WOMEN VETERANS' ACCESS TO HEALTHCARE: INCORPORATING ACCEPTABILITY INTO ACCESSIBILITY USING PATIENT REVIEWS IN GIS

by

DORRIS ALEANA SCOTT

(Under the Direction of Lan Mu)

ABSTRACT

People are increasingly relying on health information on the internet for health decision-making. One example of this is looking at reviews of providers or clinics before deciding whether to go to a provider. Compared to traditional metrics such as hospital surveys, a few advantages of using this non-traditional information is that it is user-generated, readily available, and stays instantaneously up to date. Also, some might view this data to be more trustworthy than government-produced data due to data integrity issues with government-produced data. This has especially been the case for the Veteran's Health Administration (VHA) in which it was revealed that there were some controversies with the production of its quality metrics on VA health facilities. The purpose of this research is to explore how patient reviews can be used in GIS applications of public health when it comes to women veteran's accessibility in terms of validation, integration, and application of traditional and non-traditional data sources.

In terms of validation, results show that there is some correlation between non-traditional data and traditional hospital quality metrics and that non-traditional data sources tends to have higher ratings per health facilities compared to traditional data sources. When non-traditional data is integrated in spatial accessibility modeling of

women veterans to gender-specific care, results show that accessibility scores increase for areas farther away from the city center. Finally, using the Public Participation GIS and OPT-In frameworks, this data can be applied in GIS web and mobile apps in such a way which can increase women veterans' accessibility to information about health and educational resources. This dissertation contributes to both Geographic Information Science and Technology (GIS&T) and public health for it seeks to give a better understanding how non-traditional data sources can be applied in various GIS applications for health accessibility not only from a spatial standpoint, but also from an information standpoint in terms of better understanding women veteran's accessibility to health care.

INDEX WORDS: women veterans, GIS, public health, spatial accessibility, health communication

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DEDICATION

This work is dedicated to all the women who have served our country along with the women who are currently serving our country.

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

Many people consult the internet before making various decisions, from whether it is to buy a product or go to a restaurant. This is also the case when it comes to health decision making; there is an increasing trend of people looking up the quality of their health provider or clinic before deciding whether to go to that provider or clinic. Examples include patient review portals such as Healthgrades, social media platforms such as Facebook, or internet reviews from major search engines such as Google. The advantages of using the internet to find health related information is easy accessibility, vastness of information, the ability to get input from patients, and providing a way to deal with accessibility issues to the medical facility (Yom-Tov, 2016). Issues dealing with accessibility to health facilities is related to distance, cost, and time (Yom-Tov, 2016).

This dissertation is organized into three manuscripts in which each manuscript explores different aspects of integrating patient reviews in Geographic Information Systems (GIS). The first manuscript is focused on validation and compares internet reviews of Veterans Affairs (VA) health facilities to VA produced data on quality metrics for the same facilities while the second manuscript looks at how internet reviews can be integrated into spatial accessibility modeling. Finally, the third manuscript explores how patient reviews can be applied in a way which would help women veterans better understand the quality of gender-specific providers in their area.

Using the Internet to find Health Information

In 2012, 72 percent of those who use the internet looked online for health information and 42 percent of people looked at social media for health-related reviews (Ranard et al., 2016). While many people are familiar with non-traditional data such as social media data and internet review outlets, they might not be familiar with traditional data on quality metrics such as government produced hospital metrics; only six percent knew about the Hospital Compare website, which is an online database of hospital performance and patient satisfaction data (Ranard et al., 2016; Henry J. Kaiser Family Foundation, 2008). Ranard et al. (2016) state that the information found in online consumer reviews can be used to improve rating systems and increase usage of such systems.

However, the advantages for using the internet is also the disadvantages of doing so; while there is a large amount of information, the quality of such information cannot be verified and authoritative sources of quality metrics such as government produced data is not as well-known compared to social media and internet review platforms. In Chapter 2, government data and internet reviews will be compared in order to determine if there is any correlation between the two along with the geographic dispersion of the reviews by health network and health facility.

Spatial Models to Measure Accessibility

Chapter 3 will look at the various spatial models for accessibility and introduce a modified version of a spatial model to incorporate patient reviews. While there are many spatial models to measure accessibility based on such factors as average travel impedance, distance to a provider, and the attraction between an individual and health facility (Henry & McDonald,

2013), there are few studies that incorporates acceptability into spatial accessibility modeling. The lack of integrating patient satisfaction is one limitation of spatial accessibility studies. According to Thomas and Penchansky (1984), accessibility is not only location-based, but incorporates other dimensions which are accommodation, affordability, and acceptability. For example, if a patient is not satisfied with the service they received, they could be less willing to utilize this facility in the future regardless of distance.

While a multitude of studies on spatial accessibility modeling exists, there are very few known studies which both focus on the VA and on incorporating patient satisfaction metrics in spatial accessibility modeling. Becker's (2016) study incorporated satisfaction metrics in spatial accessibility modeling of VA facilities because distance decay is not as applicable to the veteran population. Becker references the Veterans of Foreign Wars (VFW) (2015) in stating that veterans prefer the VA to private care because of the perception that it treats service-related conditions better than the private industry and because VA health care is a veteran benefit which should be used. Becker added weights to the enhanced two-step floating catchment area (ES2FCA) method to a Veteran's Integrated Service Network (VISN) based on wait time and primary care satisfaction. Higher patient satisfaction and lower wait times increased accessibility scores while lower patient satisfaction and higher wait times decreased accessibility. Becker also created a composite which combined the wait-time and patient satisfaction metrics and found that accessibility scores decreased.

Becker's study is groundbreaking for it specifically focuses on applying spatial accessibility modeling to VA health facilities, but one limitation of his study is that he did not break up the veteran population by demographic groups, particularly by gender. It is well known that female veterans have a different patient experience than male veterans at VA facilities and

only makes up a small portion of VA patients. In addition, only half of women veterans utilize the VA and those who do utilize the VA experience barriers in accessing the care they need, such as receiving gender-specific care. Because of this, it is imperative to better understand women veteran's access to health care resources.

Women Veterans and Accessibility to Healthcare

One pressing issue in health care for veterans is providing high quality care to women veterans. Women are joining the military in increasing numbers and consequently, the women veteran population is increasing every year. While the number of male veterans is decreasing, the number of female veterans is increasing (Murphy & Hans, 2014). By 2043, the number of women veterans will make up 16.3% of the veteran population (Department of Veterans Affairs, 2017). Recognizing the need to increase accessibility of women veterans to health care, in 2007, the Veteran's Health Administration (VHA) created the Women Veterans Health Strategic Health Care Group (WVHSHG) in order to increase accessibility of women veterans to primary care to women's health providers and to produce data about women veterans for policy and planning purposes (Department of Veterans Affairs, 2017).

Despite this, women still experience barriers in accessing care in the VHA, especially in accessing gender-specific care. Only a third of VA Medical Centers (VAMC) have a gynecologist on staff (Murphy & Hans, 2014). Given that women veterans underutilize the VA and have had issues in accessing gender-specific care, it is important to understand spatial accessibility of women veterans to both VA and non-VA gender-specific care. Access to gender-specific care is not the only barrier that women veterans face. They also experience barriers to accessing information about health and educational resources. Murphy and Hans

(2014) mention that while there are a number of programs that exist, such programs are scattered which makes it difficult for women veterans to access. Chapter 4 will explore how GIS web and mobile applications can be used to increase women veterans' accessibility to health and educational resources.

