL | 0.08 | -0.15 | -0.05 | 0.00 | 0.10 | -0.07 | -0.17 | 1.00 | | | | | | | | | | | |
| 9.Average RUGCMI | -0.07 | 0.00 | 0.01 | -0.01 | 0.13 | -0.12 | -0.08 | 0.36 | 1.00 | | | | | | | | | | |
| 10.Registered Nurse Hour | -0.37 | 0.31 | 0.00 | 0.03 | -0.15 | -0.25 | -0.04 | 0.09 | 0.31 | 1.00 | | | | | | | | | |
| 11.Number of Beds in Facility | 0.05 | -0.23 | 0.06 | -0.11 | 0.10 | -0.01 | -0.16 | 0.22 | 0.10 | -0.02 | 1.00 | | | | | | | | |
| 12.Chain Average Service Offering | -0.02 | -0.01 | 0.01 | 0.09 | 0.00 | 0.01 | 0.40 | -0.13 | -0.22 | 0.02 | 0.01 | 1.00 | | | | | | | |
| 13.Chain Average Service Delivery | -0.06 | -0.05 | 0.02 | 0.02 | 0.15 | -0.27 | -0.29 | 0.23 | 0.42 | 0.27 | 0.13 | -0.08 | 1.00 | | | | | | |
| 14.Chain Average Customer Mix | 0.03 | 0.02 | 0.01 | -0.05 | -0.07 | 0.42 | 0.28 | -0.21 | -0.10 | -0.16 | -0.03 | -0.04 | -0.61 | 1.00 | | | | | |
| 15.Cost | -0.66 | 0.39 | 0.01 | 0.03 | -0.06 | -0.19 | -0.07 | 0.16 | 0.29 | 0.70 | -0.01 | 0.00 | 0.19 | -0.12 | 1.00 | | | | |
| 16.Occupancy | 0.19 | -0.22 | -0.07 | 0.01 | 0.09 | 0.13 | 0.11 | 0.08 | -0.10 | -0.24 | -0.04 | 0.09 | 0.04 | -0.06 | -0.24 | 1.00 | | | |
| 17.Number of facilities in State | 0.00 | -0.01 | 0.01 | -0.07 | 0.00 | -0.01 | -0.20 | 0.07 | 0.07 | -0.02 | 0.11 | -0.10 | -0.15 | 0.15 | 0.00 | -0.17 | 1.00 | | |
| 18.For-profit | 0.02 | -0.11 | 0.02 | -0.01 | 0.05 | -0.04 | -0.14 | 0.18 | 0.19 | 0.00 | 0.31 | -0.13 | 0.05 | 0.16 | 0.02 | -0.05 | 0.21 | 1.00 | |
| 19.Hospital-based | 0.00 | 0.04 | 0.02 | 0.01 | -0.02 | -0.08 | -0.01 | -0.01 | 0.03 | 0.11 | -0.03 | 0.00 | 0.06 | 0.00 | 0.02 | -0.01 | 0.01 | -0.04 | 1.00 |

4.2. Model Specification

With our longitudinal data, we build yearly fixed effect models with clustered standard error to estimate the DoS effects in multiple operational dimensions on three nursing homes' performance outcomes. Nursing home facilities bearing the same chain name may be subject to unobserved connections and similarities; hence we cluster the standard error of facilities within the same chain. Three separate models are estimated, one for each of the outcome measures. For Facility i in Chain j in Year t , the regression equation is:

$$\mathbf{Y}_{ijt} = \boldsymbol{\alpha}^T + \mathbf{X}_{ijt}\mathbf{B}_1 + \mathbf{W}_{ijt}\mathbf{B}_2 + \mathbf{W}'_{ijt}\mathbf{B}_3 + \mathbf{Z}_t\boldsymbol{\beta}_4^T + \boldsymbol{\epsilon}_{ijt}^T, \quad (10)$$

Where \mathbf{Y}_{ijt} is a matrix of nursing home facility outcome variables: *operating margin*, *clinical outcome*, and *resident welfare*; \mathbf{X}_{ijt} is a matrix that contains explanatory variables, which are the DoS in customer mix, service offering, and service delivery; \mathbf{W}_{ijt} contains facility-level control variables; \mathbf{W}'_{ijt} contains chain level control variables; \mathbf{Z}_t is the yearly fixed effect; $\boldsymbol{\epsilon}_{ijt}$ is a vector of the facility-specific errors.

