

THE RISE OF MEDICAL CONSUMERISM, SELF-TRIAGE AND THE IMPACT ON
THE HEALTHCARE DELIVERY SYSTEM

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ABSTRACT

Increased out-of-pocket payments required from today's insurance plan designs is leading to the advent of patients acting more like regular consumers. They are shopping for the best value for their personal spending on healthcare services. This is leading to an increased use of less hospital and health system centric delivery sites. Enabled by the availability of information on the internet, more patients are using alternative settings such as urgent care centers, retail clinics, etc. Specifically, patients are opting for Urgent Care Centers (UCC) in lieu of the hospital emergency room (ER), principally due to higher out-of-pocket costs for unscheduled care but also a desire for a better overall service experience with amenities and a service orientation towards the consumer/patient. This shift in patient behavior raises questions as to how UCCs compare to ERs. Two studies were conducted: the first examining the relative patient experience at UCCs versus ERs, and the second examining the effect of UCC visits on overall cost of service.

To better understand the patient experience in UCCs compared to ERs, a quantitative analysis of reviews posted on Yelp for hospital emergency room and urgent care center was conducted. UCCs received significantly higher Yelp ratings than emergency rooms.

Machine learning was used to determine which topics in Yelp reviews were most closely correlated with 5-star and 1-star ratings. 16,447 ER Yelp reviews were analyzed from 1,566 hospitals, and 84,502 reviews from 5,601 UCCs. There were more 5-star UCC reviews (n=43,487, 51%, $p<0.05$) compared to 5-star ER reviews (n=4,437, 27%, $p<0.05$). The study determined that 5-star reviews for ERs tend to focus on clinical care

while UCC reviews focused on convenience. Online patient reviews provide an understanding of what patient's value in their unscheduled care experience offering insights for health systems and providers in planning the future care delivery systems.

To determine if urgent care centers are a less-costly *substitute* service to hospital-based emergency rooms or a *complementary, cost-amplifying* service, a second study was completed. The study compared the pre- and post-period spending differences, for selected low-acuity patient conditions, between patients who started their treatment at an urgent care center versus starting at an emergency room using difference-in-differences analysis.

The study methodology was based on a sample University of Pennsylvania Health System employees and their dependents seen at an urgent care facility or in the emergency room between 2012-2017 with a primary diagnosis among 15 most common low-acuity conditions seen in those settings. The sample included 3,055 episodes with initial index visits in urgent care and 3,650 initial index visits in a hospital emergency room.

Patients who visited the ER spent \$1,323 ($p < 0.0001$) more than those who visited urgent care centers within 30 days following the visit, and \$2,152 ($p < 0.0001$) more within 6 months following the visit. Visiting the emergency room corresponded to a 68.0% greater change in pre- to post-index period cost when evaluating the first 30 days and 40.0% comparing costs over 6 months. Thus, this study demonstrated the significant cost advantage of urgent care centers for treating selected conditions as compared to a hospital emergency rooms when the unit of analysis is total health care spending at 30-day and 6 months.

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INTRODUCTION

Patients are taking a more active role in their personal medical care decisions (Robinson, 2005; Buntin, 2006), a phenomenon called healthcare consumerism (Rosenthal, 2004). The transition from passive patients to empowered consumers is the direct result of three factors: shifting the financial burden to the patient's pocketbook through higher deductibles and co-payments (KFF, 2017), direct-to-consumer advertising (Mogull, 2015; Wallace, 2014), and the rapid increase in the availability of consumer data (e.g., health-care report card programs which seek to provide comparison between hospitals and physicians in a non-technical manner, i.e., simple star ratings.) These converging forces are driving healthcare consumerism and are changing patients' behavior as they search for greater value and quality of service, timely and convenient care and an improved patient experience. How does this consumerism, coupled with a patient's increasing need to self-triage, impact the health care delivery system? Before focusing on this central question, a deeper understanding is required.

“Consumerism arises when patients acquire and use medical information from *sources other than their physicians*” (Fang, 2011:1). This background medical information is acquired by combining their own self-assessment with other patients' reviews, star ratings, public rankings of hospital performance, interaction with other influencers digitally, and cost of care. “Are we seeing the dawn of a consumer-driven health care economy, in which patients undertake the same deliberations regarding medical purchases as they do when purchasing furniture or a new car?” (Huckman,

2013:1876). Insurance companies and health systems seemed convinced that patients will become the ultimate decision makers, not only in personal medical decisions but in their health care purchasing decisions and how they access the health care system, as well. Based on the amount of infrastructure being assembled, such as population health departments, digital marketing functions, and investments in smartphone technology, the health care provider industry views consumerism not as a trend but rather as a permanent shift.

Healthcare consumerism is about transformation; it puts the economic purchasing power—and decision-making—into the hands of the patient. Healthcare consumerism requires the health care industry to supply patients with the information and decision support tools they need to encourage their personal involvement in altering their health and healthcare purchasing decisions. It is about behavioral economics by which patients receive the financial incentives and rewards to change. In addition to its economic imperative, healthcare consumerism has a moral imperative to increase quality of care by tailoring it to the patient’s specific needs.

Many doctors and hospitals neglect to adapt to healthcare consumerism. Some physicians believe consumerism erodes the time-honored, principal-agent relationship between the physician and patient. Other critics believe healthcare consumerism is driven, in part, as a defensive move against the “corrosion of medicine,” where doctors are influenced by conflict of interest relationships with drug companies, device providers, and insurance companies. This concept and phrase was coined by John Geyman, M.D.

professor emeritus of family medicine at the University of Washington School of Medicine in Seattle, where he served as Chairman of the Department of Family Medicine.

The foundation of healthcare consumerism is built on preventative services (e.g., cancer screenings). It requires patients to actively and continuously participate in their healthcare outcomes by accessing services that improve their lives and reduce lifetime spending. Unfortunately, it has been reported that despite the redesign of insurance plans to provide patients with more control and access to preventative services, few take full advantage of this new-found consumer power (Reed, 2012). The patient's experience with consumerism has also been mixed. Consumerism requires a willing patient, which is not always the case (Levinson, 2005), and patients need access to data at a level they can understand. Patients need to build new competencies, such as understanding basic insurance terms and concepts (e.g., high deductibles and cost-sharing) and need to understand what to expect from insurance coverage (Yegian, 2013).

The rise of consumerism is directly linked to the continuous rise in the amount of out-of-pocket money patients pay towards their health care. This increased expense has given consumers greater influence over healthcare delivery. Out-of-pocket spending grew 3.9 percent in 2016 to \$352.5 billion, faster than the growth in the previous year of just 2.8 percent. This was the fastest rate of growth since 2007, and exceeded the average annual growth of 2.0 percent from 2008-15 (CMS, 2016). "Between 2006 and 2012, the prevalence of high-deductible health plans grew by 24%, exposing one third of privately

insured employees to deductibles of at least \$1,000. Copayments have shown similar growth, with nearly half of covered employees paying \$25 or more for an office visit. These trends come at a time when most families have seen little increase in real wages or benefits” (Huckman, 2013:1876). The shift in worker contributions towards their health insurance has been steady but not particularly dramatic. “In 2016, covered workers on average contributed 18% of the premium for single coverage and 30% of the premium for family coverage. These contribution percentages have remained stable in recent years for both single and family coverage” (KFF, 2017). Please see Figure 1 for a graph representation of this trend.

However, the shift that has been more dramatic is the increase in the size of covered employee’s annual deductible. In 2006, 62 percent of the covered workers with single coverage had a deductible of less than \$500 while 12 percent had a deductible of \$1,000 or more. Ten years later, in 2016, only 25 percent had an annual deductible less than \$500, while 38 percent had an annual deductible greater than \$1,000. Please see Figure 2. Most economists agree that regardless of the split between worker and employer, the burden of health care benefits falls nearly 100 percent on the worker. The rising cost of health benefits depresses the growth of take-home wages. Please see Figure 3.

The consumer mantra of “I want, what I want, when I want it” is increasingly challenging the traditional referral patterns within the hospital and physician-centric health care delivery system. New care delivery settings, e.g., urgent care centers, retail

clinics, and telemedicine, are providing consumers with alternatives to the traditional emergency room. Hospital emergency rooms are plagued with overcrowding, long wait times, and unhappy patients. The growth and variety of these new healthcare delivery options create both opportunities and challenges for patients as healthcare consumers. Patients need to decide the level of care and services they may need when they experience an acute illness or injury (Coyle, 2017), a decision known as self-triage. Consumers are increasingly turning to digital platforms to gain knowledge and actively participate in their care, including self-triage decisions (Cohen, 2010; Nijland, 2008).

Although consumers still have little influence over decisions in a true healthcare emergency or high-acuity care delivery setting, consumers have an increasing opportunity to participate in guiding much of their care in other contexts. In the current healthcare environment, patients are required to make many more choices than previously for less intense, common or unscheduled care. These low-acuity services (e.g., not a serious condition, preventative, or after-hours) are influenced by the consumer to a high degree. In effect, patients must learn to “self-triage” to reduce their out-of-pocket expenses. It has been estimated that more than half of all healthcare spending can be effected by better patient choices for unscheduled care (Anand, 2016).

Personal Research Journey

A moment on my personal research journey. I set out to use the doctoral program to answer and address all the challenges raised in the introduction. When pushed to narrow my focus, I was especially intrigued by the rise of consumers choosing to go to

urgent care centers for a wide range of low-acuity conditions, rather than treating themselves at home, or going to a primary care physician or an emergency room. My initial research question became, Does the introduction of an urgent care center into a community increase or decrease healthcare costs (e.g., for a set of common, low-acuity conditions)? It is an interesting question. It is also the kind of question an economist (my undergraduate training) might ask, but it is less of a question for a business or policy analysis because it is not clear what can be done with the results since it would require the government to restrict or encourage the expansion of urgent care centers.

Next was figuring out how to answer it. My initial plan was to partner with a large insurer to study the change in healthcare costs associated with low acuity medical conditions for insured beneficiaries when an urgent care center opened near where they lived. Looking at the total number of claims before and after that entry (aggregating across multiple communities where an urgent care center entered the market and all zeroed for the before and after analysis at the date of opening of the urgent care center), using the difference-in-differences approach, one could determine whether claims are increasing because of the increasing ease of care. My presumption was that quality is largely the same because low acuity conditions do not typically require advanced skill or expertise to treat.

At that point, I pivoted since the econometric model I designed was difficult to research due to a lack of clean data. Using the best data available, I began to answer a related question. The question I ended up targeting, is this: Conditioned on an urgent

care center already being in the market, is the total cost of care for selected low-acuity conditions really cheaper when the follow-on costs the patients incur are also included? It is conclusive in the literature that urgent care centers are cheaper than emergency rooms for the index case defined as the first treatment site – emergency room or urgent care center for a common, low-acuity condition but urgent care centers might be more expensive in the long run. My study aims to unpack that question.

In contrast to my initial question, which does not have a clear policy response, the second question does have a clear policy response, which is to alter financial incentives and benefit plan designs to drive patients towards the cheaper delivery site. The idea is that even if the population-based total cost of care is rising because urgent care center increase demand overall, there is not a lot that can be done about it. Barriers to market entry (e.g., certificate-of-need laws) could easily limit urgent care center programs but would be seen as anticompetitive and harmful to public health. I am not a political scientist, but I don't see obvious regulatory levers. So, the first question is interesting but potentially irrelevant from a policy standpoint.

The end result is answering a question – maybe accidentally answering a question – that is much more useful to answer than the research question initially posed. I still think my first research question was more elegant from an economics perspective, but the question I ultimately pursued is more relevant from a business perspective. The distinction between an interesting question in economics and an interesting question in business argued for a pivot — recognizing that interesting economic questions abound,

and important questions of business policy are fewer, in the end I wanted my research to be useful. My research progressed to an interesting question that has actionable implications. There are an infinite number of ways to do more work on this subject. So I will progress a small part of the broader question with the acknowledgement that much remains to be tested but will leave that for another paper or for someone else.

Therefore, this dissertation studies the impact of healthcare consumerism on unscheduled care from two perspectives. First, how does a patient gather information on where to best seek care for common, low-acuity conditions? As patient's financial responsibility for their care increases, patients are becoming price sensitive and using urgent care centers as an alternative to emergency rooms and primary care physician offices. Can online platforms provide the background information necessary to patients so that they can "self-triage" to a lower-cost setting. Through an essay on "learning through listening" I examine and compare Yelp ratings of hospital emergency rooms versus urgent care centers to better understand consumer satisfaction with various delivery sites of unscheduled care. In particular, the review data offers the potential to provide insights into the drivers of self-triage. Secondly, in essay two an examination of a large self-insured employer's health care for to determine if the use of alternative delivery settings is a substitute service for costlier settings, or conversely, an amplifying service which leads to higher overall healthcare spending. The second study will quantify the economic impact of patient's self-triage decisions. Data collection and analysis on consumer perceptions of ERs and UCCs is a worthwhile first step towards providing

information that is useful to health care management decision making. Understanding consumer perceptions can lead organizations to adjust their delivery models to better meet consumer expectations and to potentially lower healthcare spending. In the conclusion of the dissertation, the implications of these two research studies for healthcare management and public policy are further developed and explained.