Research Objectives and Questions

The overarching question that this dissertation attempts to answer is **how online patient reviews can be used for GIS applications in public health when it comes to better understanding the accessibility of women veterans to health care**? To give a more profound exploration of this overarching question, three objectives to this research are constructed (Figure 1.1):

1. **Validation** of online patient reviews by comparing them to government metrics of VA health facilities. The following questions are addressed in order to achieve this objective:
    a. What kind of correlation exists between various VA produced quality metrics on VA health facilities to star ratings of Facebook and Google Reviews on the same facilities?
    b. How does the VA produced data, Facebook data, and Google data varies geographically based on the Veterans Integrated Service Network (VISN) and by state?
2. **Integration** of online patient reviews in spatial accessibility modeling. To achieve this objective, these specific questions were asked:
    a. What is the spatial accessibility of women veterans to women's health providers based on the three-step floating catchment area (3SFCA) method?

   b. What is the spatial accessibility of women veterans to women's health providers based on a modified version of the 3SFCA which integrates patient reviews?
   c. How did accessibility scores increase or decrease based on integrating patient reviews in accessibility modeling?

3. **Application** of patient reviews in GIS web applications that can be useful to women veterans and women veteran stakeholders. Essential questions are:
   a. What are the experiences of women veterans when it comes to obtaining information about gender-specific services and what kind of health and educational resources do they want to know about?
   b. How do women veterans perceive internet review data and VA produced data in terms of trustworthiness?
   c. How can elements of Public Participation GIS and the OPT-In framework for the communication of public health data be integrated into creating a GIS web application tailored for women veterans?

Significance of the Study

There is an increasing amount of studies on internet reviews in health decision-making and how they compare to authoritative sources, but there are not many studies on how such reviews vary spatially. In addition, these studies are focused on one component of the U.S. healthcare system which are publicly and privately-owned hospitals and clinics, but very few focused on the VHA, which is the largest integrated healthcare network in the US. Currently, there are no known studies which focuses on comparing traditional and non-traditional data sources when it comes to VA health facilities. This research gives an opportunity to highlight

user generated data by veterans on the quality of their healthcare, and how this data compares to traditional quality metrics such as data produced by the VA.

Even more so, there are few studies in the discipline of geography that focuses on the accessibility of veterans to healthcare, especially women veterans. Women veterans underutilize the VHA which results in a selection bias in terms of who accesses VHA services. The women who have access to the VHA is not necessarily reflective of the whole population of women veterans. A geographic perspective on this issue will be insightful for women veterans' health issues for it allows an exploration of accessibility in various contexts. Accessibility is explored from a spatial perspective in terms of accessibility modeling, but also explored in terms of how GIS can be applied in order to increase the accessibility of information about health and educational resources for women veterans. By exploring accessibility from these perspectives, we can better identify barriers for women veterans and implement initiatives that increase accessibility to both health care and information about such resources.

Finally, this study does not limit itself to merely disseminating the results of this research to purely an academic audience. It is important to disseminate the results of this research to a wider population, especially, women veterans and women veteran stakeholders. The results of this research should culminate into something that women veterans and women veteran stakeholders themselves find useful and beneficial in terms of accessing health and educational resources. Through designing and distributing off-the-shelf, free, and customized tools, it allows for the results of this research to be easily disseminated to various populations which can raise awareness of women veteran's issues and be the impetus to push for policy, programs, and technological innovations to increase women veterans' access to health and educational resources.

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Figures

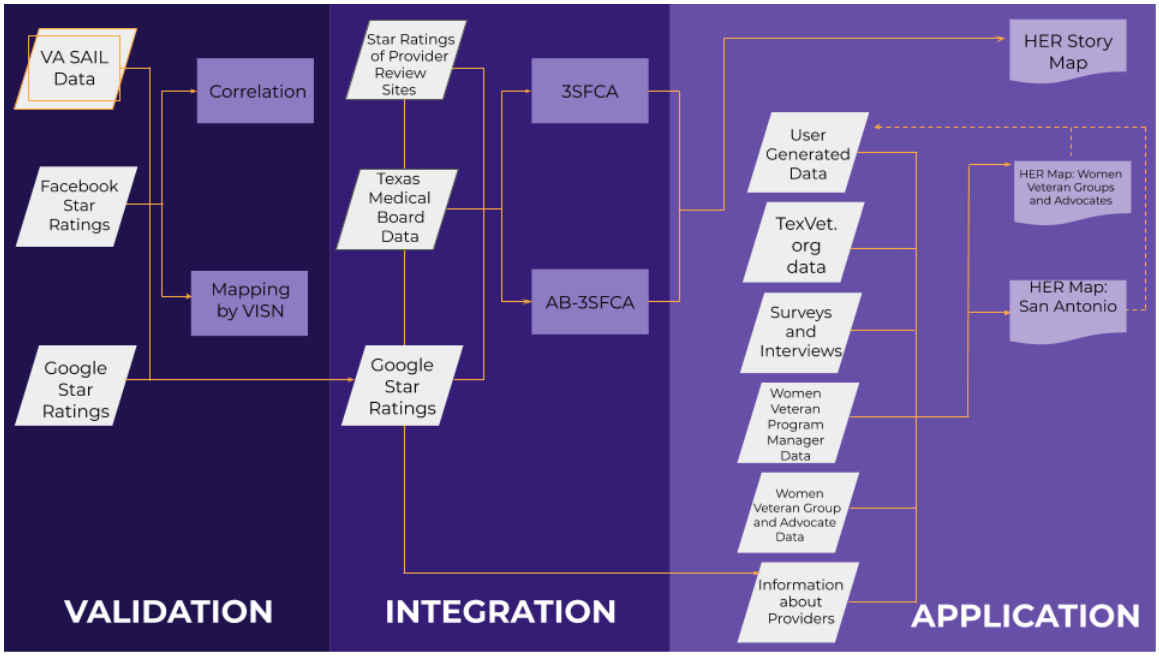

Figure 1.1: Flowchart on structure of research.

CHAPTER 2

USING INTERNET AND SOCIAL MEDIA REVIEWS TO COMPLEMENT TRADITIONAL SURVEYS TO BETTER UNDERSTANDING THE PERFORMANCE OF VETERAN'S AFFAIRS HEALTH FACILITIES[1]

[1] Scott, D. and Mu, L. To be submitted to *Health Affairs*

Abstract

The Veterans Health Administration (VHA) has come under criticism due to the mishandling of medical facility metrics on quality of care. Such a controversy can result in patients having less confidence in U.S. Department of Veteran Affairs (VA) produced metrics. We determined if there is a correlation between VA data on the quality and performance of VA health facilities with Google and Facebook star ratings. In addition, we gauged how star ratings vary by geographic region. Results show that both data sources have some correlation with various measures related to fulfilling an appointment in a timely manner. Star ratings were higher with both Google and Facebook star ratings by health facility and by Veterans Integrated Service Network (VISN). The significance of this study in GIScience is that it contributes to better understanding crowdsourced data produced by veterans in terms of their perception of health care, how it compares to traditional quality metrics, and how it varies geographically. By using Google and Facebook star ratings in conjunction with VA hospital metrics, patients can be more informed on the quality of VA facilities and provides VHA administrators and policymakers more instantaneous feedback on the quality of VA health facilities in terms of implementing initiatives and introducing policy that is more sensitive to patients' needs.

Introduction

There are an increasing number of people who are using the internet to search for health information. Reasons in which people seek health information varies from information from traditional information sources being confusing and contradictory to a mistrust of traditional sources such as patient surveys produced by hospitals or government agencies (Richardson, 2005). Also, there is a lack of awareness that such government-produced data exists publicly; only 6% of the general population knew about the Hospital Compare site in which one can look up metrics on patient quality and hospital performance (Ranard, et al., 2016; Fox & Duggan, 2013; Henry J Kaiser Family Foundation, 2008).