4.3. Results and Discussion

Table 3.2 shows a general overview of our results. In this section, we present and interpret our results in detail.

Table 3.2 Results and Hypotheses

| | DoS in Customer Mix | DoS in Service Offering | DoS in Service Delivery |
|-------------------|----------------------|-------------------------|-------------------------|
| Financial Outcome | H1A Supported | H2A Supported | H3A Not Supported |
| Clinical Outcome | H1B Supported | H2B Not Supported | H3B Not Supported |
| Resident Welfare | H1C Not Supported | H2C Supported | H3C Supported |

4.3.1. Model 1: Operating Margin Our results indicate that customization in customer mix improves nursing homes' operating margin. As shown in column 1 of Table 3.3, the coefficient is ($\beta_{CM,OM} = -2.68 \times 10^{-4}, p < 0.001$). According to this finding, to improve financial outcome, nursing home chains need to customize customer mix. Thus, Hypothesis 1A is supported. The coefficients can be better interpreted with examples. Chain A has an average customer mix (percentage of Medicaid residents) of 15%, and the chain plans to increase one belonging facility's customer mix from 20% to 90%. Thus the DoS in customer mix of this facility will change from -0.33 ($-|20\% - 15\%|/(15\%)$) to -5 ($-|90\% - 15\%|/(15\%)$). According to the model coefficient, holding all other variables constant, this change will increase the operating margin by 0.125% ($| - 2.68 \times 10^{-4} \times ((-0.33) - (-5)) | \times 100\%$). In 2015, nursing homes in the US generated an average of \$11,566,000 in revenue.⁶ In this case, the operating income would increase by \$14,458 ($0.125\% \times \$11,566,000$) for this property. The potential explanation for this is that healthcare is regional, due partly to the different population structure in each geographic area. For example, the population of 65 years and older is 20.1% of the entire population in Florida State, while the same number is 10.8% in Utah State (U.S. Census Bureau (the Administration for Community Living 2018)). Varied population structure implies a varied proportion of Medicare and Medicaid enrollees and varied demand for care. Thus, customizing customer mix to capture the local demands of each chain-belongs facility contributes to maximizing revenue.

⁶ <https://www.statista.com/statistics/323229/average-nursing-home-revenue-in-top-and-bottom-three-states/>

Table 3.3 Yearly Fixed Effect Model Results

| | Model 1 | | Model 2 | | Model 3 | |
|---|------------------|-----|------------------|-----|------------------|-----|
| | Operating Margin | | Clinical Outcome | | Resident Welfare | |
| Constant | -44.330 | *** | 632.300 | *** | 17320.000 | *** |
| | (3.994) | | (41.970) | | (3490.000) | |
| <i>Explanatory Variables</i> | | | | | | |
| DoS in Customer Mix | -2.675 | *** | -14.590 | | 334.800 | |
| | (0.801) | | (8.421) | | (700.200) | |
| DoS in Service Offering | -0.174 | | 1.760 | | 222.200 | * |
| | (0.104) | | (1.076) | | (89.480) | |
| DoS in Service Delivery | -0.856 | | 6.617 | | 862.200 | |
| | (0.551) | | (5.787) | | (481.200) | |
| <i>Facility Level Control Variables</i> | | | | | | |
| Average ADL | 0.384 | *** | -3.357 | *** | -411.000 | *** |
| | (0.088) | | (0.936) | | (77.820) | |
| Average RUGCMI | 11.780 | *** | -66.600 | ** | 38.480 | |
| | (2.262) | | (24.470) | | (2035.000) | |
| Registered Nurse Hour PPD | -1.255 | | -0.173 | | -1323.000 | * |
| | (0.721) | | (7.689) | | (639.400) | |
| Number of Beds in Facility | 0.018 | *** | -0.824 | *** | 17.660 | *** |
| | (0.004) | | (0.038) | | (3.154) | |
| Cost | 0.000 | *** | 0.000 | | 0.016 | * |
| | (0.000) | | (0.000) | | (0.007) | |
| Occupancy | 0.451 | *** | -2.359 | *** | -63.640 | *** |
| | (0.014) | | (0.143) | | (11.920) | |
| Number of NH in State | -0.001 | | -0.013 | * | -0.015 | |
| | (0.001) | | (0.006) | | (0.509) | |
| For-profit | -7.165 | *** | 32.660 | | -3104.000 | |
| | (2.021) | | (21.410) | | (1781.000) | |
| Hospital-based | 10.100 | | 19.860 | | 12170.000 | * |
| | (5.847) | | (62.220) | | (5174.000) | |
| <i>Chain Level Control Variables</i> | | | | | | |
| Number of Facility in Chain | -0.022 | *** | 0.081 | *** | 0.829 | |
| | (0.002) | | (0.021) | | (1.749) | |
| Chain Average Service Offering | 9.545 | *** | -13.930 | | 940.800 | |
| | (1.414) | | (14.640) | | (1218.000) | |
| Chain Average Service Delivery | 3.364 | ** | -36.040 | *** | 2505.000 | ** |
| | (1.029) | | (10.780) | | (896.500) | |
| Chain Average Customer Mix | -0.167 | *** | -0.939 | *** | 26.200 | |
| | (0.022) | | (0.232) | | (19.270) | |
| Yearly Fixed Effect | Yes | | Yes | | Yes | |