Figure 3: Average % of Premiums Paid by Covered Workers, 1999-2016

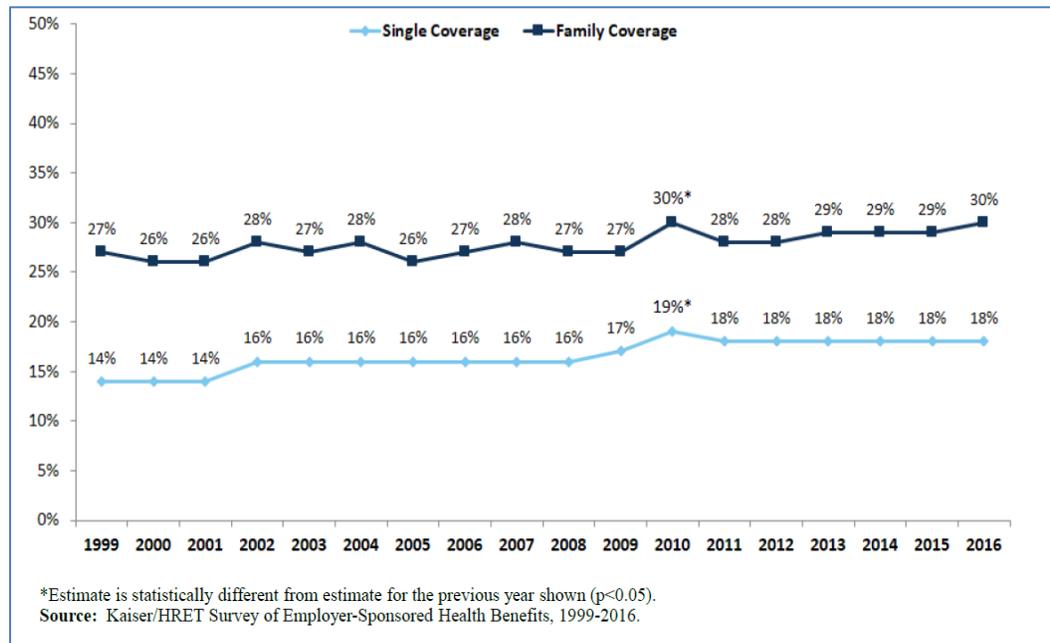


Figure 2: Distribution of Deductibles, Covered Workers, 2006-2016

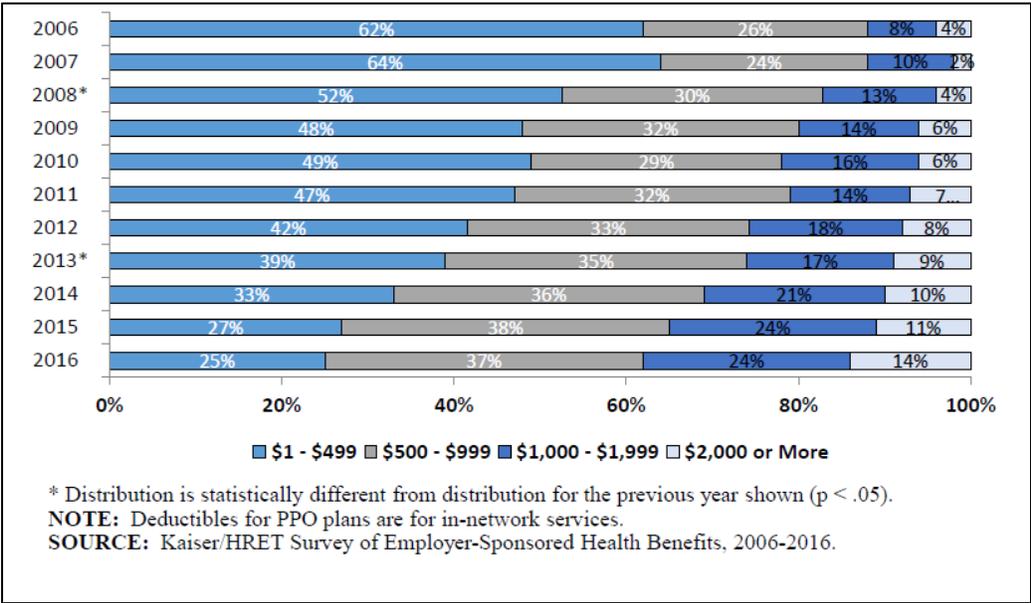
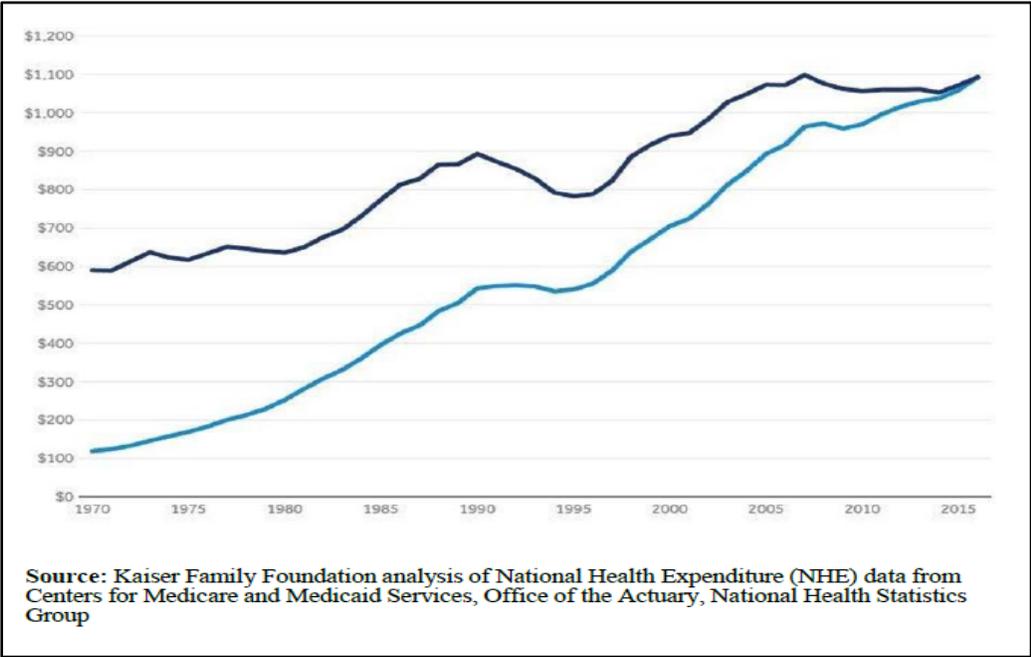


Figure 3: Per Capita Out-of-Pocket Expenditures, 1970-2016



CHAPTER ONE

STUDY 1: WHAT DETERMINES THE PATIENT EXPERIENCE? COMPARING URGENT CARE CENTERS AND EMERGENCY ROOM YELP REVIEWS

Introduction

Patients are carrying a heavier burden of out of pocket expenses in health care. Increasingly, patients have begun to act as consumers for preventative and low-acuity care. This type of care is often unscheduled (e.g., after hours) and impulsive (e.g., buying a flu shot while shopping at CVS; Ashwood, 2016). This rise in healthcare consumerism is being fueled by improved access to digital platforms (Ranard, 2016) that provide previously hard to get information on consumer experiences, cost-of-care, and clinical outcomes. Since consumerism requires the patient to be an effective “self-triager” to avoid overspending, online ratings can provide content and insight from other patients’ experiences and mindset as they make these choices. For example, patients are turning to urgent care centers when seeking care for acute but non-life threatening health conditions. But how are these choices – self-triage – informed by other patient perceptions? Prior work analyzed patient satisfaction with the emergency room experience (Kilaru, 2016), yet less is known about patient satisfaction with urgent care.

The number of urgent care centers has seen an “explosive” increase across the United States (McNeeley, 2012; Weinick, 2007). However, people also continue to use emergency room services for non-urgent care (Guttman, 2003). It has been observed that 33% to 50% of all ER visits are non-emergent in nature (Northington, 2005, p. 132). In a

recent study, for the majority (66%) of patients studied, the ER was “the only place they knew to go for their present problem,” and a surprising (27%) reported that they depended on the ER “for all medical care” (Northington, 2005, p. 135).

Increasingly, patients are choosing alternative delivery settings for unscheduled care, broadly defined as urgent care centers and retail clinics, over traditional hospital ERs. It is estimated that \$4 billion annually can be saved when less urgent visits occur in an urgent care center compared to a hospital emergency room (Weinick, 2010). Despite the long-standing health policy interest in shifting non-urgent ER cases to lower cost alternatives (Miller, 2012; Xin, 2015), health care experts still lack a deep understanding of the factors that drive patients to choose an ER over a less costly and at times more convenient setting for treating non-urgent conditions. Evidence suggests that multiple factors, including age, convenience of the ER compared with alternatives, referral to the ER by a physician, and negative perceptions about alternatives such as primary care providers all play a role in driving the choice behind non-urgent ER use (Uscher-Pines, 2013).

Moreover, patients have increasingly adopted web-based tools to report on the quality of their health care experiences. This makes these tools an untapped source of data that could be valuable for patients, researchers, policy makers and hospital administrators alike (Hawkins, 2016). In fact, while nearly 60% of patients report that online reviews are important when choosing a physician, there is little literature around this practice (Lagu, 2017). Reviews posted to sites like Yelp or TripAdvisor are the

modern day version of word of mouth testimonials, providing instant insight into millions of consumer experiences that are not only influential to other consumers, but can and should also be used as feedback by service providers (Merchant, 2016). Real time online rating platforms can therefore provide some insight into the factors driving patient decision-making between ERs and UCCs. While researchers have analyzed online ratings of ERs (Kilaru, 2016), ratings of UCCs have not yet been explored. Using Yelp user-generated data as a window into patients' perceptions of their healthcare experiences, we seek to compare the differences in online reviews of ERs and UCCs to understand patients' perception of UCCs and their impact on national healthcare spending.

Patients have adopted consumer ratings websites as a tool for sharing their healthcare experiences. In this study, an examination of online reviews comparing hospital ERs to freestanding UCCs posted on Yelp was completed to determine if different themes emerge.

Literature Review

Despite the long-standing health policy interest in deferring non-urgent emergency room cases to lower cost alternatives (Massachusetts Division of Health Care Finance and Policy, 2015), past research has highlighted a limited understanding of what drives non-urgent emergency room use. The health care industry lacks a deep understanding of why patients choose to use an emergency room over a less costly and at times more convenient setting. Multiple factors influence an individual's decision to visit an emergency room for a non-urgent condition.

Baseline insights were gained by surveying family practice patients. One survey reviewed patients' satisfaction with the care they received for an urgent health problem from their family physician, an after-hours clinic endorsed by their physician, a walk-in clinic, the emergency room, or from telephone health advisory services. The survey results revealed that patient satisfaction was highest for patients receiving care from their own family physician or their physician's after-hours clinic. These results support emerging primary care models that emphasize continuity and 24/7 access (Howard, 2007). To broaden the scope beyond selected family practices, real-time online rating platforms such as Yelp and Twitter are potentially valuable sources of data. Online review platforms can provide insights on the patient decision-making process. Although nearly 60% of patients report that online reviews are important when choosing a physician, it is unknown to what extent consumers use review websites to help them select the appropriate medical services delivery site (Lagu, 2017).

Researchers have examined online reviews posted on Yelp about ERs. Findings suggest that online reviews for emergency rooms contain similar themes to traditional surveys (Kilaru, 2016). Perhaps most importantly, online reviews allow patients the opportunity to provide instant feedback when the emergency rooms experience is fresh in on their minds. Web-based platforms also provide an emerging quality assessment tool of emergency rooms' care. The potential to evaluate the quality of care delivered was supported by an assessment of the use of Twitter to measure patient-perceived quality of care in hospitals. A researcher recently examined patient tweets that contained

established quality measures (Hawkins, 2016). Tweets describing patient experiences in hospitals cover a wide range of topics and can be identified and automatically collected. This data represents an untapped source of quality data and may be valuable to patients, researchers, policy makers and hospital administrators. Overall, key service characteristics that consistently appear in the literature as important to patient satisfaction include: facilities, staff, billing, and waiting time. In addition, the literature suggests that the analysis of consumer-generated online content can be a valuable source of information on patient perceptions of health care services.

Several studies also evaluated reasons why patients utilize emergency room services for low-acuity conditions. Previous research reported that 66 percent of patients stated that the emergency room was the only place they knew to go for their present medical problem, and 27 percent stated that they went to the emergency room for all medical care (Northington, 2005). Other studies have reported that patients primarily choose emergency room care because of worrisome pain or discomfort; as an alternative to primary care after normal office hours; perceived unavailability of timely primary care appointments; or the perception of emergency room facilities and services as a “one-stop” healthcare site (Guttman, 2003). Geographic regions with high utilization of urgent care centers have also been found to correspond to lower emergency room and physician office utilization (Merritt, 2000; Corwin, 2016) – an argument often used for increasing access to and awareness of urgent care centers (Bukowski, 2012). Yelp reviews, combined with machine learning analysis, provides a means of extracting unique and

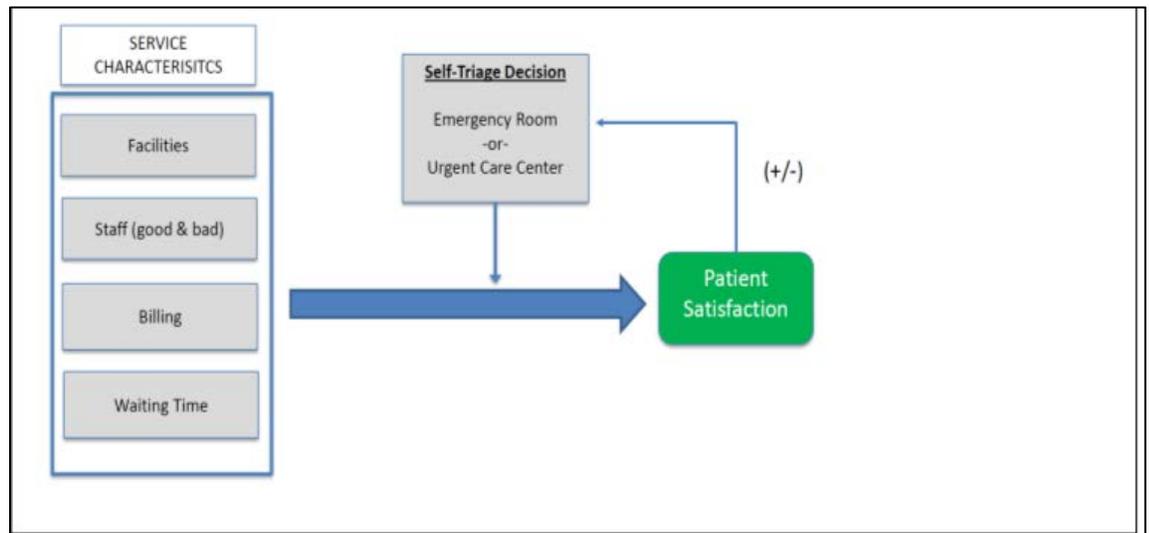
similar themes that relate to positive and negative patient experiences in these settings. A more detailed summary of the literature reviewed is included in Appendix A.

With past research as the foundation, the next step is to conceptualize the expected relationships between health care services characteristics and patient satisfaction, in the modern context of health consumerism and self-triage. The research question is “How does the consumer’s choice of type of health care provider (ER vs UCC) affect the relationship between health care service characteristics and patient satisfaction? “

Conceptual Model

The role of patient satisfaction on a patient’s self-triage decisions is described in Figure 4 below. The main service characteristics identified in past research on hospitals include facilities, staff, billing and waiting time (Jung, 2015). Unfortunately, prior research does not provide a window into whether these characteristics are similarly important to patient satisfaction with UCC experiences. It can be expected, however, that variations in relative importance will be found, to explain the extremes, very low or very high levels of patient satisfaction.