This lack of awareness of such information can also be due to a digital divide; access to the internet can depend on gender, age, and socio-economic strata. Most studies on the digital divide indicate that lower utilization of the internet occurs among older populations, populations from lower socio-economic backgrounds, and to some extent, women and minorities (Van Dijk, 2009; Serrano, Muñoz & Brusca, 2018). Low utilization can be due to various factors which can range from personal computer ownership to possessing internet skills such as web page navigation and doing basic internet searches (Ybarra & Suman, 2006; Lin et al., 2015).

This research will focus on comparing Veteran Affairs (VA) medical facility internet reviews to government data that has been produced by the Veteran's Health Administration (VHA). In addition, this research will focus on exploring the geographic variation of these quality metrics on different levels. Issues with the use and creation of government data has negatively impacted the VHA. Due to controversies regarding excessive wait-times experienced at VA health facilities and the revelation that wait-time data was fabricated has resulted in a sense of mistrust of the VHA. Because of this, it is important to gauge how newer and non-

traditional data sources such as internet and social media reviews can be used to better understand patient experience and hospital performance.

Background

Overview of the Veterans Health Administration

The VHA is one of the three government-run healthcare systems and is the largest integrated network in the US (U.S. Department of Veterans Affairs, 2018a). The VHA consists of 1,234 health care facilities, including 172 VA Medical Centers, and 1,062 outpatient sites of care (U.S. Department of Veterans Affairs, 2018b). There are also 53,000 independent health care practitioners that are affiliated with the VHA (U.S. Department of Veterans Affairs, 2018f). The VHA serves more than 9 million veterans which is around 46% of the total veteran population of 18,929,219 (U.S. Department of Veterans Affairs, 2018b; U.S. Census Bureau, 2017). The VHA is divided into 18 service areas called Veterans Integrated Service Networks (VISNs) (U.S. Department of Veterans Affairs, 2018b; Department of Veterans Affairs, 2018c). These networks are regional systems that have been formed to better facilitate local health needs and to increase patient access.

Recently, the VA has come under criticism regarding the time it takes patients to receive healthcare services. Dr. Katherine Mitchell and Dr. Sam Foote, who worked at the VA hospital in Phoenix, Arizona, revealed the issues that were going on in VA hospitals. They claimed of an unsafe environment in the emergency room and that the VA hospital was falsifying data (The Arizona Republic, 2014). In late 2012, the U.S. Department of Veterans Affairs ordered implementation of electronic wait-time tracking along with improving patient access (The Arizona Republic, 2014). A year later, the VA reported improvement on these two issues,

however Dr. Foote revealed that the VA was falsifying wait times and that veterans were dying while waiting for medical care (The Arizona Republic, 2014). In addition to the scandal regarding wait-times, the VA also came under criticism that a VA clinic in Fort Collins, Colorado was falsifying wait-times and had a backlog of disability claims which remained in the system for 125 days without a decision (Hicks, 2015). Since the VA controversy centered around falsification of data, this project aims to help patients better understand how the VA health facilities and VISNs are performing based on combining traditional and non-traditional data sources.

Comparing Internet Reviews to Government Produced Metrics of Health Facilities

Previous studies (Ranard et al., 2016; Bardarch et al., 2013; Verhoef, Van de Belt, & Schoonhoven, 2014; Hefele, Li, Campbell, Barooah & Wang, 2018; Glover, Choy, Pandharipande & Gazelle, 2015; Greaves et al., 2012) have compared online ratings to government measures of evaluating hospital performance and satisfaction, but there are no known studies which does this within the context of the VHA. Results have been mixed when it comes to finding correlation to internet review ratings and government quality metric data (Hefele et al., 2018). While Ranard et al. (2016) found that there is a positive correlation between Yelp ratings with high ratings and Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores, Hefele et al.'s (2018) study on comparing Facebook ratings to nursing home performance measures found that Facebook ratings of nursing homes were not correlated to traditional measures.

Traditional reporting of hospital performance and satisfaction can be difficult to decipher due to the complexity of the data and accessibility (Glover et al., 2015). Star ratings are an easy metric for patients to understand the quality of their healthcare provider (Glover et al., 2015;

Luca, 2011). In addition, star ratings on internet and social media platforms allows patients to give feedback right after their experience which is immediately reflected in the overall star rating as opposed to traditional surveys in which it takes longer for the patients to receive information about quality of medical facilities (Verhoef et al., 2014).

Study Objectives

One purpose of this study is to compare VA measures of patient satisfaction and performance with star ratings on Facebook and Google Reviews. Traditional reporting of hospital performance and satisfaction can be difficult to decipher due to the complexity of the data and accessibility (Glover et al., 2015). Star ratings are easy metrics for patients to understand the quality of their healthcare provider (Glover et al., 2015; Luca, 2011). In addition, star ratings on internet and social media platforms allows patients to give feedback right after their experience which is immediately reflected in the overall star rating as opposed to traditional surveys in which it takes longer for the patients to receive information about quality of medical facilities (Verhoef et al., 2014).

This study will be using the Strategic Analytics for Improvement and Learning (SAIL) data set that is produced by the VA and is released quarterly. The SAIL dataset assesses 25 quality measures on all VA Medical Centers and Healthcare systems such as patient satisfaction, average wait times, and call abandonment (U.S. Department of Veterans Affairs, 2019). In addition, SAIL data includes yearly hospital star ratings.

No other study has compared user generated patient reviews and government metrics of hospital performance for VA hospitals. Given that the size of the VHA and that the VHA has a social media presence for most of their medical facilities, it is important to address this gap.

Also, given one of the scandals that involved the VA had to do with falsifying data (Hicks 2015; The Arizona Republic, 2014), comparing data online patient reviews can give multi-layered insights on patient experience.

In addition, this objective is addressing the gap of studies on comparing reviews made on Google to traditional hospital performance measures. Google reviews and Facebook reviews are of interest for this study due to the popularity of such platforms. The VA has both a Facebook and Twitter page for their VA health facilities, but the Facebook page has more options for user feedback such as the ability of giving facility a star rating along with written feedback. Another reason these platforms were chosen was because they had a high amount of patient reviews on VA facilities on these platforms compared to others like Yelp, which had very few reviews.

Given the veteran population is older, there might be lower rates of participation on social media platforms. The median age of veterans is 64 compared to non-veterans which is 44 and the greatest proportion of veterans (29.4%) are between 65 and 74 years old (National Center for Veterans Analysis and Statistics [NCVAS], 2018). According to the Pew Research Center (Fox & Duggan, 2013), 64% of Americans between the age of 50 to 64 use social media while this rate drops to 37% for Americans over 65 years old. 44% of Americans have Gmail and 36% of Americans between 45-64 years old uses Gmail (Armstrong, 2017). In order to give a Google review, one must have a Google account which one automatically signs up for when they have a Gmail account. The VA has no administrative control over Google reviews for they are purely user generated. One can create a review by searching for the location on Google Maps and clicking on a prompt to write a review (Google Maps Help, n.d).

Another objective of this study is to compare VA measures of patient satisfaction and performance with patient star ratings in Facebook and Google reviews by VISN and state. Given

the VA created the VISNs with the purpose of providing region specific healthcare, aggregating the data by VISN will allow a better understanding of the perceived quality and satisfaction of each network along with seeing how such metrics varies geographically. No other study has compared patient satisfaction and hospital performance for VA hospitals and the geographic variation of such metrics. Given that the size of the VHA and that the VHA has a social media presence for most of their medical facilities, it is important to address this gap. Most of the known studies comparing traditional and non-traditional data sources merely touch geography by directional indicators such as "South" and "Southeast" which can be vague. Geography is a social determinant of health; hospital performance and patient satisfaction can vary by geographic location. By breaking down hospital quality and satisfaction by state, we can better understand the variations within the VISNs.