| | | | |
|-------------------------|-----------|-----------|----------|
| R ² | 20.36 | 10.87 | 2.18 |
| Adjusted R ² | 20.16 | 10.62 | 1.91 |
| Degree of Freedom | 10110 | 8868 | 8868 |
| F-statistic | 103.4 *** | 43.26 *** | 7.91 *** |

Notes. The reported coefficients were multiplied by 10⁴

.p < 0.1; * p < 0.05; ** p < 0.01; *** p < 0.001

According to our results, customization in service offering improves nursing homes' operating margin as well. As shown in column 1 of Table 3.3, the coefficient is

($\beta_{SO,OM} = -1.74 \times 10^{-5}, p < 0.1$). According to this finding, to improve

financial outcome, nursing home chains need to customize service offering. Thus,

Hypothesis 2B is supported. The following example illustrates the impact: Chain B

has 100 facilities; 99 out of 100 facilities do not have SCUs. If Chain A decides to

equip 1 of these 99 facilities with an SCU, then the DoS in service offering of this

specific facility will decrease from -1 ($-|0-0.01|/0.01$) to -99 ($-|1-0.01|/0.01$).

According to the model coefficient, holding all other variables constant, this change

will increase the operating margin by 0.17% ($|(-1.74 \times 10^{-5} \times ((-1) - (-99)))| \times 100\%$). In

the average case of 2015, this will increase operating income by \$19,662 (0.17% ×

\$11, 566, 000) for this specific property. A plausible explanation is that due to various

factors such as local demographics and environment, diseases such as Alzheimer's

(Alzheimer's Association 2019), stroke, and heart disease can be geographically

patterned. Offering SCUs only in facilities with higher demands can capture the

demand while saving the property unnecessary costs. In addition, regulations

concerning nursing home SCUs vary by state (Grande 2002), from initial inspection

before the opening of a facility to regular survey inspection and disclosure statements.

This political factor creates a local economic scale. Thus, whether to implement SCUs

in a nursing home facility also depends on the state that nursing home operates in.

4.3.2. Model 2: Clinical Outcome Our results indicate that standardization in customer mix improves chain-belonging nursing home facilities' clinical outcome. As shown in column 2 of Table 3.3, the coefficient is $\beta_{CM,CO} = -1.46 \times 10^{-3}, p < 0.1$). This suggests that a chain-belonging facility will have fewer deficiency citations (the desirable outcome) if its customer mix is closer to the chain norm. Thus, Hypothesis 1B is supported. Take another example: Chain C has an average of 90% customer mix, and Chain C intends to increase one of its facility's customer mix level from 10% to 90%. Thus, the DoS in customer mix of this facility will change from -0.89 to 0. According to the coefficient, the number of deficiency citations per occupied bed in the clinical area will decrease by 0.0013. If this facility has 100 occupied beds, adjusting its customer mix level to the chain norm can decrease its clinical deficiency citation by more than 1.