Figure 4: Potential Impact of Patient Satisfaction on Future Self-Triage Decisions



The primary objective of this analysis was to define and compare online review content and ratings of hospital ER and UCC on Yelp. This analysis may help to reveal the drivers of high and low patient satisfaction in these health care settings. This could lead to a better understanding of how patients perceive the site-specific experience allowing providers, managers, insurance companies and owners adjust and alter their care processes and amenities on a site-specific basis. Optimally, this research will lead to the development of a national standard for measuring patient satisfaction at urgent care centers. This national standard has been developed successfully in the hospital industry through the Medicare survey and the use of Press-Ganey proprietary surveys (Westbrook, 2014, Zusman, 2012). The urgent care center industry would benefit from a similar approach.

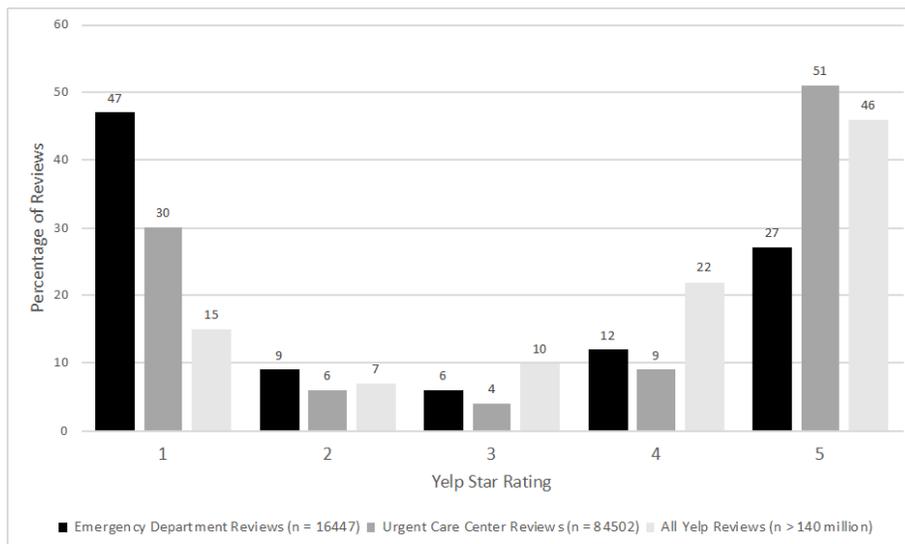
Research Methodology

To test the expected relationships illustrated in the conceptual model, it was necessary to complete a retrospective analysis of online reviews of ERs and UCCs in the United States. With the assistance of the Penn Medicine Center for Digital Health, user-generated content from Yelp was extracted and analyzed. The data set included more than 100,000 Yelp reviews across both ER and UCC settings, collected from May 2005 to March 2017. There were 16,447 ER Yelp reviews from 1,566 hospitals, and 84,502 reviews from 5,601 urgent care centers.

Yelp has a publicly available Application Programming Interface (API), which was used to identify and obtain information on U.S. urgent care centers with online reviews. The American Hospital Association (AHA) database was used to identify hospitals by name, and Yelp reviews were searched for mentions of ER related terms: “emergency room,” “emergency room,” “ER,” and “emergency medicine.” A programming script constructed from Yelp’s API pulled each relevant review, associated star rating, and date. This scraping process is consistent with the Yelp terms of service. Next, all reviews labeled as “not recommended” by Yelp were eliminated. Not recommended reviews are determined automatically by Yelp’s proprietary algorithm that considers a number of factors to identify and remove fake reviews. One indicator of a fake review activity is when one IP address produces a large number of reviews (Yelp, 2017).

The distribution of Yelp ratings across ER and UCCs was analyzed. Yelp users are able to select 1-star (lowest rating) through 5-stars (highest rating) for each review. A comparison on how these ratings compared with all other business reviews on Yelp from the same time period was completed. Please see Figure 5 below. The horizontal axis represents the star ratings for the reviews, and the vertical axis represents the percent of reviews. Black bars represent ER reviews (n = 16,447), grey bars represent Urgent Care reviews (n = 84,502), and the light grey bars represent all other Yelp reviews (n > 140 million). Both ER and UCC reviews show a bimodal distribution, whereas all other Yelp reviews are skewed towards higher star ratings. Interestingly, the ER reviews when compared to UCC reviews tend to be mirror images of each other. Due to this distribution, all 2, 3, and 4 star reviews were discarded, focusing only on 1 and 5-star reviews.

Figure 5: Distribution of Yelp ratings across ER and UCCs



Creating Themes from Yelp Reviews

Two analyses were conducted to identify the themes most associated with 1-star and 5-star reviews that met the search criteria: Latent Dirichlet Allocation (LDA), and subsequently Differential Language Analysis (DLA). Latent Dirichlet Allocation (LDA) – an automated process used to analyze co-occurrences of words in narrative text – was first used upon the 100,947 Yelp reviews of UCCs and ERs to produce a predetermined number of topics. DLA was then used to analyze each review as it relates to each of these topics. More detailed explanations of the LDA and DLA methods are located in Appendices B and D, respectively.

The initial LDA analysis was run using 100 topics for ERs and (a potentially different) 100 topics for UCCs. During the initial analysis, it was uncovered that the distribution of topics related to the ER and UCCs was uneven. This compromised the results. Therefore, the analysis was rerun using the same 25 topics from both ER and UCC reviews. Generic stop words, and the search terms used to identify ER reviews were removed from the dataset. Additionally, words had to be present in at least 5% of the reviews to be included in the dataset. In the end, only 20 topics were used in the analysis with 5 being removed since they were too similar to other topics, or having words that were not clearly related to an overall theme. These 20 topics are fully listed in Table 1 on the next page.

Table 1: Theme labels for topics produced by Latent Dirichlet Allocation (LDA) analysis	
Theme labels	
1	Comfort and overall experience
2	Professionalism
3	Facilities
4	Pediatric Care
5	Staff Interactions
6	Poor Communication
7	Phone Experience
8	Waiting
9	Billing or insurance
10	Pain Management
11	Diagnostic Testing
12	Bedside Manner
13	Care for family members
14	Access to care on nights or weekends
15	Service
16	Overall speed of care
17	Recommendation
18	Prescription and Pharmacy
19	Lack of Confidence
20	Reception

Topic modeling was used to analyze the large volumes of unlabeled text contained in the more than 100,000 Yelp reviews. Each "topic" consisted of a cluster of words that frequently occur together. Typically, this can be represented as a list of the top words that appear in a particular topic. Beyond the simple list of words, the ratio of words present in the list is critical for understanding a topic fully. It is also important to give weight to words that do not occur frequently but carry the same meaning, or are unlikely to be associated with another topic. Human coders then labeled these topics, or groups of words, with overall themes. This implementation of LDA was computed using the MALLET package (<http://mallet.cs.umass.edu/>).

Differential Language Analysis (DLA), a method of open-vocabulary analysis, was then used to determine which of the 20 LDA generated topics (see Appendix B), or groups of co-occurring words, were correlated with 5-star or 1-star reviews. A fuller explanation of the DLA method is available in Appendix C.

A Pearson correlation between 1 star reviews and the topic feature was performed with default settings. Reviews were coded as 1 for 1 star reviews and 0 for all other scores. Some themes were similar across 1 and 5-star reviews for both UCCs and ERs, while others differed. Below, Figure 6 displays an example of how this correlation analysis was applied to a sample review for an ER, as well as a UCC. It is clear that the topic 'Comfort & Overall Experience' is correlated with both:

Figure 6: Example of Correlation Analysis

Theme	Example Review Text	Pearson's r
5-Star Themes		
Comfort & Overall Experience	<i>"I cannot say enough good things about this hospital and staff. The emergency room was great. I had wonderful doctors. But the nurses are beyond wonderful. They made me feel safe and calm and well cared for. Every person I encountered was exceptional. I am so impressed and thankful to have been treated at this hospital."</i>	ER r=0.53
	<i>"The staff here were great. They always make me feel comfortable in an uncomfortable situation."</i>	UCC r=0.49

Thematic similarities and differences in 1 and 5-star reviews for UCCs and ERs are further illustrated in Table 2 and 3, on next three pages, along with more example quotes from Yelp reviews that best represent each topic.

Statistical Analysis

Summary statistics describe the sample of Yelp reviews and ratings. Correlation analysis was performed between the topic distribution of each review and its respective star rating. In the initial analysis, the correlation of the topics to all star ratings (1 to 5) were calculated. Correlations were calculated between a binary variable, with a value of 1 for 1-star review and 0 for all other reviews, across the previously calculated topic distribution present in each Yelp review. This process was repeated for 5-star reviews.

Pearson's correlation coefficients were calculated between topics and review star ratings to determine an association between topics and high or low star ratings. A more positive r value would indicate a higher correlation between a given topic and the Yelp

Table 2: Similar themes in reviews of emergency rooms and urgent care centers		
Theme	Example Review Text	Pearson's r
5-star themes		
Comfort & Overall Experience	<i>"I cannot say enough good things about this hospital and staff. The emergency room was great. I had wonderful doctors. But the nurses are beyond wonderful. They made me feel safe and calm and well cared for. Every person I encountered was exceptional. I am so impressed and thankful to have been treated at this hospital."</i>	ER r=0.53
	<i>"The staff here were great. They always make me feel comfortable in an uncomfortable situation."</i>	UCC r=0.49
Professionalism	<i>Excellent care excellent service. They attend to the patient's needs. The ER staff is excellent. They all deserve a medal</i>	ER r=0.47
	<i>"Excellent and prompt service. The staff was very professional and competent. Highly recommend!"</i>	UCC r=0.47
Facilities	<i>"Large parking garage next to ER with free parking. Very efficient check in system. Wifi in ER."</i>	ER r=0.19
	<i>"Beautiful, exceptionally clean building. Friendly, helpful, super nice people."</i>	UCC r=0.30
Pediatric Care	<i>"My 6 year old daughter visited the Pediatric ER for a severe asthma attack. She was seen immediately, and received excellent, expert care."</i>	ER r=0.12
	<i>"Hands down the best place to take your child during off hours! So friendly, really great kid environment. They make it easy to be a parent of a sick child here"</i>	UCC r=0.12
Staff Interactions	<i>"Best customer service. ER super fast n attentive. The best hospital, super clean. Stayed under intensive care for a week had a good experience."</i>	ER r=0.45
	<i>"Friendly staff, fast care, excellent providers. Top notch urgent care!!!"</i>	UCC r=0.46
1-star themes		
Poor Communication	<i>"This is without a doubt the most unorganized ER ever. Dr's treat patients in hallways . No patient confidentiality or privacy in the hallway with other patients sitting there. Blood pressure and vitals taken directly in waiting room when you enter, no privacy at all."</i>	ER r=0.36

Table 2 (cont.)		
Theme	Example Review Text	Pearson's r
1-star themes		
Poor Communication	<i>"I waited over two hours for a general check-up despite having an appointment. Understaffed. Poor communication."</i>	UCC r=0.37
Phone Experience	<i>"I called to ask a question and was transferred to the ER nursing station where a male nurse answered the phone, sighed several times, treated me like I was his biggest problem, and hung up on me mid-sentence."</i>	ER r=0.29
	<i>"They will not answer my calls left a message with my phone number and never called back poor customer service."</i>	UCC r=0.29
Waiting	<i>"Left the ER unseen after three-and-a-half-hour wait. Only other person beside me in waiting room left at same time, they'd been waiting five hours. What a joke...."</i>	ER r=0.23
	<i>"It's ridiculous to wait 1hr 23mins to see a doctor for 2mins and there was only 4 people ahead of me."</i>	UCC r=0.20
Billing or Insurance	<i>"Billing is outrageous, they send me a bill for almost \$5000 dollars for one er visit, \$2300 for using an er room for freakin less than an hour, and \$1500 for an ultrasound!!!"</i>	ER r=0.19
	<i>"Very good service but lousy billing. The full amount was charged to my credit card before I could set up a payment plan!"</i>	UCC r=0.25
Pain Management	<i>"Had to wait 2 hours at the ER in extreme pain.... nurses were not acknowledging. Worst experience ever"</i>	ER r=0.23
	<i>"My first time here and this place is disgusting and unprofessional...The medical assistant was eating Cheetos and rubbed it off her scrubs NOT WASHING HER HANDS before taking my temperature and blood pressure."</i>	UCC r=0.23

Table 3: Unique themes in reviews of emergency rooms and urgent care centers		
Theme	Example Review Text	Pearson's
ER: 5-star themes		
Bedside Manner	<i>“my ER doctor was wonderful, great bedside manner and very informative. The staff also, very courteous and attentive... Cudos! Much better than our last two, previous visits some years ago!”</i>	0.37
Care for Family Member	<i>“Took mom to the emergency room, they are great fixing mom up right now with her blood pressure everyone is top notch!!!”</i>	0.18
ER: 1-star themes		
Overall Service	<i>“The employees who were working in the ER at the time were very rude and the facilities were disgusting. All over the ER, there were dirty gloves and paper towels thrown on the floor. Nobody who worked there seemed to care. The nurses are also unprofessional.”</i>	0.34
Overall Speed of Care	<i>“Slowest ER in the area. There is not one ounce of hurry in any of them. A simple issue can take hours. Fumming!”</i>	0.23
UCC: 5-star themes		
Recommendation	<i>“Very good experience. I went to the recommended location, very short wait, staff was very friendly and professional.”</i>	0.38
UCC: 1-star themes		
Lack of Confidence	<i>“Awfulllllll staff is incompetent managers are incompetent and lack time management skills.”</i>	0.38

rating. All statistical analyses were performed using Python 2.7.10 (Python Software Foundation, <http://python.org>).

Results

Using the ER related terms, we identified 16,447 Yelp ER reviews from 1,566 hospitals (mean = 10.5 reviews per hospital). The UCC review search returned 84,502 Yelp reviews from 5,601 urgent care centers (mean = 15.09 per urgent care center).

Although the conceptual model on page 7 was not directly tested in the study, it provides

a background to the analysis of Yelp reviews regarding patient satisfaction with ER and urgent care experiences.

The star rating distribution of all Yelp reviews during the period was also noted (n > 140 million). The distribution of Yelp star ratings for ER, Urgent Care, and all Yelp reviews are shown in Figure 5. Both ER reviews and Urgent Care reviews show a bimodal distribution, whereas all other Yelp reviews are skewed towards higher star ratings. The median of ER reviews (2.0) was lower than the median of UCC reviews (5.0, Wilcoxon Signed Rank, $p < 0.0001$). 62% of ER reviews are 3-stars or less which is below the 2017 norms of 33%. Surprisingly, 60% of UCC reviews are rated at 4 or 5 stars compared to 2017 norms of 67%. In other words, the distribution of UCC ratings is similar to the all Yelp rated businesses, while emergency rooms far well below the 2017 norms as retrieved from <https://www.yelp.com/factsheet>.