Methods

Two years of SAIL data was collected from 2016 quarter one, to 2018, quarter four. In addition, End of Year hospital star ratings provided by the VA based on the SAIL data were collected from 2016 to 2018 (U.S. Department of Veterans Affairs, 2018d).

The SAIL star ratings are based on comparing performance to other VA medical centers along with improvement in performance from last year (U.S. Department of Veterans Affairs, 2018e). Star ratings were collected from Google and the Facebook pages of VA medical facilities and Healthcare systems. Since some of the Facebook pages were for VA healthcare systems which consists of several health facilities, star ratings were only assigned to one location in the VA healthcare system. Weighted averages of the VA health facilities were calculated to take in

consideration the number of ratings per VA health facility in each VISN as shown in Equation 2.1:

$$WA = \frac{\sum(r*n)}{\sum n} \text{ (Eq 2.1)}$$

- WA refers to the weighted average of the VA health facilities based on the number of ratings in each VISN.
- r refers to the star rating per VA health facility.
- n refers to the number of reviews per VA facility.

The SAIL, Google and Facebook star ratings were aggregated by VISN and general descriptive statistics such as the mean was calculated on this data. Maps of star ratings by VISN and health facility were created to see how patient satisfaction and performance varied by VISN and each individual facility. Following Ranard et al.'s (2016) and Gaudet et al.'s (2018) studies, VA health facilities and healthcare systems with at least three reviews were only considered and Spearman's ordered rank correlation coefficients were calculated to determine if there is any correlation between end of the year SAIL star ratings and the star ratings on both Facebook and Google. Spearman's order rank correlation was chosen because the star ratings data are ranked, and the data is skewed. Given the VA scandals revolved around wait times in terms of making and fulfilling appointments, Spearman's ordered rank correlation was also calculated between related dimensions in the SAIL data with the Facebook and Google star ratings.

Results

A total of 40,093 reviews were collected from the Facebook pages. There are 144 Facebook pages for the 172 VA Medical Centers and Healthcare Systems and 109 pages have star ratings with at least three ratings, which makes up 75% of the Facebook pages. The reason

that there are less Facebook pages than actual facilities because while the VA does have Facebook pages for all of its medical centers and healthcare systems, multiple health facilities are part of healthcare systems. A healthcare system is made up of various medical centers and clinics that work together to offer services to veterans (U.S Department of Veterans Affairs, 2018b). These facilities work together to share services between medical facilities to increase access to advanced medical procedures to veterans (U.S Department of Veterans Affairs, 2018b). Therefore, multiple clinics and medical centers grouped under a healthcare system are represented by that healthcare system's Facebook page. The average number of reviews across all facilities with a star rating on Facebook is around 368 and the average rating for all facilities is 3.9. There were at least 136 VA health facilities that had at least Google Reviews. There was a total of 12,572 reviews for VA medical facilities. The average number of Google reviews per facility was 92.4 and the average star rating for all facilities was 3.8.

Correlation between Online Reviews and the SAIL Data

Both the Facebook and Google data were proved to have a statistically significant correlation with the SAIL Hospital Star Rating, the overall rating of the hospital, and completing primary care appointments within 30 days of making the appointment. (See Table 2.1). Both data sources did not show a statistically significant correlation with completing specialty care appointments within 30 days, but the Google star ratings had statistical significance with completing mental health appointments. The Facebook and Google star ratings were not statistically significant when comparing these star ratings to call abandonment and call center speed when responding to calls. In short, there were significant correlations with both the Google and Facebook star ratings when it came to the quality of the hospital and how the hospital improved in comparison to others based on the SAIL measures, but not so much in

terms of the process of making an appointment and completing appointments in a timely manner with the exception of primary care appointments.

Comparison of Star Ratings by VISN

The average star ratings for the Facebook and Google star ratings were higher than the SAIL data (See Figure 2.2). The average ratings for the SAIL data, Google star ratings and Facebook star ratings were 3.0, 3.8, and 3.9 respectively. The Google star ratings and the SAIL star ratings show two of the same VISNs with the highest star ratings which are VISNs 23 and 1. Based on the Facebook data, the VISNs with the highest star ratings are VISNs 21, 12, and 2. Both the Facebook and Google star ratings have VISN 12 and 21 as having the highest ratings, however in the SAIL data, VISN 21 had the lowest rating which indicates lower performing health facilities.

Another interesting trend to note is the location of the higher and lower reviews. For the SAIL data, it appears that higher performing health facilities are in the northern and northeast areas of the country and the lower ratings are along the west. While more information is needed to fully understand these trends, it is worth nothing that the VISNs with some of the lower star ratings were the VISNs in which the previously mentioned data controversies occurred (VISNs 19 and 22, which had ratings of 2 and 2.9 respectively). The Facebook and Google review star ratings also showed lower ratings for VISN 19 and 22 as well. For both the Facebook and Google star data, higher rated health facilities tend to be in the north and northwest while there tends to be no concentration of low ratings in a specific location.

Comparison of Star Ratings by VA Medical Facility

It is also important to look at the star ratings by individual VA medical center and healthcare system to see how each facility is performing on an individual level (See Figure 2.2).

Doing so also serves as a point of comparison of which data source has star ratings in a geographic area. Out of all the three data sources, the SAIL data has the most star ratings for the VA medical centers and healthcare systems, followed by Google and Facebook. The reason why the SAIL data had the most ratings is because that the VA reports hospital performance for all VA medical centers and healthcare systems while Facebook and Google star ratings are user-generated. Even though the VA has Facebook pages for all its medical centers and healthcare systems, not all Facebook pages have the option for patients to give star ratings. Comparing the three maps, it appears that the Facebook and Google data have higher star ratings compared to the SAIL data and there is little variation between these two data sources. With the SAIL data, the states with the lowest rated medical facilities are Arizona, New Mexico, and Georgia.

Limitations

There are several limitations for this study. The data that was collected is only for VA Medical Centers and Healthcare systems. The VHA also consists of outpatient clinics, nursing homes, and domiciliaries and there is no publicly available data related to medical facility performance for these facilities. This study only gives a snapshot of certain VA facilities and not all VA facilities. Due to this, using measures of spatial association could not be justified to see if there was any correlation to high and low rated hospitals by location which limits the statistical measures used for this study to descriptive statistics.

Another limitation is that the VA healthcare systems consists of various VA medical centers and some of the SAIL ratings are for the healthcare systems themselves and not individually for each VA medical center. Therefore, the inevitable modifiable areal unit problem (MAUP) takes place and there is no way to tell whether the ratings are for a specific VA clinic

within the healthcare system. In addition, some of the SAIL measures were not consistent across VA medical centers or healthcare system. For example, some VA medical centers did not have an overall hospital satisfaction score. Also, many of the measures changed throughout the years for which the data is collected. Because of this, the numbers that could be used for comparison is limited. It is also worth noting that the overall hospital satisfaction measure was based on the percentage of respondents that rated a facility a 9 or 10 from the Shaping Healthcare Experiences of Patients (SHEP) survey and does not record the percentage of respondents that gave a facility a lower rating (U.S. Department of Veteran Affairs, 2018d).