Having similar resident structure across facilities enables a chain to establish uniform clinical procedures and staff training programs at the chain level. As proved in multiple studies focused on single organization operations, strictly following standardized procedures in the clinical environment can decrease human errors and increase conformance quality. In a chain, similar effects can even be magnified through knowledge transfer (Brock and Yaniv 2007, Winter et al. 2012). When one facility discovers a set of efficient practices, other facilities in the same chain can also execute the same practices since they all have similar resident structures, hence similar types and levels of care. A pioneering example in standardizing care receivers for better clinical results is the Shouldice Hernia Centre. Only patients with specific types of abdominal hernia will be treated in Shouldice Hospital. Patients' conditions such as body weight and previous medical records are also strictly controlled. Despite its controversial reputation, Shouldice Hospital was found to be associated with a

significantly lower risk of subsequent surgery for recurrence (of inguinal hernia repair) than repair at a general hospital (Malik et al. 2016). Also, as a nursing home industry leader points out, having the same customer mix level across belonging facilities enables the chain corporate to design an efficient staffing strategy by establishing the optimal staffing ratio and applying it in all belonging facilities.

4.3.3. Model 3: Resident Welfare Results indicate that customization in service offering across chain belonging facilities improves nursing homes' resident welfare. As shown in column 3 of Table 3.3, the coefficient is ($\beta_{SO,RW} = 2.22 \times 10^{-2}, p < 0.05$). Thus, Hypothesis 2C is supported. Back to the example of Chain B: implementing one facility with SCUs in Chain B will decrease the number of deficiency citations per occupied bed in the resident welfare area by 2.18. When interpreting the results of Model 3, an industry leader revealed that, oftentimes, it is difficult to mix residents with special care needs and those without. For example, the living environment designed for dementia residents needs to be "safe," meaning no sharp objects, fewer steps, etc. But this safe environment may suit residents without dementia as well. Thus, to attract more customers and improve revenue, as well as to improve residents' quality of life, it is reasonable for a corporate chain to have some facilities with SCUs and some without.

We also find that customization in service delivery across facilities improves nursing homes' resident welfare. As shown in column 3 of Table 3.3, the coefficient is ($\beta_{SD,RW} = 8.62 \times 10^{-2}, p < 0.1$). Thus, Hypothesis 3C is supported. In another example, Chain D has an average service delivery (staffing ratio) level of 5%, and intends to increase one facility's service delivery level from 5% to 50%. Thus, this facility's DoS in service delivery will change from 0 to -9. According to the

coefficient, the number of deficiency citations per occupied bed in the resident welfare area will decrease by 0.78. If this facility has 100 beds, then its number of resident welfare deficiency citations will decrease by 78. Nursing homes is a low margin industry, with an average profit ranging from three to four percent (Mathews 2018). Many aspects concerning resident welfare improvements require financial investment, for example, staff training on how to treat residents, accommodating resident needs, designing and hosting resident activities, and improving the physical environment. From a resource allocation perspective, money saved from (1) not offering SCUs in low demand facilities, and (2) maintaining the appropriate staffing level for each facility to satisfy both residents' needs and minimum state regulation requirements, can be invested in improving resident welfare.

One piece of insight from a nursing home practitioner is the role of the leadership of each facility in this matter. Although whether or not to implement an SCU in a belonging facility is a corporate decision, the leadership in each facility can strongly drive their implementation. The focal facility leadership is trusted with their expertise in local demands, and their requests to either implement or remove SCUs are often considered by the corporate leadership. Also, when the staffing level reaches a certain level, resident welfare is highly related to the culture within a facility. If the culture is nourishing and loving, residents will have a higher quality of life. The forming of a facility's culture is also highly correlated with that facility's leadership. Furthermore, when each facility has its own culture, personality, strength, and focus, its staff will have more autonomy at work and feel more fulfilled. Thus the turnover rate will be decreased, and the relevant costs, such as rehiring, retraining, and hire agency costs, will be decreased; the quality of service will also be improved, which drives up the

occupancy. This insight helps explain why service offering and service delivery are better left to local decisions rather than standardized across all facilities.