Table 2 displays themes across positive and negative reviews regardless of delivery site. A correlation coefficient of $r=0.20$ was set as the threshold for relevance. Positive themes in 5-star reviews in both ERs and UCCs included: comfort and overall experience ($r=0.53$, $r=0.49$); professionalism ($r=0.47$, $r=0.47$); clean facilities ($r=0.19$, $r=0.30$); and friendly staff interactions ($r=0.45$, $r=0.46$). Themes similar across ER and UCC in 1-star reviews included: poor communication ($r=0.34$, $r=0.37$); phone or reception experience ($r=0.29$, $r=0.29$); wait time ($r=0.23$, $r=0.20$); billing or insurance experience ($r=0.19$, $r=0.25$); and pain management ($r=0.23$, $r=0.23$).

Table 3 displays themes across positive and negative reviews that are unique to either the ER or UCC. Themes unique to ER in 5-star reviews included: bedside manner ($r=0.37$). Themes unique to ER in 1-star reviews included: overall service ($r=0.34$); and speed of care ($r=0.23$).

Themes unique to UCC 5-star reviews related to: recommendation from another reviewer ($r=0.38$). Themes unique to UCC in 1-star reviews included lack of confidence ($r=0.38$).

Discussion

This study had three main findings: 1) Patients are using and seemingly trust online platforms to share experiences; 2) Yelp reviewers rate UCCs significantly higher than ERs; and 3) Patient expectations differ between ERs and UCCs, and this is reflected in user-generated reviews.

The first finding revealed that patients and caregivers are very willing to use Yelp to share their concerns and give feedback on their experiences with ERs and UCCs. The data set included 100,000 Yelp reviews collected over eleven years across both ER and UCC settings. Patients seemingly trust Yelp reviews to assist them in deciding the location of their care delivery-in effect, self-triaging to alternative and less costly settings. This is a critical finding for the industry as both UCCs and ERs. By studying the content of online reviews, management and providers can implement strategies to maximize their unique strengths (e.g., care for critical conditions in the ER) and improve or eliminate

their inherent weaknesses (e.g., lack of confidence in UCCs) to improve their market position.

Importantly, Yelp's ability to offer free text provides a rich trove of data when compared to traditional hospital review platforms, such as the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS), a patient satisfaction survey tool mandated for all hospitals receiving Medicare reimbursement. Rigid patient satisfaction surveys ignore the compelling narratives of patients provided through online rating websites such as Yelp or TripAdvisor. Since user-generated data corresponds to a more thorough and engaged review of patients' experiences and drives other patients' choice of care, there is substantial value in considering it when designing management approaches for urgent care centers and redesigning ERs. Several national surveys such as Hospital Compare, are mimicking the Yelp look and feel by using star ratings to make its website more engaging for customers (Ranard, 2016).

The second finding, that Yelp reviewers rate their UCC experience significantly higher when compared to ERs, reflects a growing change in how patients perceive the delivery of their care. No longer tied to the traditional hospital, new consumers are seeking "value" in their patient experiences. Based on this study, "value" seems to include convenience, time to complete a visit, amenities, and out of pocket costs.

The last finding showed that patient online reviews generally aligns with healthcare consumer's biases and expectations. For example, the expectation of waiting time differs between ERs and UCCs, so online reviews correspond not to actual waiting

time but rather patients' expectations of how long the treatment should take. A further example of differing expectation could be amenities, which are rarely posted in ER reviews- presumably since patients are already negatively disposed to availability of ER amenities.

Yelp user-generated data revealed many similar themes across emergency room and urgent care center reviews. This is most likely due to the similarities in the conditions and/or injuries patients present within each setting. Due to the confidence patient's place in other patients Yelp reviews, this may present an avenue to shape public opinion towards urgent care centers. There are also themes distinct to each setting, most likely due to the priority ERs place on critical care, as well as the more onerous compliance factor with hospital ER regulations. Most importantly, patient expectations for each setting vary by patient's pre-disposed expectations (e.g., a 3-hour wait in the emergency room might be expected but never in an urgent care center.)

Online rating platforms like Yelp enable providers, health systems, and healthcare consumers to compare and contrast various health delivery settings, and offer many advantages over other hospital rating platforms. Individuals presenting to an emergency room may be asked to complete a Press Ganey, or other national patient satisfaction survey. However, there is not yet a standardized patient experience survey for urgent care centers, so individuals may use online rating platforms like Yelp or TripAdvisor to disclose details about their experience. This data, if properly collected and analyzed, is a rich source of insight for healthcare managers.

There are advantages and disadvantages to both methods of rating a patient's experience. Online platforms offer a more informal, real-time method of capturing the patient's thoughts, feelings, and experience. Traditional patient satisfaction surveys, like Press Ganey, are often completed 48 hours to six weeks post encounter. One patient posted online about their experience, "This place is absolutely terrible... I've been here for 7 hours and still have not been treated... I pressed the nurse button and did not get a response for over 4 hours. Terrible." Since online reviews are often posted in real time, an individual posting an on-line review can be located in the waiting room or treatment room and service recovery can be implemented immediately.

In contrast, Press Ganey surveys contain data that is inaccessible to the public. Yelp, and other online platforms allow for sharing a public, searchable review in a forum where patients can read about others' experiences before their own encounter. Yelp is also unique in that patient's family, friends, or caregivers can post a review of an emergency room or urgent care center highlighting yet another key perspective.

Online review platforms, however, do have disadvantages. Unlike national surveys, online reviews are not structured data, nor does a third party validate them. Thus, any individual could post a review without actually interacting with the provider or hospital. Additionally, aside from the star rating, reviewers are not required to comment on specific questions or to use a standard measure for each area making it hard to compare on a more granular level.

While the current study found that emergency room and urgent care centers exhibit many similar themes in hospital reviews on Yelp, there were many differences that illustrate patients' perceptions of emergency room and urgent care centers (Ranard, 2016). Expectations may be different for the two delivery sites. Whereas the emergency room might be described as having a "nice clean waiting room," one patient noted that the urgent care center "had a clean self-service coffee and water bar" and that the "receptionist offered chocolate as well."

An important theme that arose in urgent care reviews was the delivery of care during vacation or travel away from home, which indicates patients view urgent care centers as a quick stop versus life-saving care. Patients and their families often cite the convenient location and "plentiful parking" of urgent care centers – topics that are important to patients that visit the emergency room, but are not prioritized at the top for urgent care.

Conclusion

The conceptual model for the study identified service characteristics (e.g., wait time, facilities, billing and staff) as driving of the patient experience and impact factors on a future patient's decision to select either and UCC or ER for treatment. The majority of the posted Yelp reviews are highly skewed towards service and away from evaluation of professional competence or clinical outcomes. This is critical to industry professionals as they plan for the new delivery system. More emphasis is being placed on the overall patient experience not just the clinical outcomes. Based on Yelp reviews, UCC's are

developing a competitive advantage over hospital ERs in amenities and service. Patient expectations differ between ERs and UCCs and the user-generated reviews reflect these differences. This difference may be understandable given that individuals who use ERs and UCCs likely differ, along with their conditions and expectations. However, reviews in these overlapping clinical settings reflect patient expectations, and they align with experiences. The reviews reveal themes that are at times similar across ERs and UCCs and at times unique. These similarities and differences provide insights that may improve patient experiences or, at a minimum, allow providers to align them with expectations.

The availability of online ratings may also reduce the burden of self-triage on patients by making information readily available. Yelp information is provided in layperson terms, is easy to find and is presented in a familiar format. However, as always, a note of caution since not all reviews are legitimate, truthful and helpful. Consumers may be confused by conflicting information provided by reviewers, and providers may be harmed by reviews that are inaccurate.

Study Limitations

This study has several limitations. First, Yelp has an inherent selection bias in the reporting of emergency room and urgent care center experiences, as the reviews are subjective and could reflect patients' emotional states rather than their actual experiences. Second, Yelp users are not representative of the general population in terms of education achievement, 81.4% have a college or advanced degree and socio-economic status; 46.3% make more than \$100,000 annually (Yelp, 2017). While this limits the

generalizability of this study, it does not impact the nature or legitimacy of the Yelp reviews or the conclusions drawn from them. Finally, only 16,000 reviews were available for emergency rooms versus 85,000 reviews for urgent care centers, which could have skewed the data in favor of urgent care centers.

When attempting to compare differences in the patient experience between two care delivery sites, an obvious shortcoming is the lack of heterogeneity of urgent care centers. Unlike hospital emergency rooms that tend to be very similar due to government and independent regulatory bodies (e.g., Joint Commission on the Accreditation of Healthcare Organizations), urgent care centers are defined broadly to include small local entrepreneurs, hospital affiliated and large private, national, equity-backed chains. Due to this broad definition, the analysis may not be capturing the inherent variation within urgent care centers.

CHAPTER TWO

STUDY 2: URGENT CARE CENTERS: SUBSTITUTE SERVICE OR COST AMPLIFIER? WHERE YOU START MATTERS

Introduction

Urgent care centers provide treatment to patients suffering from non-life-threatening illnesses or injuries that require medical attention but not in an emergency room. “Once derided as ‘Doc in a Box’ medicine, urgent care has mushroomed into an estimated \$14.5 billion business, as investors try to profit from the shifting landscape in health care” (Cresswell, 2014). The urgent care sector of the health care delivery system has become one of the fastest growing sectors in the American health care industry by morphing from a primarily emergency room alternative to serving as a resource for patients seeking primary care treatment. This evolution is driven by the urgent care centers interaction with patients and their primary care physician relationship. For example, urgent care centers substitute for the patient’s primary care physician in three ways: when their regular primary care physicians’ offices are closed; when they can’t get a timely appointment with their regular primary care physician; and when they don’t have a regular primary care physician. The number of patients seeking care at urgent care centers and retail clinics reached 166 million visits in 2012 (Ashwood, 2016; The Urgent Care Association of America, 2016). By comparison, emergency room visits were only 136.3 million nationally (CDC, 2012).

Often, health systems or hospitals will construct an urgent care network to alleviate volumes in their hospitals' emergency rooms and provide their community members with another resource for medical care. According to the Urgent Care Association of America, there are approximately 7,100 urgent care facilities in the United States with an ownership breakdown of 35.4% of centers owned by physicians or physician groups, 30.5% owned by a corporation, 25.2% owned by a hospital, 4.4% owned by a non-physician individual and 2.2% owned by a franchise. Interestingly, 66% of all patients visiting an urgent care center do so despite having a regular primary care physician (The Urgent Care Association of America, 2016). The urgent care industry is experiencing rapid growth in most major markets, fueled by recent health system and for-profit investment.

The cost implications of this shift from traditional delivery sites has been studied at the level of unit price of a patient visit comparing the cost of an urgent care center to a traditional hospital emergency room. It is estimated that \$4 billion could be saved annually if most or all low-acuity visits occur in an urgent care center compared to a hospital emergency room (Weinick, 2010). A recent study by Solucient concluded, "58 percent of patients visiting the ER, or 62 million individuals, could have been treated in less-acute care settings. About 75% of all pediatric ER patients could have been seen in a less-acute setting, such as fast-track units or urgent care facilities. Single females younger than 55 are the greatest users of non-emergent ER services" (Baisden, 2002).

Although the unit cost of an urgent care center visit is lower than a comparable emergency room visit, other associated cost patterns have not been thoroughly studied. For example, it is not uncommon for a patient to visit an urgent care center first, only to eventually be sent on to a hospital emergency room or physician's office for additional treatment. This situation can be framed conceptually as the difference between urgent care centers as a substitute service provider (substituting for the more expensive emergency room), and urgent care centers as a complementary or cost-amplifying service provider (adding additional costs to the treatment of a condition).

In other words, it has been established that low-acuity diagnoses have a lower unit price when treated at an urgent care center as compared to a hospital emergency room, but an unanswered question is what happens to aggregate healthcare spending when an urgent care center is introduced into a market. Does it serve as a substitute service or a complementary service? The answer to this question is important for future health care policy and management decisions. As one researcher put it, "Retail clinics have been viewed by policy makers and insurers as a mechanism to decrease health care spending, by substituting less expensive clinic visits for more expensive ED or physician office visits. However, retail clinics may actually increase spending if they drive new health care utilization" (Ashwood, 2016: p. 449).

Although it would be good to study the question of whether the introduction of an urgent care center into a market increases or decreases costs, due to the availability of

data, a related but fundamentally different question is offered: are costs higher when patients initiate their treatment at an urgent care center or an emergency room?

Literature Review

The economics of unscheduled care is driven by patient demand (e.g., patient has a cold) but also from the supply-side (e.g., provider owns the x-ray machine and financially benefits from ordering the test.) An important aspect of the research question is whether the economic incentives of the physician and health care providers is an underlying cause of increased costs. The supply-side of healthcare is often discussed through three inter-related concepts: supplier-induced demand, induced-demand and supply-sensitive demand. The first concept, supplier-induced demand, is based on the principal-agent theory wherein healthcare providers increase patient demand for services since they do not act as a perfect agent for their patients (Carlsen, 2000; Davis, 2000; Leonard, 2009; Trybou, 2014; Van Dijk, 2013). The second concept, induced-demand, is said to occur when the patient would not have chosen the service, except for its availability. (Levine, 2015) For example, “To assess whether retail clinic visits represent new utilization or a substitute for more expensive care, we used insurance claims data from Aetna for the period 2010–2012 to track utilization and spending for eleven, low-acuity conditions. We found that 58% of retail clinic visits for low-acuity conditions represented new utilization, and that retail clinic use was associated with a modest increase in spending of \$14 per person per year. These findings do not support the idea that retail clinics decrease health care spending” (Ashwood, 2016: p. 452).

The third concept is supply-sensitive demand, wherein the supply of a certain resource influences its use. Also known in healthcare, as Roemer's Law "in an insured population, a bed built, is a bed filled" (Roemer, 1961). Critics of hospital costs will also add "... is a bed billed" to Roemer's Law. Supply-sensitive demand is largely due to differences in local capacity. This regional variation in practice patterns and utilization has been deeply studied through the Dartmouth Atlas of Health Care (2018, March 11).

The literature and analysis on urgent care centers is nascent yet growing with a focus on the delivery site as the unit of analysis. Many of the published studies looked at the provider of convenience care, i.e., retail clinics and urgent care centers, in an attempt to ascertain if their utilization helped lower overall cost (Ashwood, 2016; Chang, 2015; Kaissi, 2016; Mehrotra, 2009; Sussman, 2013).