There are also limitations with using the social media data as well. There were mixed results in finding a correlation between the Google and Facebook data and various hospital performance measures. This is consistent with the overall findings of similar studies to be mixed (Hefele et al., 2018). It is also important to note that there is a selection bias for who gives star ratings on Facebook and Google due to a higher proportion of younger demographics using such platforms. For example, 80% of adults in the U.S. within the 18-24, 25-29, and 30-49 age groups use Facebook (Smith & Anderson, 2018). On the other hand, only 55% of adults 50 and older uses the platform (Smith & Anderson, 2018). Since the average age of veterans is older compared to the primary users of these internet platforms, the star ratings given to the VA medical facilities and healthcare systems might not be representative of their experience.

Finally, it is important to recognize the assumptions and limitations of the star ratings itself. There could be an assumption that the meaning star rating on Facebook or Google is the same as the meaning of a SAIL star rating. A “star rating” is not ubiquitous across data platforms, and the SAIL star rating is based on the improvement of a VA health facility in comparison of other VA health facilities, while Google and Facebook star ratings are more

subjective in nature and is based on the specific experience of each person, and rating a hospital might be based on different experiences. However, looking at the correlations between these various star ratings can give us an insight of how people rate their experience at a hospital in accordance to the performance of the hospital itself.

Making this connection can be valuable for both VA patients and VA administration. For patients who might have skepticism of the VA hospital metrics, the social media metrics can validate the VA metrics in accordance to the star ratings given they correlate with some VA medical facility metrics. For VA administrators, seeing that there is some correlation between the social media ratings and their metrics gives an alternative and more instantaneous source in which they can see how VA patients view the quality of the VA medical facilities which can further validate their metrics of the hospitals.

Discussion

This study is the first of its kind in gauging if there is a correlation between VA health facility performance and satisfaction measures with social media and internet review star ratings. Given the VA scandals revolved around manipulation of data, looking at what VA patients self-reported can shed some light on how they perceive their quality of care compared to the traditional performance measures. To better serve the health needs of veterans in the future, it is important to better understand how they use social media and internet review portals in assessing their health care are VA health facilities. This study was also the first known study that used Google star ratings in comparing traditional measures of hospital performance. It is especially important to look at other alternatives to Facebook reviews because not all individuals have a Facebook account or give star ratings of Facebook pages.

This study also shows the strength of visualizing how hospital performance and patient satisfaction vary by location on various levels. It is important to note how hospital performance can vary individually in comparison to the overall performance by VISN. Given that geography is a major determinant of health, by identifying VISNs and hospitals with high and low performance on specific metrics, policy makers can take steps in implementing policy that can address these low performing metrics within a specific region. One example of this could be identifying a VISN that had low performance in fulfilling primary and specialty appointments within 30 days and creating initiatives to increasing funding for staffing and better technology in terms of making appointments. By considering the various spatial aggregation of various metrics and how they play out on various levels (i.e. VISN vs individual medical facility), policymakers can identify high and low performing hospitals within a specific VISN and work with VA administrators to understand what makes the high performing hospitals successful and implementing various measures to bring the low performing hospitals up to par with the higher performing facilities.

Conclusion

This study built off previous studies to investigate whether there are any correlations between ratings of medical facilities on the internet with traditional measures of patient satisfaction and hospital performance. Among the 18 VISNs, VISNs 1, 4 and 23 have the most consistent reviews among the three data sources while VISNs 21 and 22 had the least consistent reviews (See Figure 2.3). It is especially important to gauge patient satisfaction of veterans on internet platforms moving forward since younger generations have higher rates of use of the internet compared to older generations.

Online reviews can complement traditional measures and be both beneficial for patients and providers in improving VA medical facility performance and patient experience. Despite the limitations of internet reviews, it does provide a means in which patients are able to give instantaneous feedback which can be viewed by a broad audience as opposed to having to wait every quarter to receive updated information on hospital quality and performance. Even though these reviews are more subjective, there might be more transparency with these reviews for many patients leave written feedback which gives a context to why they gave a facility a certain star rating. On the other hand, the methods in which the VA produces quality metrics can be difficult to understand for some. Comparing these data sources also gives a multi-faceted understanding of how health facilities and VISNs are performing for the government reviews give a top-down perspective while the patient reviews gives a bottom-up perspective. Seeing similarities and deviations within the metrics can show how user generated information is in alignment or not alignment with the authoritative measures. This could prove beneficial to audiences who hold skepticism of either authoritative or user produced data in terms of finding these data sources to be trustworthy.

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Tables

Table 2.1 Correlation between VA health facility measures, Google star ratings, and Facebook star ratings using Spearman's Rho

SAIL Measure	Google Review Star Rating	Facebook Star Rating
Internet star ratings and overall rating of hospital	ρ = .3688058, p-value = .3.966e-05	ρ = .3984612, p-value = .6.092e-05
Correlation with SAIL star ratings	ρ = .3367699, p-value = .6.101e-05	ρ = .4323353, p-value = 2.672e-06
Completion of primary care appointments within 30 days of making appointment	ρ = .2575333, p-value = .004872	ρ = .4484952, p-value = 5.805e-06
Completion of specialty care appointments within 30 days of making appointment	ρ = .1184216, p-value = .2015	ρ = .3133126, p-value = .002106
Completion of mental health appointments within 30 days of making appointments	ρ = .02420367, p-value = .7947	ρ = .1848675, p-value = .07446
Call Abandonment	ρ = -.1038603, p-value = .263	ρ = .004178384, p-value = .9681
Call center speed in responding to calls (in seconds)	ρ = -.08315178, p-value = .3707	ρ = -.1855477, p-value = .07338