5. Conclusion

This study investigates the relationships between the within-chain degree of standardization (DoS) in three operational dimensions (customer mix, service offering, and service delivery) and chain-belonging nursing homes' performance outcomes, including financial outcome, clinical outcome, and resident welfare. These relationships are crucially important and worth exploring. Over the last century, chains of multi-unit organizations have emerged as the dominate organizational form in service industries (Greve and Baum 2001); examples can be found in hotels, airlines, and nursing homes. Specifically, more than 60% of U.S. nursing homes are chain operated, mostly as a result of acquisitions (Banaszak-Holl et al. 2002). Thus, within a chain, how similar the facilities should be is a decision faced by every multi-unit firm: should all facilities that bear the same chain name follow the same operating procedures, or should they each maintain their own characteristics? Despite the necessity of an answer, no adequate research has solved this puzzle. Our study intends to fill this gap.

We find that for improvements in different outcomes, different standardization and customization strategies should be considered. When focusing on financial outcome, a nursing home chain needs to customize customer mix and service offering across its belonging facilities. We find that customization in service offering and service delivery positively affects chain-belonging nursing homes' resident welfare. Our results also suggest that standardization in customer mix among chain-belonging nursing homes is positively associated with their clinical outcome. We hypothesized

that the DoS in customer mix would negatively impact resident welfare, and that the DoS in service delivery would negatively affect chain-belonging facilities' financial and clinical outcomes. These hypotheses are, to our surprise, not supported.

5.1. Contributions to Literature

To our knowledge, this study is the first systematic multi-dimensional assessment of service firms' standardization strategies from a chain perspective. We summarize the novelty and contribution of our study in the following paragraphs.

First, we are among the very few studies to explore service standardization and customization strategies at a chain level. Although chain operation is a major managerial format in the service industry, only a few studies explore chain units' DoS and its impact on outcomes. To a certain extent, literature in brand consistency, multi-property localization, and organizational structure is relevant to this topic. However, as literature in these areas focuses more on marketing strategies and organization theories, we did not find research exploring multiple operational dimensions to draw conclusions on whether a chain in the service sector should standardize or customize its operations practice.

Second, our study focuses on multiple operational dimensions. We empirically examine the impact of within-chain DoS in each of three dimensions – customer mix, service offering, and service delivery – on outcomes, with all three dimensions present in the same model. Intuitively, these three operational dimensions seem to be interconnected: on a certain level, targeted customers determine which services are offered, which further shapes service delivery methods. Thus, decisions on standardization for all dimensions could be intertwined and may seem able to be made

once for all. However, our correlation analysis shows no evidence that the DoS of the three dimensions are correlated. Hence, the effect of each dimension needs to be estimated uniquely while the other two are also in the picture.

Moreover, we establish our own method to identify nursing home chains. The purpose of this study is to find out how standardized the belonging facilities within a chain should be, so the “spillover” effect between facilities needs to be taken into consideration: when multiple facilities bear the same chain name, their reputations are shared. Many nursing home chains choose not to brand some of their facilities due to litigation issues (Lu et al. 2013). When belonging facilities do not use the same chain name, the chains may not even take within chain standardization strategies into consideration. Thus, to identify customer-recognizable chain names, we used both owner and facility name information to identify big, mostly single-owner nursing home chains. Lastly, the data we use is very inclusive, covering all nursing homes in the United States certified by Medicare and Medicaid. Thus, we were able to identify all chains that meet our analysis standards and study the DoS effect across chains.

5.2. Managerial Insights

Our findings also provide important implications for nursing home practitioners.

First of all, our results suggest that the DoS among chain-belonging facilities significantly impacts nursing home outcomes. This finding not only invites big chain owners’ attention to the dispersion of practices across belonging facilities, but also alerts each facility to use chain norms as a benchmark to better position itself.

To summarize, nursing home chains should customize service offering across belonging facilities. By doing this, chain-belonging facilities can improve their financial outcome and resident welfare without hurting their clinical outcome. Also, nursing home chains should customize service delivery across belonging facilities to enhance resident welfare; no evidence shows this customization strategy has a negative influence on facilities' financial and clinical outcomes. The only operating aspect that shows the trade-off effect is customer mix, as more standardized customer mix will improve clinical outcome, while more customized customer mix will enhance financial outcome. Nursing home practitioners have to prioritize their operating goals before making this decision. When discussing our findings with practitioners, they also pointed out that our results provide valuable guidance in nursing home chain investment strategies: when chains acquire new properties, they will be able to choose those that have similar or different customer mix, service offering, and service delivery strategies compared to the chain norm.