An article in the *American Journal of Managed Care* (Sussman, 2013), studied the healthcare spending patterns of CVS Caremark employees and their dependents from 2008-2011. The researcher compared two groups: retail clinic users (exposed) and nonusers (unexposed). Approximately 15% of the insured population utilized a retail clinic during the study time frame. The findings showed that utilization of the retail clinic was mostly associated with proximity to the clinic. The 15% that utilized retail clinics lived an average of 6.2 miles away compared to non-user population, which lived an average of 33 miles away from a retail clinic.

The findings also validated a \$262 reduction in the unit price of care for care delivered in a retail clinic compared to non-users. A variety of reasons were cited for

these findings. The common theme was that patients would utilize a retail clinic for non-urgent matters if the option is nearby; otherwise they will go to a higher cost delivery site. Retail clinics appear to reduce the cost of care if they are conveniently located. This may become an important component of the healthcare delivery system in the future (Sussman, 2013). Based upon the increased proliferation of the retail clinic and the urgent care center model within the healthcare delivery system, a number of articles reviewed the characteristics of the urgent care center and the associated benefits and potential risks. The business model is simple: treat as many patients as quickly as possible. Urgent care is a low-margin, high-volume proposition (Le, 2016).

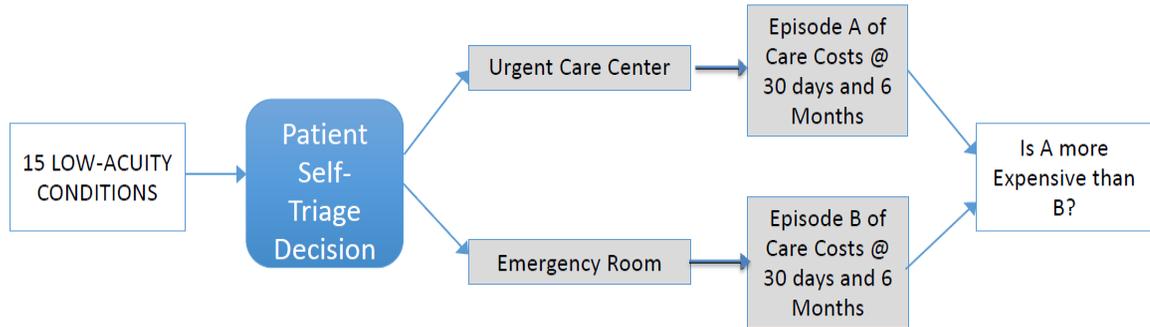
Attempts have been undertaken to delineate which model is best from a consumer perspective, as well as from the health care delivery system perspective. The criteria generally include a focus on cost, quality, access, patient navigation and continuity of care. Both the retail clinic model and urgent care model addresses all the above, though with varying degrees of success (Chang, 2015). Urgent care centers possess a crucial business advantage over traditional hospital emergency rooms for a variety of reasons including: they can avoid adverse selection by only treating insured patients, staffing costs in urgent care centers are generally less and “stand-by” infrastructure costs (technology and staff) are not present in urgent care centers. Most urgent care centers do not accept Medicaid, and will turn away the uninsured and underinsured, unless the patients pay up front or make financial arrangements. Hospital emergency rooms, to contrast, are legally obligated to treat everyone.

Much has been written about the location of urgent care centers and the factors that go into choosing a geographic location for an urgent care center. Le (2016) sought to identify the demographics and traits of communities containing an urgent care center and what community drivers influence where urgent care centers are located. Retail clinics were not a part of this analysis. The analysis showed that urgent care centers generally are located in suburban areas that have high levels of income and private insurance. Decisions to refrain from locating an urgent care center in economically downtrodden and/or rural areas are clearly driven by profitability or lack thereof (Le, 2016; cf. Chang, 2015).

Conceptual Model

The conceptual model for the study (see Figure 7) will test whether urgent care centers are a substitute service leading to reduced spending, or a complementary, cost amplifying service leading to higher overall costs. Higher costs are defined as more aggregate money spent on health care. Since more health care is delivered, costs can be higher, even if higher aggregate spending leads to lower per visit unit cost.

Figure 7: Conceptual Model for Study Two



The hypothesis is:

H1: Patients seeking treatment for selected low-acuity conditions that begin their treatment at an urgent care center will have lower aggregate health care spending within a given time period compared with patients who begin their treatment at an emergency room.

The study tested the impact of urgent care centers on health spending for selected low-acuity conditions. Whether the urgent care center produced either a substitute effect, leading to lower overall spend both at the visit and in the post-visit period, or an amplifier effect to a patient's health care utilization, leading to higher aggregate health care costs was tested. An example of an amplification effect would be any patient service that occurs after an urgent care visit. A referral or incidental findings at the index urgent care center visit can lead to additional services after the urgent care visit. Conversely, when

used as a substitute service, urgent care centers may have an elimination effect on the need for additional costlier services.

The model is straightforward and compares longitudinal health care spending for the 15 most prevalent low-acuity conditions. A recent article defined a low-acuity visit to an emergency room as “ambulatory arrival, low triage score, and discharge to home from the ED” (Schull, 2007). This study uses a working definition of low-acuity diagnoses as defined by Independence Blue Cross in its quarterly report to the University of Pennsylvania. The study measures the aggregate health care spending to treat selected low-acuity conditions, and compares patients who start their initial treatment at an urgent care center versus patients who begin their treatment at an emergency room. Aggregate health care spending includes hospital visits, doctor visits, diagnostic testing and pharmacy costs. The total cost of care was measured over 30 days, and separately over 6 months, from the initial visit to compare episodes originating in urgent care with those originating in the emergency department.

Methodology for data collection and data analysis

An analytic approach is often a compromise between what one would like to do and what data exists. The research approach utilized in this study was built on the availability of data. An experiment conducted as a randomized control trial, would randomize patients to always begin their treatment at urgent care centers or at an emergency room, allowing an observation of their outcomes. Since that was not possible,

the analytic power of a randomized control trial was emulated in our analyses of observational data as closely as possible.

Sample Selection

The study sample included University of Pennsylvania Health System employees and their Penn-insured dependents seen at an urgent care facility or in the emergency room between 2012-2017 with a primary diagnosis among the 15 most common low-acuity conditions seen in those settings. The specific diagnoses included acute pharyngitis, acute upper respiratory infection, headache, urinary tract infection, low back pain, acute sinusitis, acute bronchitis, conjunctivitis, back pain, acute obstructive laryngitis, chronic sinusitis, shingles, candidiasis, scabies, and ingrown nail.

The unit of analysis was a patient's episode of care. The episode included the initial urgent care or emergency room visit together with 30 days of follow-up (and 6 months of follow-up in a separate analysis), with no prior occurrence in the previous 6 months. For example, if the patient was treated for back pain in the initial visit and returned within 6 months for sinusitis, the back pain case was included, but the sinusitis case was excluded. These cases were excluded to avoid overlapping costs and reduced potential bias by only including the earlier visit. Even if the costs related to sinusitis have nothing to do with that initial back pain case, the inclusion criteria are being applied evenly between the two groups. Please see Table 4 on next page.

Table 4: Comparison of included and excluded patient episodes (30 days pre/post follow-up)					
		Excluded Episodes (<30 Days Pre/Post Follow-up) No. (%)	Included Episodes (≥30 Days Pre/Post Follow-up) No. (%)	P-Value	
Index Visit Type					
	Urgent Care	648 (44.5)	3055 (45.6)	0.4757	
	ER	807 (55.5)	3650 (54.4)		
Sex					
	Male	584 (40.1)	2006 (29.9)	< .0001	
	Female	871 (59.9)	4699 (70.1)		
Age at Index Visit, yr.					
	Mean +/- SD	28.9 +/- 15.2	31.2 +/- 17.3	< .0001	
	Range	0–70	0–79		
Charlson Comorbidity Score					
	Mean +/- SD	0.34 +/- 0.88	0.78 +/- 1.39	< .0001	
	Range	0–12	0–16		
Household Income Estimate					
	< \$35,000	274 (18.8)	1095 (16.3)	0.0021	
	\$35,000 – \$50,000	283 (19.5)	1199 (17.9)		
	\$50,000 – \$75,000	437 (30.0)	1953 (29.1)		
	≥ \$75,000	461 (31.7)	2458 (36.7)		
Diagnosis					
	Acute Pharyngitis	303 (20.8)	1178 (17.6)	0.2098	
	Acute Upper Respiratory Infection	261 (17.9)	1197 (17.9)		
	Headache	211 (14.5)	1043 (15.6)		
	Urinary Tract Infection	156 (10.7)	693 (10.3)		
	Low Back Pain	107 (7.4)	504 (7.5)		
	Acute Sinusitis	93 (6.4)	512 (7.6)		
	Acute Bronchitis	98 (6.7)	498 (7.4)		
	Conjunctivitis	61 (4.2)	278 (4.2)		
	Back pain	49 (3.4)	241 (3.6)		
	Acute Obstructive Laryngitis	41 (2.8)	235 (3.5)		
	Chronic Sinusitis	24 (1.7)	123 (1.8)		
	Shingles	20 (1.4)	99 (1.5)		
	Candidiasis	15 (1.0)	57 (0.9)		
	Ingrown Nail	5 (0.3)	22 (0.3)		
Total		1455	6705		

An additional example: if the patient's index visit was at an urgent care center for shingles, with another visit to an urgent care center two months later for back pain, the second case was excluded. In this case, any charges over the next six months would be included in the urgent care group for the 6-month cost analysis (but not the 30-day). If the patient had gone to urgent care center first, but then later needed to go to the emergency room two months later, all costs would still be attributed to urgent care center. Counting the back pain instance as an emergency room episode might introduce bias because the patient had initially opted for urgent care.

Episodes were excluded from the analysis if patients had follow up within a period shorter than 30 days before or after the index visit. Episodes were also excluded if there was an earlier occurrence, defined as any emergency room or urgent care visit with one of the 15 low-acuity diagnoses, within the prior 6 months for all analyses. Health care utilization and costs were also assessed over the 30 days and 6 months preceding the initial index visit to serve as a baseline. In order to account for changes in employee benefits (e.g., employee turnover, end of probationary period, end of benefits waiting period, etc.), patients had to have at least one medical or pharmacy claim at least 30 days (and 6 months) prior to the index visit or at least 30 days and 6 months after the index visit for inclusion. Please see table 5 on next page.

Multiple episodes could be included in the analysis, under the same or different diagnoses,) as long as they were separated by at least 6 months. If someone came in for a respiratory infection and had a headache one week later, they were classified as having

Table 5: Comparison of included and excluded patient episodes (6 month pre/post follow-up)

	Excluded Episodes (<182 Days Pre/Post) No. (%)	Included Episodes (≥182 Days Pre/Post) No. (%)	P-Value
Index Visit Type			
Urgent Care	1437 (44.4)	2266 (46.1)	0.1354
ER	1802 (55.6)	2655 (54.0)	
Sex			
Male	1134 (35.0)	1456 (29.6)	< .0001
Female	2105 (65.0)	3465 (70.4)	
Age at Index Visit, yr.			
Mean +/- SD	29.2 +/- 16.2	31.8 +/- 17.4	< .0001
Range	0-76	0-79	
Charlson Comorbidity Score			
Mean +/- SD	0.50 +/- 1.15	0.83 +/- 1.41	< .0001
Range	0-13	0-16	
Household Income Estimate			
< \$35,000	559 (17.3)	810 (16.5)	0.6711
\$35,000 – \$50,000	586 (18.1)	896 (18.2)	
\$50,000 – \$75,000	957 (29.6)	1433 (29.1)	
> = \$75,000	1137 (35.1)	1782 (36.2)	
Diagnosis			
Acute Pharyngitis	609 (18.8)	872 (17.7)	
Acute Upper Resp. Infection	598 (18.5)	860 (17.5)	
Headache	491 (15.2)	763 (15.5)	
Urinary Tract Infection	344 (10.6)	505 (10.3)	
Low Back Pain	237 (7.3)	374 (7.6)	
Acute Sinusitis	232 (7.2)	373 (7.6)	
Acute Bronchitis	212 (6.6)	384 (7.8)	
Conjunctivitis	129 (4.0)	210 (4.3)	
Back Pain	111 (3.4)	179 (3.6)	
Acute Obstructive Laryngitis	108 (3.3)	168 (3.4)	
Chronic Sinusitis	55 (1.7)	92 (1.9)	
Ingrown Nail	13 (0.4)	14 (0.3)	
Total	3239	4921	

a respiratory infection. Multiple episodes for an individual patient were included in the analysis, provided the index visit did not occur within the 6-month window after an earlier episode. Episodes were excluded from the analysis if the patient had no claims at least 30 days prior to the index visit (e.g., new hires) or no claims at least 30 days after the visit (e.g., employee attrition). A modified score on the Charlson Comorbidity Index that excluded age was calculated for each episode based on prior diagnoses in the medical claims. Household income was estimated based on the median income of the zip code of the patient's home address at the time of the index visit. Health care costs included all medical and pharmacy claim amounts paid by the health plan in the pre- and post-index periods and the cost of the index case. The total costs were standardized to January 2015 dollars using the monthly index for the "All items" category from the Consumer Price Index for All Urban Consumers (Bureau of Labor Statistics, 2017).

Statistical Model

Unit of analysis: The unit of analysis was patient episodes of care comprising an initial urgent care or emergency room visit with 30 days of follow-up (and 6 months of follow-up in a separate analysis), with no prior occurrence of the same condition, and with no prior urgent care or emergency room visit for any of the 15 specified conditions in the previous 6 months. Please note: A patient could have had a recurrence of the same condition if it was greater than 6 months apart. Although not always the case, we assumed that a condition had resolved if a patient didn't have an ER or UCC visit for that condition within 6 months. Inclusion criteria for the sample were:

- UPHS employees and their dependents on the PennCare PPO plan;
- Urgent care facility or emergency room visit between 2012-2017; and
- Primary diagnosis of acute pharyngitis, acute upper respiratory infection, headache, urinary tract infection, low back pain, acute sinusitis, acute bronchitis, conjunctivitis, back pain, acute obstructive laryngitis, chronic sinusitis, shingles, candidiasis, scabies, and ingrown nail.

Exclusion criteria for the sample were:

- Subsequent episodes of care for the above diagnoses that occur within six months or earlier.

Dependent variable: The total episode spending, including all health care spending (in medical and pharmacy claims) regardless of diagnosis.

Independent variables: Initial use of urgent care vs. emergency room, time period, gender, age, comorbidity score, estimated household income, and diagnosis.