Figures

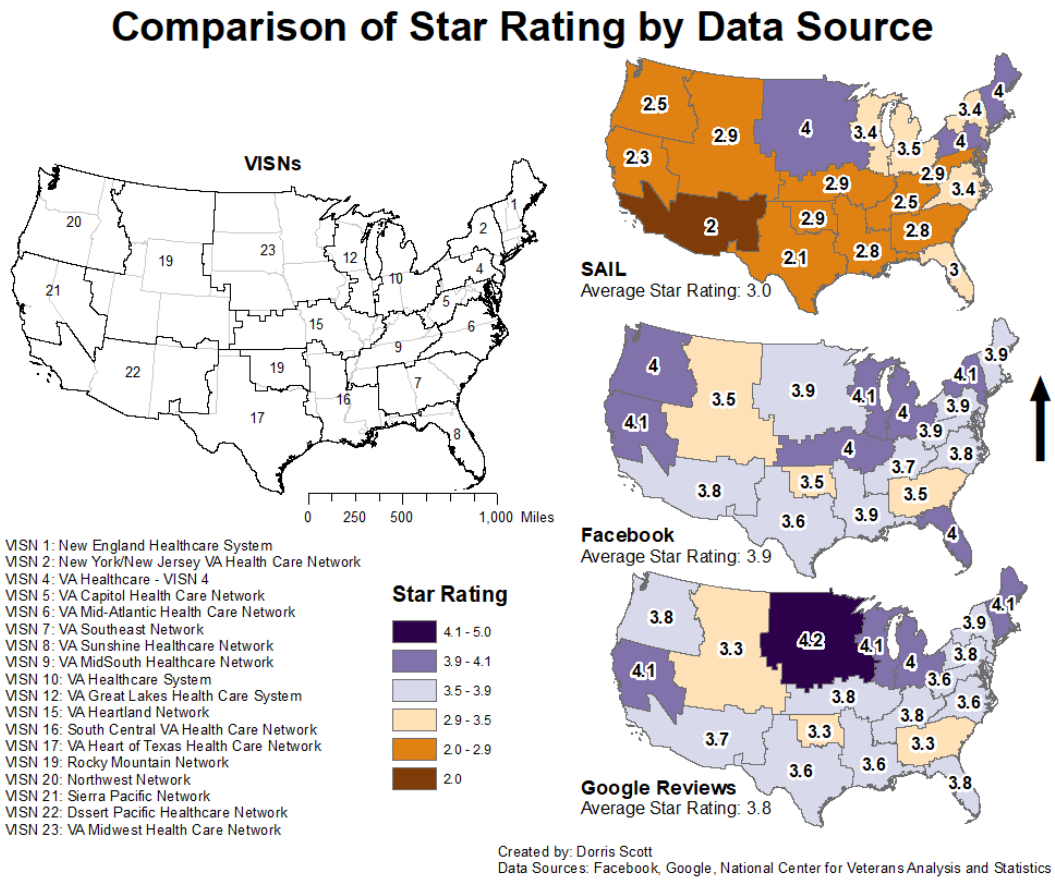

Figure 2.1: Comparison of Google, Facebook, and SAIL star ratings

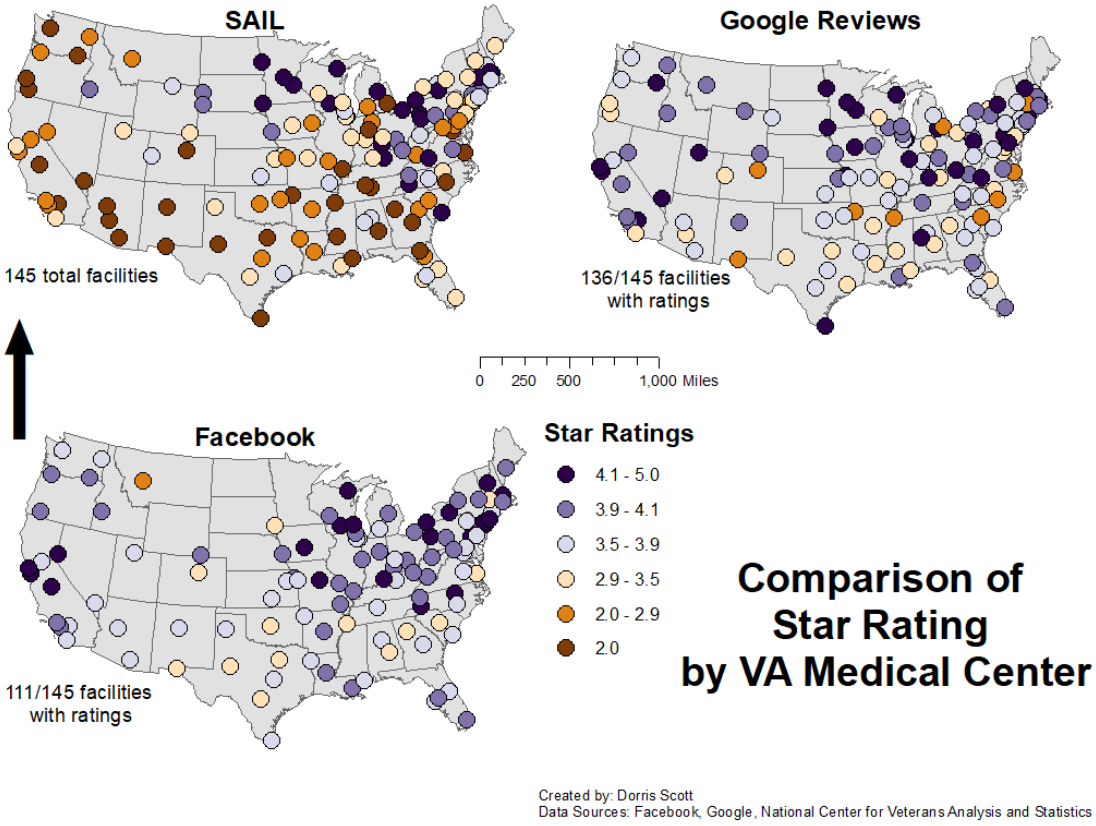

Figure 2.2: Google, Facebook, and SAIL star ratings by VA Medical Center

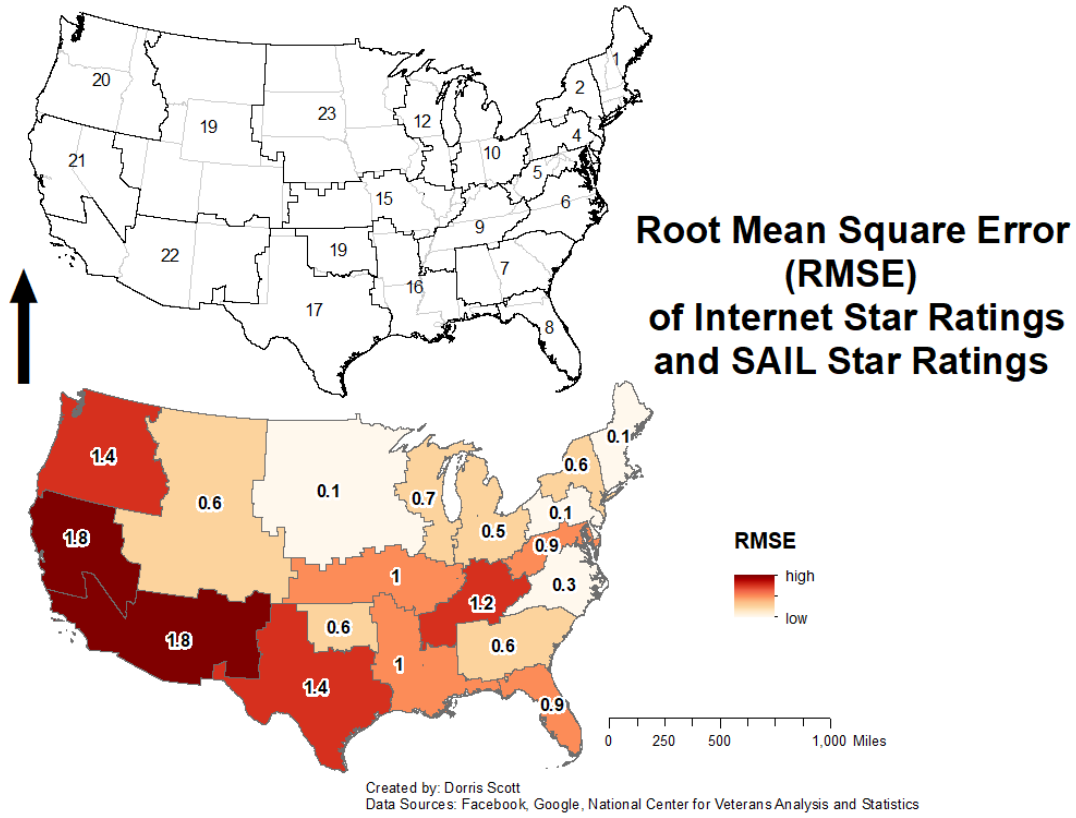

Figure 2.3: Root Mean Square Error of internet star ratings from SAIL data

CHAPTER 3

INCORPORATING PATIENT REVIEWS IN MEASURING SPATIAL ACCESSIBILITY OF WOMEN VETERANS TO GENDER SPECIFIC CARE IN SAN ANTONIO[2]

[2] Scott, D. and Mu, L. To be submitted to *Environment and Planning B: Urban Analytics and City Science*

Abstract

Given the increasing women veteran population, stakeholders such as policy makers, governmental entities, and veteran organizations have prioritized better understanding accessibility issues in providing gender-specific care to women veterans. One way in which we can better understand accessibility is through gravity-based spatial access models. The three-step floating catchment area (3SFCA) method is a commonly used gravity-based model that incorporates competition of other facilities in the area to determine spatial accessibility. However, such a method does not take in consideration other dimensions of access such as acceptability of providers. This study uses a modified version of the 3SFCA that incorporates online patient reviews to calculate accessibility of women veterans to gender-specific health providers in the City of San Antonio (COSA). Results indicate that the modified method, acceptability-based 3SFCA (AB-3SFCA) that incorporates patient reviews in the 3SFCA shows increased accessibility scores in in the north and southwest part of COSA compared to the accessibility scores of the crude 3SFCA that did not incorporate patient reviews.