Policymakers can benefit from our results as well. For example, since merge and acquisition is still the dominate approach for nursing home chains to expand, how to manage the newly acquired facilities becomes an issue (Banaszak-Holl et al. 2006, Paruchuri et al. 2006). Our findings can help policymakers in establishing policies regarding their post-acquisition strategies, in terms of whether to standardize or customize new facilities' operating practices.

5.3. Limitations and Future Research

Our study guides chains in the service sector in their decisions regarding general standardization strategies; future research may expand the scope of this paper by investigating the threshold where a chain should choose standardization or

customization, and what factors impact this threshold. Also, future research could collect more data to estimate service offering, and add a geographic proximity measure for nursing homes belong to the same chain. One limitation of the research is that the deficiency citation data is collected by CMS during their yearly inspection. Although the number of citation is widely used as a nursing home quality measure, the fact it is based on a once-per-year sampling is still of concerns for many. Future research could collect other measures to verify the findings of this study. Also, although our measure of the resident welfare overcomes the selection bias might be induced from a self-report satisfaction score, the results may still be further validated by other measures of resident welfare, such as yearly change in residents' ADL.

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CHAPTER 5

CONCLUSIONS

In this dissertation, we look at the service aspects in healthcare and investigate the methods to infuse service excellence into healthcare settings. This dissertation is constructed with three essays; each explores service excellence in healthcare from a different perspective. Since customers are the ones who ultimately define and evaluate service excellence, we study the U.S. healthcare customers' preferences and concerns in my first essay. In the second essay, we turn to a more specific healthcare setting and explore how Information Communication Technology (ICT) can change healthcare delivery. Then in the third essay, we look at the issue from the healthcare organization perspective, and investigate how standardization and customization in service strategies impact nursing home operational outcomes. Among the hypotheses we established, some are supported by empirical evidence from our analysis; some are not. I elaborate upon each essay in the following paragraphs.

1. Essay 1: Aligning Priorities in Healthcare Operations with Customer Preferences.

In this study, we empirically examine U.S. healthcare customers' preferences and concerns, and compare them to current Healthcare Operations Management (HOM) research themes. The alignments and mismatches resulted from this comparison point out some future research opportunities.

We found that cost of care, access to care and coverage for all, and quality of care and system efficiency are perceived by healthcare customers as the healthcare issues that need to be most urgently addressed. This suggests that customers want the care to be affordable, demand access to insurance coverage, and need reliable care. Our results also indicate that only a few people believe that physical access to health service and quality of hospitals are urgent issues in the U.S. healthcare system. Although not many HOM research articles directly address the cost issues, many explore how to contain and reduce the costs. Also, as expected, many HOM research make efforts to address the quality issue. The most noticeable mismatch in the HOM literature is access to care and coverage. This was the second most frequently cited healthcare issue of customers, but it was not explored often in HOM literature. Some identified research opportunities include but not limited to: (1) explore how insurance companies could provide affordable plans to boarder population while making reasonable profit; (2) study the decision processes of customers making insurance purchases; (3) cheaper and more efficient ways to deliver healthcare, such as involving technologies; (4)the quality and coverage of preventive care; (5) senior care issues. We also find that customers' perception of healthcare can be influenced by government policies and customers' demographic characteristics and living environment.

The results presented in this paper have several implications for healthcare stakeholders, including healthcare insurers, providers, and policymakers. For example, when non-healthcare companies move into the healthcare area, such as Amazon.com

and JPMorgan, they may want to contain the costs for customers and broaden access to coverage before rushing to new incentives. Healthcare policymakers could draw upon our findings and encourage more value-based healthcare programs and policies to contain customer costs and increase value. Also, the conclusions regarding personal characteristics could help companies design and market their products to fit customer segments.

2. Essay 2: Usage and Impact of Information and Communication Technologies in Healthcare Delivery.

In this study, we explore patients' perspectives on Information Communication Technology (ICT) in healthcare delivery. More specifically, we approach this problem from two aspects: the prevalence of using tablets and computers by physicians during healthcare visits and the growing trend of using such technologies for receiving care remotely. We also investigate the role of sociodemographic characteristics on patient's perceptions of physicians' computer use and patient preferences in using remote care services involving ICTs. Our results contribute to the literature of technology in healthcare and provide practical implications to care providers and policymakers.