The estimated model is shown below as Equation 1:

$$\log(E(\text{Total Episode Spending})) = \beta_0 + \beta_1 \text{Urgent Care} + \beta_2 \text{Time Period} + \beta_3 \text{Urgent Care} * \text{Time Period} + \beta_4 \text{Gender} + \beta_5 \text{Age} + \beta_6 \text{Comorbidity Score} + \beta_7 \text{HH Income} + \beta_8 \text{Diagnosis} \quad (1)$$

Several possible models were considered to evaluate costs. The total costs were highly skewed, with many instances where total cost was zero (i.e., no spending during

the pre-period). Therefore, a generalized linear model with a log link was selected for the final analysis rather than adding a non-zero value and taking the log of the costs. An alternative equation to $\log(E(\text{total episode spending}))$ would be the expected value of total episode spending, $\log(\text{total spending})$. In an initial attempt to model the log of the costs, there were a number of cases identified with zero spending (e.g., many of the pre-index visit costs were \$0). The log of 0 is undefined so those cases would have had to be excluded. Coding the \$0 visits by adding \$0.01 to each would have remediated the issue but the literature advised against that method. Instead, a generalized linear model was used in order to take the log of the mean costs, which is not equal to the mean of the log of the costs.

Statistical Analysis

Urgent care and emergency room patient episodes were compared using chi-square tests for categorical variables and t-tests for continuous variables. See Table 6 on next page. Utilization is a key metric and is defined as the frequency a patient uses a health care service, fills a prescription or visits a doctor's office. A comparison of pre- and post-index period spending and utilization differences between patients who visited an urgent care center and those who visited the emergency room using difference-in-differences analysis. Difference-in-differences analysis addressed individual sources of confounding that may have led to differential selection (e.g., urgent care vs. emergency room) by comparing changes in health care utilization for the treatment group over time relative to the comparison group. It was expected that patients using urgent care centers

Table 6: Comparison of patients with initial visits at urgent care facilities versus the emergency room

	Urgent Care No. (%)	Emergency Room No. (%)	P-Value
Sex			
Male	867 (28.4)	1139 (31.2)	
Female	2188 (71.6)	2511 (68.8)	
Age at index visit, yr			
Mean +/- SD	31.1 +/- 16.3	31.3 +/- 18.1	
Range	0-79	0-79	0.7273
Charlson Comorbidity Score			
Mean +/- SD	0.64 +/- 1.13	0.90 +/- 1.56	
Range	0-11	0-16	< .0001
Household Income estimate			
<\$ 35,000	143 (4.7)	952 (26.1)	
\$35,000 – \$50,000	361 (11.8)	838 (23.0)	
\$50,000 – \$75,000	964 (31.6)	989 (27.1)	
> = 75,000	1587 (52.0)	871 (23.9)	< .0001
Diagnosis			
Acute Pharyngitis	817 (26.7)	361 (9.9)	
Acute Upper Respiratory Infection	716 (23.4)	481 (13.2)	
Headache	45 (1.5)	998 (27.3)	
Urinary Tract Infection	256 (8.4)	437 (12.0)	
Low Back Pain	77 (2.5)	427 (11.7)	
Acute Sinusitis	453 (14.8)	59 (1.6)	
Acute Bronchitis	381 (12.5)	117 (3.2)	
Conjunctivitis	91 (3.0)	187 (5.1)	
Back pain	21 (0.7)	220 (6.0)	
Acute Obstructive Laryngitis	22 (0.7)	213 (5.8)	
Chronic Sinusitis	73 (2.4)	50 (1.4)	
Shingles	52 (1.7)	47 (1.3)	
Candidiasis	24 (0.8)	33 (0.9)	
Scabies	14 (0.5)	11 (0.3)	
Ingrown Nail	13 (0.4)	9 (0.3)	
			< .0001
Pre-Period (30 Day) Cost			
Mean (SD)	\$310 (\$1,899)	\$891 (\$4,229)	< .0001
Median (IQR)	\$0 (\$0-171)	\$23 (\$0-375)	< .0001
Range	0 – \$88,150	0 – \$87,315	
Total	3,055	3,650	

might be different from those who visit the emergency room with respect to health care spending and utilization. Next a difference-in-differences analysis was used to estimate the difference in cost and utilization that can be attributed to using those services. Comparing the pre- and post-index period spending between patients who visited an urgent care center and those who visited the emergency room accounted for baseline differences that were present in those groups.

Unadjusted differences in the mean pre- and post-index period costs and visit counts were compared between groups for each selected low acuity diagnosis and combined using t-tests. The patient's gender, comorbidity score, estimated household income, and diagnosis were significantly associated with the delivery site, urgent care center or emergency room, of index visit (Table 6).

The final model followed Equation 1 and predicted $\log(E(\text{total spending}))$ as a function of the facility, time, an interaction term for facility and time, diagnosis, patient age, gender, modified Charlson Comorbidity Score, and estimated household income. Because the model used the log of spending, the differences are presented as ratios. Additionally, logistic regression was used to compute odds ratios for any inpatient admission within 30 days of the index visit.

In order to test the assumption of similar trends, an evaluation of the difference-in-differences estimates of cost for two 30-day periods (60 to 31 days vs. 30 to 1 day) and two 6-month periods (12 to 6 months vs. 6 to 0 months) prior to the index visit. The difference-in-differences estimate comparing the 30-day trends were significant (1.54,

95% CI: 1.12-2.11), suggesting the 30-day difference-in-differences estimate may violate the similar trends assumption. The estimate comparing the two six-month periods, however, was not significant (1.04, 95% CI: 0.88-1.23).

For more details on the statistical analysis performed for this study, consult Appendix D.

Results

The final sample included 6,705 total episodes, of which 3,055 were initial visits to urgent care and 3,650 episodes were initial visits to the emergency room. Significant differences between the groups included gender, Charlson comorbidity score, estimated household income, diagnosis, and pre-period cost (Table 6). The mean 30-day cost during the pre-index period was \$310 (SD: 1,899) for patients with urgent care visits and \$891 (SD: 4,299) for patients with emergency room visits. The median 30-day cost during the pre-index period was \$0 (\$0-171) for patients with urgent care visits and \$23 (\$30-375) for patients with emergency room visits.

The unadjusted model shows the difference-in-difference estimate for cost between the two groups in dollars. The adjusted model included the variables gender, age, estimated household income, diagnosis, and comorbidity score. Those variables were not perfectly balanced across the groups, so the adjusted model controlled for them when comparing outcomes. Because of this, the differences were presented as ratios. Both models found higher difference-in-difference estimates of cost for the emergency room. The unadjusted estimate of the difference-in-differences for patients who visited the

emergency room compared to urgent care was \$1,323 ($p < .0001$) for 30-day difference and \$2,152 ($p < .0001$) for the 6-month difference for all diagnoses.

The change in the number of emergency room visits from the pre-index period to post-index period was 0.75 ($p < .0001$) greater for patients initially seen in the emergency room compared to urgent care. The 30-day change in the mean number of outpatient visits was 0.83 ($p < .0001$) higher for patients visiting the emergency room compared to urgent care. Emergency room patients also experienced a greater increase in inpatient admissions difference-in-differences was 0.0336 ($p < .0001$) following the index visit.

Under the adjusted model see Table 8 on next page, visiting the emergency room corresponded to a 68.0% (95% CI: 32–114%) greater change in pre- to post-index period cost when evaluating the first 30 days, and 40.0% (95% CI: 20.2–63.0) when comparing costs over 6 months. The change in mean emergency room visits from the pre- to post-index period was 3.39 times greater (95% CI: 2.38–4.82) among the emergency room group. The difference-in-difference estimate of the odds ratio for inpatient admissions was 1.167 (95% CI: 0.46–3.00) times greater for patients who visited the emergency room, though the difference was not significant. See Table 9 on the following page.

As a robustness test, an analysis excluding the cost of the index visit was completed. It was found that the unadjusted difference-in-differences estimates for using the emergency department versus urgent care were \$930 (down from \$1,323 when including the cost of the initial visit) and \$1,768 (down from \$2,152) at 30 days and 6 months. In the adjusted analysis, the difference-in-difference estimates of the change in

Table 7: Multivariable adjusted difference-in-differences estimates for cost at 30 days and 6 months

	30 Day Difference-in-Differences Estimates			6 Month Difference-in-Differences Estimates		
	Mean Cost Ratio	95% Confidence Interval	P-Value	Mean Cost Ratio	95% Confidence Interval	P-Value
Index Visit Type						
Urgent Care	1.0			1.0		
Emergency Room	1.842	1.447 – 2.346	< .0001	1.212	1.047 – 1.403	0.0099
Time						
Pre-Index	1.00			1.00		
Post-Index	2.060	1.736 – 2.444	< .0001	1.213	1.076 – 1.369	0.0016
Post-Index*ER Visit Interaction	1.680	1.321 – 2.136	< .0001	1.400	1.202 – 1.630	< .0001
Patient Gender						
Male	1.00			1.00		
Female	0.971	0.842 – 1.119	0.6810	1.168	1.031 – 1.323	0.0146
Patient Age	1.005	1.001 – 1.010	0.0238	1.006	1.003 – 1.010	0.0004
Charlson Comorbidity Score	1.407	1.347 – 1.471	< .0001	1.491	1.423 – 1.562	< .0001
Household Income estimate						
< \$35,000	1.00			1.00		
\$35,000 – \$50,000	0.948	0.761 – 1.180	0.6318	0.909	0.775 – 1.065	0.2381
\$50,000 – \$75,000	0.786	0.658 – 0.939	0.0080	0.827	0.717 – 0.955	0.0097
> = \$75,000	0.943	0.795 – 1.120	0.5041	0.939	0.834 – 1.056	0.2929
Diagnosis						
Acute Bronchitis	1.00			1.00		
Acute Obstructive Laryngitis	0.887	0.598 – 1.315	0.5493	0.804	0.529 – 1.222	0.3081
Acute Pharyngitis	1.027	0.629 – 1.677	0.9151	1.130	0.696 – 1.833	0.6205
Acute Sinusitis	0.731	0.513 – 1.041	0.0826	0.637	0.424 – 0.957	0.0298
Acute Upper Resp. Infection	0.803	0.509 – 1.269	0.3478	0.694	0.454 – 1.060	0.0912
Candidiasis	0.888	0.621 – 1.269	0.5142	0.769	0.513 – 1.153	0.2044
Chronic Sinusitis	0.753	0.492 – 1.154	0.1929	0.490	0.307 – 0.782	0.0028
Conjunctivitis	1.216	0.699 – 2.114	0.4888	1.046	0.623 – 1.755	0.8650
Back pain	0.736	0.485 – 1.116	0.1487	0.651	0.415 – 1.020	0.0610
Headache	1.608	1.024 – 2.526	0.0393	1.019	0.651 – 1.596	0.9336
Ingrown Nail	1.651	1.139 – 2.393	0.0081	1.187	0.787 – 1.790	0.4147
Low Back Pain	0.553	0.269 – 1.136	0.1069	1.657	0.707 – 3.882	0.2454
Scabies	1.287	0.846 – 1.956	0.2385	1.112	0.733 – 1.685	0.6176
Urinary Tract Infection	0.984	0.503 – 1.926	0.9626	0.794	0.364 – 1.731	0.5612
Shingles	1.648	1.051 – 2.585	0.0295	0.994	0.660 – 1.497	0.9787
	1.00			1.00		

Table 8: Multivariable difference-in-differences estimates for additional visits in ER and outpatient settings

	Additional ER Visits (30 Days)			Additional Outpatient Visits (30 Days)		
	Mean Visit Ratio	95% Confidence Interval	P- Value	Mean Cost Ratio	95% Confidence Interval	P- Value
Index Visit Type						
Urgent Care	1.0			1.0		
Emergency Room	3.573	2.560 – 4.986	< .0001	1.218	1.101 – 1.348	0.0001
Time						
Pre-Index	1.00			1.00		
Post-Index	2.057	1.491 – 2.838	< .0001	1.336	1.243 – 1.436	< .0001
Post-Index*ER Visit Interaction	3.388	2.381 – 4.821	< .0001	1.540	1.406 – 1.688	< .0001
Patient Gender						
Male	1.00			1.00		
Female	1.044	0.856 – 1.273	0.6699	1.115	1.034 – 1.201	0.0045
Patient Age	0.998	0.992 – 1.004	0.5666	1.006	1.004 – 1.008	< .0001
Charlson Comorbidity Score	1.225	1.158 – 1.297	< .0001	1.230	1.202 – 1.258	< .0001
Household Income estimate						
< \$35,000	1.074	0.833 – 1.384	0.5834	0.761	0.687 – 0.844	< .0001
\$35,000 – \$50,000	0.986	0.770 – 1.264	0.9134	0.712	0.651 – 0.779	< .0001
\$50,000 – \$75,000	0.952	0.748 – 1.212	0.6907	0.857	0.793 – 0.926	0.0001
>= \$75,000	1.00			1.00		
Diagnosis						
Acute Bronchitis	0.967	0.446 – 2.097	0.9332	0.758	0.586 – 0.980	0.0346
Acute Obstructive Laryngitis	0.654	0.308 – 1.386	0.2676	1.147	0.854 – 1.540	0.3629
Acute Pharyngitis	0.745	0.369 – 1.504	0.4109	0.672	0.525 – 0.861	0.0016
Acute Sinusitis	0.914	0.415 – 2.014	0.8231	0.677	0.521 – 0.879	0.0035
Acute Upper Resp. Infection	0.872	0.432 – 1.760	0.7022	0.844	0.661 – 1.077	0.1730
Candidiasis	0.697	0.267 – 1.817	0.4601	0.746	0.526 – 1.058	0.1004
Chronic Sinusitis	1.150	0.412 – 3.206	0.7900	0.700	0.487 – 1.007	0.0545
Conjunctivitis	0.952	0.440 – 2.061	0.9003	0.801	0.612 – 1.048	0.1063
Back pain	2.039	0.911 – 4.564	0.0829	1.000	0.756 – 1.324	0.9980
Headache	1.341	0.686 – 2.621	0.3903	1.146	0.896 – 1.465	0.2775
Ingrown Nail	0.152	0.051 – 0.449	0.0007	0.503	0.282 – 0.899	0.0203
Low Back Pain	1.221	0.597 – 2.497	0.5853	1.169	0.907 – 1.506	0.2280
Scabies	0.305	0.091 – 1.023	0.0545	1.153	0.632 – 2.104	0.6425
Urinary Tract Infection	1.149	0.575 – 2.300	0.6938	0.867	0.674 – 1.117	0.2704
Shingles	1.00			1.00		

Table 9: Multivariable difference-in-differences estimate for inpatient admissions				
		Inpatient Admissions 30 Days		
		Odds Ratio	95% Confidence Interval	P-Value
Index Visit Type				
	Urgent Care	1.0		
	Emergency Room	7.164	3.029 – 16.945	< .0001
Time				
	Pre-Index	1.00		
	Post-Index	3.023	1.241 – 7.363	0.0149
Post-Index*ER Visit Interaction		1.167	0.455 – 2.995	0.7476
Patient Gender				
	Male	1.00		
	Female	0.945	0.706 – 1.264	0.7012
Patient Age		1.003	0.995 – 1.011	0.4642
Charlson Comorbidity Score		1.379	1.275 – 1.491	< .0001
Household Income estimate				
	< \$35,000	0.741	0.510 – 1.076	0.1150
	\$35,000 – \$50,000	0.553	0.368 – 0.832	0.0044
	\$50,000 – \$75,000	0.749	0.525 – 1.069	0.1111
	>= \$75,000	1.00		

cost was 61% (95% CI: 24–110%) greater for the emergency department at 30 days and 32% (95% CI: 13-54%) greater at 6 months when excluding the cost of the index visit. These additional results support that even when the index case is excluded the overall cost is still higher when patients visit the emergency department. Please see the supplemental data in Table 10 on next page.