Introduction

Despite the yearly increase in the women veteran population and the prioritization of women veteran health issues both on the local to national level, they still experience issues in accessing health care, specifically, gender-specific care. While there have been calls for research to better analyze the needs of women veterans (Murphy & Hans 2014), there are no known studies at assesses women veterans' spatial accessibility to health care. This study aims to fill this gap by gauging accessibility of women veterans to gender-specific care in San Antonio through a modified spatial accessibility model that incorporates patient reviews. Such information on accessibility is valuable, for it can be used by researchers, policy makers, program directors, and non-profits to identify gaps and needs for women veterans when it comes to providing specialized care and drive policy to improve women veterans' accessibility to gender-specific care.

A second purpose of this study is to incorporate online patient reviews in spatial accessibility modelling to the influence of such reviews on the accessibility to health care. According to Penshansky & Thomas (1981), there are five As in access to health care: availability, accessibility, accommodation, affordability, and acceptability. Internet reviews can be considered a form of acceptability for users can give an assessment of their healthcare provider both qualitatively through leaving a written comment and quantitatively through leaving a star rating. People are increasingly relying on the internet for their health decisions and many consider what they read on the internet as a reliable source of information. Some reasons that people use the internet to assist them in making health decisions is due to easy accessibility, vastness of information, and the ability to get input from patients. Also, if a user is too far from a medical facility for an actual visit, they can use the internet reviews to get pertinent information.

In 2012, 72 percent of the U.S. population who used the internet looked online for health information and 42 percent of the population looked at social-media for health-related reviews (Ranard et al., 2016; Fox & Duggan, 2013; PricewaterhouseCoopers Health Research Institute, 2012).

Background

Women Veterans and Access to Healthcare

Women veterans make up 8.3 percent of the overall veteran population of around 19 million (U.S. Census Bureau, 2018). The number of women joining the military is increasing; they make up approximately 20 percent of new recruits, 14.5 percent of those on active-duty, and 18 percent of the reserves (Murphy & Hans, 2014). According to Murphy and Hans (2014), in 2020, the number of women veterans will continue to increase to 11 percent while the number of male veterans will decline. By 2043, the number of women veterans will increase to 16.3 percent (U.S. Department of Veterans Affairs, 2017).

Once attaining veteran status, one is eligible for Veterans affairs (VA) benefits and healthcare. Despite being eligible for Veterans Health Affairs (VHA) benefits, only half of them utilizes the VHA (Mankowski and Everett, 2016; Carlson, Stromwall, and Leitz, 2013; Mattocks et al., 2012). As a result of this underutilization, women veterans make up a small proportion of patients in the Veterans Health Affairs (VHA) system which is 6.5% of all patients (Women's Health Services, Department of Veterans Affairs, 2014).

Despite the number of women veterans increasing throughout the years and the emphasis on providing better gender-specific care, they have had issues in accessing health care resources in the VHA system. One in five women have gone without care or had delayed care within the past

12 months. Not all VA medical centers have a gynecologist on-site and only 44% of the centers that have a primary care women's clinic offers gender specific exams (Murphy and Hans, 2014; Yano et al., 2010). Other reasons that women veterans do not utilize the VA has to do with fear of reprisal in terms of employment or maintaining military status and misconceptions about the VHA (Yano et al., 2011; Mulhall, 2009; Mankowski and Evertt, 2016).

Overview and Adoption of the Floating Catchment Area (FCA) Spatial Accessibility Methods

There are various spatial methods to measure accessibility of health facilities. Many of the spatial accessibility equations take in such factors such as patient to provider ratio, average travel impedance, and the attraction between an individual and a health facility in a specified area (Henry & McDonald, 2013). For example, the assumption of gravity-based accessibility models is that the closer the facilities are to the individual, the more interaction the individual will have with the facilities. On the other hand, the farther away the patient is from the facility, the less interaction the individual will have with the facilities.

Two Step Floating Catchment Area Method

The two-step floating catchment area method (2SFCA), developed by Luo and Wang (2003a, 2003b) which is based on an earlier prototype (Radke & Mu, 2000), is an improvement on the gravity- based models. It incorporates demand from each medical site through the calculation of patient per provider ratios and is more sensitive to distance given the use of catchment zones (Wan, Zou, & Sternberg, 2012). The 2SFCA method measures accessibility in two steps (Wang, 2006):

$$R_j = \sum_{j\in(d_{ij}\leq d_0)} \left(\frac{S_j}{\sum_{k\in(d_{ij}\leq d_0)} P_k} \right) \quad \text{(Eq 3.1)}$$

$$A_i^F = \sum_{j\in(d_{ij}\leq d_0)} R_j \quad \text{(Eq 3.2)}$$

In Equations 3.1 and 3.2,

- R_j is the physician-to-population ratio.
- i is each population location.
- j is each physician location.
- d_{ij} is the distance between the population location and the physician location.
- d_0 is the travel time catchment (i.e 30 minutes, 40 minutes, 50 minutes)
- S_j is the number of physicians at location j.
- k is a given census tract.
- P_k is a population of a given census tract that falls within the catchment area.
- A_i^F accessibility score of location i.

The first step is to compute a physician-to-population ratio R_j at each supply location j within a specific catchment area $j \in (d_{ij} \leq d_0)$ which could be based on a time or distance impediment (Henry & McDonald, 2013). The second step is to look for supply locations within a specific catchment area of each population of a given census tract that falls within the catchment of a population (P_k) and sum the physician-to-population ratios for each census tract (Henry & McDonald, 2013). This sum is the geographic accessibility score (A_i^F), also known as a spatial access index (SPAI) for location i. Some limitations of the 2SFCA is that it does not take in consideration distance-decay and it does not take in consideration the other dimensions of access (Dai & Wang, 2011; Polzin, Borges, & Coelho, 2014).

Enhanced Two Step Floating Catchment Area Method

Luo and Qi (2009) made an enhancement to the 2SFCA (E2SFCA) by adding spatial weights that take in consideration distance-decay:

$$R_j = \frac{S_j}{\sum_{k\in\{d_{kj}\in D_r)} P_k W_r} = \frac{S_j}{\sum_{k\in\{d_{kj}\in D_1)} P_k W_1 + \sum_{k\in\{d_{kj}\in D_2)} P_k W_3 + \sum_{k\in\{d_{kj}\in D_3)} P_k W_3} \quad \text{(Eq. 3.3)}$$

$$A_i^F = \sum_{j\in\{d_{ij}\in D_r\}} R_j W_r = \sum_{j\in\{d_{ij}\in D_1\}} R_j W_1 + \sum_{j\in\{d_{ij}\in D_2\}} R_j W_2 + \sum_{j\in\{d_{ij}\in D_3\}} R_j W_3$$

(Eq. 3.4)

In Equations 3.1 and 3.2,

- R_j is the physician-to-population ratio.
- i is each population location.
- j is each physician location.
- d_{ij} is the distance between the population location and the physician location.
- S_j is the number of physicians at location j.
- k is a given census tract.
- P_k is a population of a given census tract that falls within the catchment area.
- W_r is the Gaussian weight (i.e. r = 1,2,3 which represents the 30, 40, and 50 minute catchment area respectively) which captures the distance decay in accessing physician j.
- D_r is the travel time catchment (i.e. r = 1,2,3 which represents 30 minutes, 40 minutes, 50 minutes respectively).
- A_i^F accessibility score of location i.