We find that the majority of patients hold positive opinions of computers or tablets by physicians during a healthcare visit, as they believe that using electronic medical record can: (1) enhance the efficiency and organization of record keeping; (2) improve care coordination among care providers; (3) enhance patient access to care providers and medical records; and (4) improve reliability and security of information. Only

11% of patients report a negative reaction to physician computer use, with concerns mostly regarding the depersonalization of medical encounters. Our findings also suggest that the majority (more than 75%) of patients are willing to receive care remotely, mostly for minor health issues. Willingness to use remote care service becomes considerably lower as the severity of care needs increases. Statistical analysis proves that sociodemographic characteristics, such as age, gender, household size, education, and income level, have a significant impact on patients' perception of ICT in healthcare delivery.

Our results provide profound implications to healthcare stakeholders, in terms of how to promote the benefits of ICT in healthcare delivery while avoiding its disadvantages. For example, providing training for caregivers on the proper use of computers and tablets can help providers improve patient-centered communications while using such technologies for integrating electronic health records into the medical visit (Duke et al. 2013). Also, when providing care for specific demographic groups, the care provider may try different approaches. For example, since females, older individuals, and those with children in the household held less favorable attitudes toward ICT, providers serving those population groups may consider providing information to patients regarding the potential benefits of using ICT, including cost and time-saving opportunities.

***3. Essay 3: Chain Operators' Service Strategies: Standardization or Customization?
Evidence from the Nursing Home Industry***

In the service industry, most activities are completed in chains. Thus, within a chain, how similar the facilities should be is a decision faced by every multi-unit firm: should all facilities that bear the same chain name follow the same operating procedures, or should they each maintain their own characteristics? Despite the necessity of an answer, no adequate research has solved this puzzle. Our research makes contributions to fill this gap. In this study, we investigate the relationships between the within-chain standardization strategies and the nursing home operations outcomes. Specifically, we examine standardization in three operational dimensions: customer mix, service offering, and service delivery; and their impact on three nursing home outcomes: financial outcome, clinical outcome, and resident welfare.

Our results suggest that to improve financial outcome, nursing home chains need to customize customer mix and service offering across its belonging facilities; to enhance clinical outcome, nursing home chains should standardize customer mix; and to improve resident welfare, nursing home chains need to customize service offering and service delivery across units.

To our knowledge, this paper is the first systematic multi-dimensional assessment of nursing homes' standardization strategies from a chain perspective. We contributed to the literature in the following two aspects: (1) we study within-chain standardization strategies on multiple operational dimensions. Most previous research only focuses standardization in one dimension, such as product offering; while we empirically examine the impact of within-chain DoS in each of three dimensions – customer mix,

service offering, and service delivery – on outcomes, with all three dimensions present in the same model. In the real world, decisions of standardization in multiple dimensions need to be made simultaneously, and the tradeoffs among them need to be examined. (2) We established our own method to identify nursing home chains. Using this method, we can identify the customer recognizable nursing home chains, as we believe that when multiple facilities bear the same chain name, their reputations are shared, and we can assess the “spillover effect” among chain-belonging facilities.

Our results also provide important implications for nursing home practitioners. Firstly, our results suggest that DoS among chain-belonging facilities significantly impacts nursing home outcomes. Nursing home chains should customize service offering and service delivery, and assess the tradeoffs between financial outcome and clinical outcome when making decisions on the DoS of customer mix. These findings can guide the nursing home chain decisions when establishing the strategies of within-chain standardization and acquiring new nursing home facilities.

4. Future Research

The service aspect of healthcare is an increasingly important area that requires more attention and effort from all healthcare stakeholders. How to deliver high-quality care with excellent services remains a challenging issue that raises many research opportunities. Future research could continue to explore the possibilities to use service operations methods in healthcare settings to improve patient health outcomes, overall patient satisfaction, and healthcare organization outcomes. Research topics such as

technology use in healthcare delivery, the generalization of preventive care, patient and physician decision-making processes, and senior care could be further explored.