Overall, the results support the hypothesis that patients seeking treatment for low-acuity conditions that begin their treatment at an urgent care center have lower aggregate

Table 10: (Supplemental table) Multivariable difference-in-differences estimates for cost at 30 days and 6 months

	30 Day Difference-in-Differences Estimates			6 Month Difference-in-Differences Estimates		
	Mean Cost Ratio	95% Confidence Interval	P-Value	Mean Cost Ratio	95% Confidence Interval	P-Value
Index Visit Type						
Urgent Care	1.0			1.0		
Emergency Room	1.784	1.388 – 2.292	< .0001	1.196	1.031 – 1.389	0.0183
Time						
Pre-Index	1.00			1.00		
Post-Index	1.588	1.318 – 1.914	< .0001	1.153	1.019 – 1.305	0.0238
Post-Index*ED Visit Interaction	1.613	1.236 – 2.104	0.0004	1.319	1.126 – 1.544	0.0006
Patient Gender						
Male	1.00			1.00		
Female	0.973	0.829 – 1.142	0.7387	1.178	1.034 – 1.342	0.137
Patient Age	1.006	1.001 – 1.012	0.0164	1.007	1.003 – 1.010	0.0003
Charlson Comorbidity Score	1.441	1.375 – 1.511	< .0001	1.506	1.436 – 1.580	< .0001
Household Income estimate						
< \$35,000	0.956	0.744 – 1.230	0.7282	0.905	0.768 – 1.068	0.2377
\$35,000 – \$50,000	0.768	0.630 – 0.936	0.0089	0.825	0.710 – 0.958	0.0119
\$50,000 – \$75,000	0.923	0.767 – 1.111	0.3945	0.936	0.828 – 1.058	0.2890
>= \$75,000	1.00			1.00		
Diagnosis						
Acute Bronchitis	0.881	0.572 – 1.357	0.5661	0.804	0.527 – 1.233	0.3204
Acute Obstructive Laryngitis	1.131	0.638 – 2.003	0.6736	1.130	0.707 – 1.920	0.5491
Acute Pharyngitis	0.703	0.476 – 1.038	0.0764	0.637	0.417 – 0.956	0.0297
Acute Sinusitis	0.812	0.475 – 1.386	0.4445	0.694	0.450 – 1.068	0.0965
Acute Upper Resp. Infection	0.886	0.599 – 1.308	0.5419	0.769	0.511 – 1.164	0.2161
Candidiasis	0.736	0.459 – 1.179	0.2021	0.490	0.293 – 0.770	0.0025
Chronic Sinusitis	1.384	0.734 – 2.610	0.3157	1.046	0.630 – 1.836	0.7896
Conjunctivitis	0.702	0.437 – 1.128	0.1436	0.651	0.409 – 1.028	0.0652
Back Pain	1.623	1.007 – 2.615	0.0469	1.019	0.651 – 1.628	0.9022
Headache	1.761	1.183 – 2.621	0.0053	1.187	0.801 – 1.850	0.3572
Ingrown Nail	0.471	0.187 – 1.185	0.1099	1.657	0.705 – 3.968	0.2429
Low Back Pain	1.351	0.867 – 2.106	0.1840	1.112	0.743 – 1.732	0.5581
Scabies	0.997	0.477 – 2.086	0.9943	0.794	0.349 – 1.762	0.5568
Urinary Tract Infection	1.674	1.049 – 2.673	0.0309	0.994	0.657 – 1.512	0.9887
Shingles	1.00			1.00		

health care spending within a given time period than patients who begin their treatment at an emergency room.

Discussion and Research Contribution

This research provides guidance to the health care industry, in general, and insurance companies, specifically on the economic impact of urgent care centers on a market in order to prepare successfully for the future. It can be argued that the study points to a conclusion that urgent care centers reduce overall market costs. If so, should insurers deny coverage of visits at emergency rooms for these low-acuity conditions? This is an extreme conclusion and one currently being tested by a major Ohio health insurer. Anthem is under severe criticism for plans to deny coverage for what it says are non-emergency visits to the emergency room. “Anthem says it had tried to educate its customers about when to seek emergency care and when to visit a primary-care physician, but those efforts have failed to keep people with seasonal allergy flare-ups and ingrown toenails out of the ER.” (Rose, 2017). Anthem and other insurers would argue that it needs to be extreme since softer alternatives exist. However, as reviewed in Study 1, the ability for effective patient self-triage is still developing and patients should not be penalized for their inability to correctly diagnose their condition. Instead, insurers should encourage the use of urgent care centers over emergency rooms in markets where both exist. This can be accomplished through a variety of insurance plan design changes and use of behavioral economic incentives.

The American Hospital Association and others wrote to Anthem with the following argument “As most individuals are not medical professionals, they rely on physicians and other clinicians for diagnosis and treatment and those clinicians in turn rely on their training and diagnostic tools to aide them in making their determinations (e.g., a CT scan). Thus, when a patient enters the emergency department, neither the patient nor the physician knows the diagnosis, yet the clinician is obligated to act.” (AHA; 2018). Further research to ascertain the cost and clinical outcome impact of this new policy change is warranted.

Other initiatives are underway that deserve further study, such as patient self-triage apps and concierge service desks that nudge patients into making the most effective self-triage decisions. Another option to study would be the effect of amending the Emergency Medical Treatment and Active Labor Act of 1986 (42 U.S. Code § 1395dd) rules and allow emergency room triage nurses to divert low-acuity issues to lower cost settings, without seeing a doctor, possibly leading to an amelioration of overall costs.

Further research is also needed to guide local and federal policy groups on health department regulations, local zoning issues and economic impact (Chokshi, 2014; Wong, 2016). A health policy brief in the *New England Journal of Medicine* clearly articulated the dilemma facing policy makers, “Convenient ambulatory care poses a double-edged sword for policymakers. On one hand, assisting their growth could help address the imperative to reduce cost while increasing access to care. On the other hand, concerns

about quality, the potential to mislead patients in need of higher levels of care, and fragmentation of care call for regulatory safeguards for patients” (Chang, 2015, p. 386). The projected shortage of primary care physicians (Bodenheimer, 2010) will only exacerbate patient access issues and push for a loosening of corporate practice of medicine statutes and an expanded scope of practice for nurse practitioners (Fairman, 2011; Lowe, 2011).

Although the research findings are important, limitations of the analysis remain in terms of generalizability and confounding factors. The results show that older patients, females, patients with comorbidities, and patients with higher estimated income were more likely to be included. Selection bias should be addressed by difference-in-differences or by the multiple regression for the measured variables.

Unmeasured variables could be a source of confounding that is not accounted for in the analysis. Specifically, an unmeasured variable that might be problematic is severity of illness. For example, it may be a new condition so difference-in-differences wouldn’t account for it both pre and post. If severity of illness were associated with both emergency department usage and higher costs, it would bias the findings. However, by limiting the selected diagnoses to study to only low-acuity conditions the bias, if any, has been mitigated.

This analysis studied the total episode cost as the primary outcome. A future secondary analysis might investigate diagnosis-specific costs, which require a deeper data set matching any related follow-up care to the initial index visit. Finally, the

interdisciplinary nature of the research (e.g., statistics, economics and geo-spatial design, etc.) encourages future research to further integrate these academic disciplines to develop insights for health policy.

An important result of this study is the identification of the need for an expanded and hopefully definitive analysis on the economic impact of urgent care centers on the health care delivery system. This study offered an evaluation of costs of episodes of care that are received at urgent care centers and emergency rooms. The only way to definitively answer the question is to look at markets that have urgent care centers versus markets without urgent care centers.

CONCLUSION

Healthcare consumerism is gathering speed as patients are taking a more active role in their personal medical care decisions. The transition of previously passive patients into empowered consumers is the direct result of the shift of the financial burden to the patient's pocketbook. Healthcare consumerism is being driven by several converging forces changing patient's behavior, as they search for greater value and quality of service, timely and convenient care, and improved patient experience.

The consumer experience has been mixed. Consumerism requires a willing patient, which is not always the case, and patients need access to data at a level they can understand. They need to build competencies with basic insurance terms and concepts such as high deductibles and cost-sharing, and need to understand what to expect from insurance coverage

The consumer mantra of "I want, what I want, when I want it" is increasingly challenging the traditional referral patterns within the hospital and physician-centric health care delivery system. New care delivery settings, e.g., urgent care centers, retail clinics, telemedicine, are providing consumers with alternatives to the "bricks and mortar" of the hospital dominated system. The growth and variety of these healthcare options creates both opportunities and challenges for patients as healthcare consumers. Patients need to decide the level of care and services they may need when they experience an acute illness or injury, a decision known as self-triage. Consumers are

increasingly turning to digital platforms to gain knowledge and actively participate in their care including self-triage decisions.

This dissertation studied the impact of healthcare consumerism on unscheduled care in two ways. First, an essay on “learning through listening” that examined and compared Yelp ratings of emergency rooms versus urgent care centers to better understand consumer satisfaction with various delivery sites of unscheduled care. The data provided four specific insights: patients are increasingly comfortable and willing to share their patient care experiences via Yelp or other online platforms; urgent care centers are rated higher than emergency rooms; patients have confidence in Yelp ratings and are seemingly willing to follow recommendations from other patients on which delivery setting to use; and both settings have common and divergent themes that are driven by patients’ expectations. In particular, the review data offers the potential to provide insights into the drivers of self-triage. Secondly, an examination of the spending in a large self-insured employer’s health care plan to determine if the use of alternative delivery settings is a substitute or cost-amplifying service. This research examines the potential to further reduce unscheduled care by assisting patients in making more informed self-triage decisions.

The overarching goal of this research is to contribute insights into the linkage between a patient’s ability to self-triage and its overall impact on the health care delivery system. The research contributes to an understanding of multiple aspects, including costs, patient satisfaction, and effectiveness of care provided in two different settings. The

research provides guidance on how to drive better decision making by patients, providers and payers regarding site of care selection. The research will benefit employers, policy makers and consumers. In particular, this research will help guide the changes needed in the healthcare delivery system as it shifts from a traditional focus on “bricks and mortar” to a more virtual and less hospital-centric industry.

Future research is needed in exploring patient self-triage as a critical success factor in reducing health care costs and what determines its effectiveness; the impact of the increasing interoperability between electronic medical records and e-health tools, and improvement in the continuity of care, will patients be able to switch physicians and providers more easily in the future; and the need to develop a uniform, commonly accepted patient satisfaction survey for the urgent care industry with consistent data collection of quality and safety metrics.

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**APPENDIX A
SUMMARY OF LITERATURE REVIEW**

Author (date)	Title	Key findings
Ashwood, et al (2016)	Retail Clinic Visits for Low-Acuity Conditions Increase Utilization and Spending	<ul style="list-style-type: none"> ● Tracked insurance claims from Aetna subscribers from 2010-2012. ● Found that 58 percent of retail clinics represented new utilization. ● Retail clinics were associated with a \$14 person per year increase in costs.
Borkowski (2012)	Solutions for ED Overcrowding: Increasing Urgent Care Centers	<ul style="list-style-type: none"> ● Urgent care centers can manage patients who have non-emergent conditions. ● UCCs can absorb 30% to 50% of ER patients. ● We need a serious effort to provide more urgent care centers in urban areas. ● Without intervention, the national crisis of ER overcrowding will continue and worsen.
Corwin, et al (2016)	Site of Treatment for Non-Urgent Conditions by Medicare Beneficiaries: Is There a Role for Urgent Care Centers	<ul style="list-style-type: none"> ● Retrospective cross-sectional study of fee-for-service Medicare beneficiaries for FY 2012. ● Main outcome was a comparison of rate and geographic variation for UC, ER and physician office visits.
Coster, et al (2017)	Why Do People Choose Emergency and Urgent Care Services? A rapid review Utilizing a Systemic Literature Search and Narrative Synthesis	<ul style="list-style-type: none"> ● Aim: bring together published research from UCCs and ERs to identify drivers of why patients choose ERs vs. UCCs. ● 38 UK studies were compiled for review. Application of results to US not ideal. ● 6 reasons were identified: <ul style="list-style-type: none"> ○ limited access to in primary care; ○ patient perceived urgency; ○ convenience; ○ family views, friends, or other health professionals; and ○ a belief that their condition required the resources and facilities offered by a particular healthcare provider

Appendix A (cont.)		
Author (date)	Title	Key findings
Guttman, et al (2003)	The Many Faces of Access: reasons for Medically Nonurgent emergency Department Visits	<ul style="list-style-type: none"> • Investigation of why people use an ER for visits considered medically non-urgent. • This study identified reasons for ER use from patients' perspective. • 408 survey respondents were asked to explain what brought them to the ER. • Findings indicate most patients had medical insurance and a regular place of care and most arrived by car or taxi. • Twelve main themes emerged under three main categories: conceptions of needs, appropriateness, and preference for the ER.
Hawkins, et al (2016)	Measuring patient-perceived quality of care in US hospitals using Twitter	<ul style="list-style-type: none"> • To assess the use of Twitter to measure patient-perceived quality of care in hospitals. • Compare patient tweets with established quality measures. • Tweets describing patient experiences in hospitals cover a wide range of topics and can be identified and automatically collected. • This data represents an untapped indicator of quality and may be valuable to patients, researchers, policy makers and hospital administrators.
Howard, et al (2007)	Patient Satisfaction with Care for Urgent Health Problems: A Survey of Family Practice Patients	<ul style="list-style-type: none"> • This study compared patients' satisfaction with care received for an urgent health problem by delivery site (e.g., ER, physicians' office, etc.) • Satisfaction was highest for patients receiving care from their own family physician or their physician's after-hours clinic. • These results will impact emerging primary care models that emphasize 24/7 access.

Appendix A (cont.)		
Author (date)	Title	Key findings
Jung, et al (2015)	Identifying key hospital service quality factors in online health communities	<ul style="list-style-type: none"> • The researchers proposed a novel approach to identifying and mining hospital service quality characteristics from online health communities. • To evaluate the proposed text mining techniques, the authors performed manual evaluations on the extraction and classification results.
Kilaru, et al (2016)	What do patients say about emergency departments online reviews? A qualitative study	<ul style="list-style-type: none"> • Research examined online reviews posted on Yelp about ERs. • Concluded that online reviews of ERs contain similar themes to traditional surveys. • Consumer rating websites give patients an opportunity to provide instant feedback on their experiences in the ER. • Consumer web sites are an emerging tool for quality assessment of ER care.
Lagu, et al (2017)	Website Characteristics and Physician Reviews on Commercial Physician-Rating Websites	<ul style="list-style-type: none"> • Nearly 60% of patients report that online reviews are important when choosing a physician. • Since traditional quality data is not reported at the physician level, patients must consult physician-rating websites to find such data. • The authors found that few sites allowed the user to effectively search for a physician since data is not sorted (e.g., clinical condition, sex of physician, hospital affiliation, languages spoken, or insurance accepted.) • The researchers concluded that "these results demonstrate that it is difficult for a prospective patient to find ... reviews that would accurately relay the experience of care with that physician."

Appendix A (cont.)		
Author (date)	Title	Key findings
McNeeley (2012)	Urgent care Centers: An Overview	<ul style="list-style-type: none"> • General overview of trends in the growth and the dynamic volatility in the urgent care center marketplace.
Merchant, et al (2016)	Learning by listening: Physicians say online reviews can improve health care	<ul style="list-style-type: none"> • Reviews posted to sites like Yelp or TripAdvisor are the modern day version of word-of-mouth testimonials, providing insight into millions of consumer experiences that are not only influential to other consumers, but can and should be influential to service providers.
Merritt (2000)	The influence of an urgent care center on the frequency of ED visits in an urban hospital setting	<ul style="list-style-type: none"> • Studied the effect of a visit to an UCC on ER use by patients with non-emergent complaints. • A study population of 1,629 patients with no previous visit to a UCC were identified and served as their own controls. • The ER and clinic usage 6 months before and 6 months after a UCC visit were examined. After the UCC visit for adults there was a 48% reduction in ER visits and 49% increase in clinic visits. • We conclude that UCC usage decreases non-emergent ER use without adverse effects of increased patient hospitalization.
Northington (2005)	Use of an emergency department by nonurgent patients	<ul style="list-style-type: none"> • The objectives of this study were do patients seeking nonurgent care at the ER have a primary care doctor and if so determine the reasons why they choose to use the ER. • A cross-sectional survey was administered to self-referred nonurgent patients for 6 weeks. • 563 approached, 314 were eligible and 279 agreed to participate. 56% had PCPs. For 66%, the ER was the only place they knew to go for their present problem, and 27% depended on the ER for all medical care.

Appendix A (cont.)		
Author (date)	Title	Key findings
Ranard, et al (2016)	Yelp reviews of hospital care can supplement and inform traditional surveys of the patient experience of care	<ul style="list-style-type: none"> ● Compared the content of Yelp reviews on hospitals to the national HCAHPS survey. ● Significantly, the Yelp topics that most strongly correlate with positive or negative reviews are <i>not measured</i> by HCAHPS. ● The large collection of patient and caregiver experiences found on Yelp can be analyzed, identifying for policy makers the quality measures that matter most to patients and caregivers. ● The data on Yelp can also provide actionable feedback for hospitals.
Schlesinger, et al. (2015)	Taking patients' narratives about clinicians from anecdote to science	<ul style="list-style-type: none"> ● Incorporating user-generated content into public reporting can highlight issues that may be missed in conventional surveys. Asking patients for their open-ended feedback can lead to higher participation in patient experience surveys by allowing patients to report on what matters most to them. ● Patient online reviews may have deeper potential: <ul style="list-style-type: none"> ○ posting patient's narratives might encourage providers to post responses. ○ public dialogues of how patients addressed their own unique problems might expand how others might become empowered. ○ an accessible, minable "socio-data- bank" of patient narratives will assist health policymakers in detecting systemic failures

Appendix A (cont.)		
Author (date)	Title	Key findings
Schull, et al (2007)	The effect of low-complexity patients on emergency department waiting times	<ul style="list-style-type: none"> • Hypothesis is patients going to ERs for minor conditions contribute to delays and crowding is still controversial. To test the study looked at the impact of low-complexity ER patients on the waiting times of other patients. • Looked at the administrative records on all ER visits to Ontario hospitals from April 2002 to March 2003. • Low-complexity ED patients are associated with a negligible increase in ED length of stay and time to first physician contact for other ED patients. Reducing the number of low-complexity ED patients is unlikely to reduce waiting times for other patients or lessen crowding.
Uscher-Pines, et al (2013)	Emergency department visits for non-urgent conditions: a systematic literature review	<ul style="list-style-type: none"> • Multiple factors influence an individual's decision to visit an ER for a non-urgent condition. • Evidence suggests that factors such as age, convenience, referral to the ER by a physician, and negative perceptions about alternatives all play a role in driving non-
Weinick, et al (2010)	Many Emergency Department Visits Could Be Managed at Urgent Care Centers and Retail Clinics	<ul style="list-style-type: none"> • Many non-emergent visits are cared for in ERs. • Urgent care centers and retail clinics have emerged as alternatives to the ER. • Study estimated between 13–27% of all ER visits are non-emergent. • Potential cost savings of \$4.4B annually. • The primary conditions that should be treated at UCCs are minor acute illnesses, strains, and fractures. • There is some evidence that patients can safely direct themselves to UCCs.
Xin, et al (2015)	Can Nonurgent Emergency Department Care Costs Be Reduced? Empirical Evidence from a U.S. Nationally Representative Sample.	<ul style="list-style-type: none"> • A well-functioning primary care has the capacity to provide effective care for patients avoids the non-urgent ER use and related costs. • These findings highlight the improvement in ambulatory care quality as the potential target area to effectively reduce non-urgent ER care costs

APPENDIX B
EXPLANATION OF LATENT DIRICHLET ALLOCATION (LDA) ANALYSIS USED
IN STUDY ONE

LDA was used to first generate ‘topic clouds’ of associated words, and then to assign relative weights to each word within the cloud. Let’s say I have the following topic with the most frequent words (the words appearing in the cloud) being:

river, bank, bed, water, wave

The weights attached with those words might be:

River: 0.10

Bank: 0.05

Bed: 0.05

Water: 0.10

However, that same topic has the word ‘estuary’ in it, but this word is much less frequent (and won’t be in a cloud). That being said, estuary has a weight 1.0 for this topic because this topic is focused on bodies of water and there is no real ambiguity to ‘estuary’ (i.e., estuary won’t belong to any other topic whereas ‘bed’ and ‘bank’ can refer to many other things). The probabilities are calculated $p(\text{topic}|\text{word})$: the probability of estuary would be 1.0 for the topic since it only belongs to one topic.

A review may have minimal words that appear in the cloud for the topic, but this does not mean the review does not contain any words from the topic. In most cases this is

an iterative process. Researchers normally generate several different topic sets. For example:

- Generate 25 topics, 50 topics, and 100 topics
- Manually review the topic clouds

The decision on how many topics to generate is based on a careful judgment. One wants to be able to see all ‘general’ topics of conversation without too much overlap between topics. For example, if I have 100 topics I may have 5 topics about ‘billing’, but if I have only 20 topics I may not have any about ‘billing’. However, with 50 topics there will be 1-2 about billing which is more ideal. 25 topics were chosen for this study. The 20 topics that ended up being used in further analysis are included in Table 2.

Depending on the nature of the data, the assumptions may be different. For a general topic, I might start in the range of 200 topics up to 2,000 topics, as there would be a wide range of topic content (restaurants, bars, concert venue, dog groomer, etc.). In a case where the content is a bit more focused (ERs & UCCs), use a much smaller number of topics (100 or less).

Using LDA, the raw data is used to generate the topic clouds. An example is shown below. The weight column is the conditional probability $p(\text{topic}|\text{term})$. The word count is the count of the number of times the word appeared in any review. The scaled weight is the conditional probability multiplied by the word frequency in the dataset

(weight * word count). The table below displays the top 20 of 249 words from one cloud with weights:

Top 20 words associated with a sample topic

id	word	category	weight
5628	ease	0	0.813455657
5640	comfortable	0	0.729431368
5693	comforting	0	0.615625
5843	nervous	0	0.602002503
5570	understood	0	0.569117647
5657	cared	0	0.541666667
5670	gentle	0	0.540682415
5744	answered	0	0.538832998
5586	appreciated	0	0.512653651
5539	feel	0	0.505165049
5529	smile	0	0.499189627
5638	genuinely	0	0.495155039
5789	warm	0	0.485920105
5573	confident	0	0.480357143
5870	genuine	0	0.480300188
5623	calm	0	0.476953908
5546	detail	0	0.450138504
5644	kindness	0	0.438080495
5550	sweet	0	0.428390901
5811	rushed	0	0.420557229

These produced the topic cloud below, which was labeled “Comfort and Overall Experience”:



APPENDIX C
EXPLANATION OF DIFFERENTIAL LANGUAGE ANALYSIS (DLA) USED IN
STUDY 1

Differential Language Analysis (DLA), was used to score each selected Yelp review for each topic. Scoring for one topic requires taking every word in a review, and applying the topic-related weight calculated during the previous Latent Dirichlet Allocation (LDA) step. (Recall, the topic-related weight of a word is associated with the conditional probability of it being related to a given topic.) These weights are then summed- words that appear multiple times are summed according to their frequency (i.e., as seen in Review 1, below, “receptionist” appears twice and is included in the score twice).

An example for a topic, appears below:

Review 1

The receptionist was rude. I did not like the receptionist.

$$\text{Null} + 0.21 + 0 + 0.54 + 0 + 0 + 0 + 0 + \text{null} + 0.21 = 0.96$$

Review 2

The staff was wonderful and welcoming.

$$\text{Null} + 0 + 0 + 0 + 0 + 0 = 0$$

Every review is scored for each of the 25 topics. The review is then assigned to the topic with the highest or maximum score- each review is assigned to one and only one topic. The score of the message indicates the level of fit with the assigned topic. This yields a dataset consisting of Review Text, Star Rating, Topic, and Topic Score.

After scoring, the score of each message is correlated with the review’s star rating (either 1 or 5) using Pearson correlation. The dataset was then divided into reviews about emergency rooms and those about urgent care facilities. Statistically significant positive or negative correlations reveal topics that are related to high and low star ratings, and these were identified for both ER and UCC reviews.

The correlation is between the message scores and the ‘is_1star’ variable (0 if 2,3,4,5; 1 if 1 star). Topic 1 is used as an example below:

Message	Topic Proportion	is_1star
The staff was nice	0.1	0
The staff was mean	0.9	1
Nice Staff	0.05	0

Where the topic proportion is the sum of all the words’ weights for the topic in each message. The correlation is between the topic proportion column and the “is_1star” column:

$$\frac{\sum_i^n(\text{topic_proportion}_i - \text{mean topic_proportion})(\text{is_1star}_i - \text{mean is_1star})}{\sqrt{\sum_i^n(\text{topic_proportion}_i - \text{mean topic_proportion})^2} \sqrt{\sum_i^n(\text{is_1star}_i - \text{mean is_1star})^2}}$$

Statistically significant positive or negative correlations reveal topics that are related to high and low star ratings, and these were identified for both ER and UCC reviews. After identifying the reviews most associated with star ratings, the topics most strongly associated with 1 and 5-star ratings across the two types of facility were compared.

APPENDIX D

FURTHER EXPLANATION OF STATISTICAL METHODS USED IN STUDY TWO

A sensitivity analysis for the robustness of the findings, by fitting different statistical models, was completed. The original study compared the 30-day medical costs between patients who visited an urgent care center and those who visited the emergency room, with adjustment of baseline covariates using a propensity score based matching approach. And to compare the results from this analysis with the results obtained from the main analysis in the manuscript, as a sensitivity analysis for the robustness of the findings.

Statistical analysis:

Step 1: Using propensity score matching method to balance the baseline covariates and to construct matched pairs.

In order to make the two study groups comparable, patients who visited an urgent care center were matched to patients visiting an emergency room using a propensity score based matching approach to balance the baseline covariates. Specifically, the baseline covariates included the primary diagnosis, gender, comorbidity score, estimated household income, and patient age. After matching, the balance of covariates was evaluated using t-test and chi-squared test.

Step 2: Analysis of the 30-day cost outcome using the matched pairs.

A comparison of pre- and post-period spending differences between the two groups was performed using the difference-in-differences analysis. Specifically, paired t-test was used to test the difference of 30-day pre- and post-period cost difference between the two groups (i.e., urgent care visits vs. emergency room visits). The difference was quantified, and the relative ratio of the change in pre- and post-period 30-day costs, comparing the emergency room visit with urgent care.

The data consists of 6,705 patients, including 3,055 patients with initial visits in urgent care facilities and 3,650 patients in the emergency room. After matching, 2,170 pairs of patients (4,340 patients in total) who visited urgent care facilities and the emergency room. The following results are obtained from these 4,340 patients, whose covariates are balanced between two groups.

The mean pre- and post-period cost difference with 30-day was \$1,742 (SD: \$4,760) for patients who visited the emergency room, and \$227 (SD: \$2,727) for patients who visited urgent care centers. The pre- and post-period cost difference with 30-day cost for patients who visited the emergency room was significantly higher than patients who visited urgent care facilities, with an increase of \$1,515 (SE: \$118; 95% CI: \$1,285 - \$1,747; $p < 0.0001$). The estimated relative ratio of the emergency room visits compared to urgent care in pre- to post-period cost difference with 30-day was 2.04 (SE: 0.27; 95% CI: 1.52 – 2.56).

These quantitative results are comparable to the main analysis findings, with the 30-day cost difference being \$1,515 (SE: \$118) in the propensity score matching method,

vs \$1,323 in the main analysis; and 30-day cost ratio being 2.04 (95% CI: 1.52 – 2.56) in the propensity score matching method, vs 1.68 (95% CI: 1.32 – 2.14).