The steps of the E2SFCA are essentially the same, but a weight based on the Gaussian function (W_r) is added in both steps (Luo & Qi, 2009). The weight that is used is based on the specific catchment of travel time that the locations fall in (Luo & Qi, 2009). The advantage of using Gaussian weights is that it differentiates access in different catchments, unlike the 2SFCA (Luo & Qi, 2009) however, this model can over-estimate demand for some of the service sites (Wan et al., 2012b). The E2SFCA assigns an equal demand weight for all of the service sites in a specific catchment regardless of the number which results in over-estimating the demand. In reality, demand might decrease for a given facility based on the competing facilities that are nearby.

Three Step Floating Catchment Area Method

The three-step floating catchment area method (3SFCA) (Wan et al., 2012b) addresses the issue of over-estimating demand and includes a competition weight that takes in consideration the presence of facilities within a time-based catchment. The first step involves breaking up a population location (*i*) based on a 60-minute driving zone and further dividing that zone in 10, 20, and 30-minute catchments. All service sites within a specific catchment will be assigned a Gaussian weight (i.e. W_1) based on the catchment on which it lies. A selection weight (G_{ij}) which takes in consideration the number of competing facilities is also added to the service site (*j*) and population location (*j*) pairs:

$$G_{ij} = \frac{T_{ij}}{\sum_{k\in\{\mathrm{dist}(i,k) < d_0\}} T_{ik}} \quad \text{(Eq. 3.3)}$$

In Equation 3.3,

- i is each population location.
- *j* is each physician location.
- *k* is any service site within the catchment area.
- G_{ij} is the selection weight which takes in consideration the number of competing physician locations at location i.
- T_{ij} and T_{ik} are assigned Gaussian weights for *j* and *k* that are calculated using Equation 3.6.
- d_0 is the travel time catchment (i.e 30 minutes, 40 minutes, 50 minutes).

The second step involves determining the 60-minute catchment area for j and following the same procedures as in step 1 to calculate a physician to population ratio (R_j) (Wan, et al, 2012b):

$$R_j = \frac{S_j}{\sum_{r=1,2,3,4} \sum_{k\in D_r} \sum G_{kj} P_k W_r} = \frac{S_j}{\sum_{k\in D_1} G_{kj} P_k W_1 + \sum_{k\in D_2} G_{kj} P_k W_2 + \sum_{k\in D_3} G_{kj} P_k W_3 + \sum_{k\in D_4} G_{kj} P_k W_4} \quad \text{(Eq. 3.4)}$$

In Equation 3.4,

- j is each physician location.
- k is each population location.
- S_j is the number of physicians at location j.
- D_r is the travel time catchment (i.e. r = 1,2,3 which represents 30 minutes, 40 minutes, 50 minutes respectively).
- G_{kj} is the selection weight between each population location (k) and physician location (j).
- P_k is a population of a given census tract that falls within the catchment area.
- W_r is the Gaussian weight of the specific travel time catchment (D_r).

Finally, the spatial access index (SPAI) is calculated by summing the products of the selection weights, Gaussian weights and physician to population ratios for each catchment area (Wan et al., 2012b).

$$A_i^F = \sum_{r=1,2,3,4} \sum_{j \in D_r} G_{ij} R_j W_r =$$

$$\sum_{j \in D_1} G_{ij} R_j W_1 + \sum_{j \in D_2} G_{ij} R_j W_2 + \sum_{j \in D_3} G_{ij} R_j W_3 + \sum_{j \in D_4} G_{ij} R_j W_4 \quad \text{(Eq. 3.5)}$$

In Equation 3.5:

- i is each population location.
- j is each physician location.
- A_i^F is the accessibility score (SPAI) of location i.
- D_r is the travel time catchment (i.e. r = 1,2,3,4 which represents 30 minutes, 40 minutes, 50 minutes, and 60 minutes respectively).
- G_{ij} is the selection weight which takes in consideration the number of competing physician locations at location i .

- R_j is the physician-to-population ratio at each physician location.
- W_r is the Gaussian weight (i.e. r = 1,2,3 which represents the 30, 40, and 50 minute catchment area respectively) which captures the distance decay in accessing physician j.

A modified version of the method was chosen for this study since it reflects a more realistic scenario in terms of the method taking in consideration other health facilities in the area which can influence accessibility.

Methods

The method that will be used to calculate spatial access is a modified version of the 3SFCA which incorporates a weighted average of patient review star ratings collected on health provider information websites and reviews generated on Google and health information websites. This weighted average will be incorporated in the second step of the 3SFCA after calculating the physician to population ratios. The weighted average will adjust the physician to population ratios based on the median of all the star ratings, which is 3.4. A rating lower than 3.4 stars will lower the physician to population ratio, while a rating 3.4 stars and above will raise the ratio. This is done with the assumption that lower star ratings indicate lower acceptability of a provider which has a negative effect on perceived accessibility, while higher star ratings indicate higher acceptability of a provider which has a positive effect. There will be no change to the physician to population ratio for physicians without any patient reviews. The lack of patient reviews could be due to various reasons such as being a new medical resident, or a physician having recently moved to the area. In light of the five As of the health care system, we name the method Acceptability-Based 3SFCA (AB-3SFCA).

The Gaussian function, which is represented by a bell-shaped curve, was chosen to calculate the distance impedance coefficient which is incorporated into the Gaussian weight:

$$W_{ij} = f(d_{ij}) = e^{-d_{ij}^2/\beta} \quad \text{(Eq 3.6)}$$

In Equation 3.6:

- i is each population location.
- j is each physician location.
- $-d_{ij}$ is the distance or time between population location i and physician location j.
- β b is the distance impediment coefficient.

The use of the Gaussian function best captures distance-decay compared to other measures such as the inverse power and exponential function measure due to the gradual drop of the curve at the beginning which continues to drop the farther it is from the origin (Wan et al., 2012a; Wan et al., 2012b, Wang, 2007).

A second modification that was done with the 3SFCA was removing the sub-zones which were used in previous studies. Most studies that use the 3SFCA divide the study area into sub-zones based on driving distance or driving time (Wan et al., 2012a; Wan et al., 2012b) which is used to calculate the Gaussian and selection weights. The use of such sub-zones can be arbitrary, especially in urban areas or smaller study areas in which small distances and time intervals can make a difference in choosing a provider. Instead, individual Gaussian weights were calculated for each facility using a distance impediment coefficient of 195 which was based off a 30-minute catchment using Equation 3.6. The impediment coefficient is a constant value and is calculated using the scenario that the Gaussian function is approaching zero with the maximum travel time in a particular study, which is 30 minutes in this case. Therefore, W_{ij} was set equal to .01 and $-d_{ij}$ was set equal to 30 in order to calculate the impedance coefficient. A 30-minute catchment

area was considered appropriate given the study area involves the area that is mostly within the City of San Antonio (COSA).

$$A_i^F = \sum G_{ij} B_j W_r \quad \text{(Eq 3.7)}$$

In Equation 3.7:

- i is each population location.
- j is each physician location.
- A_i^F is the accessibility score (SPAI) of location i.
- G_{ij} is the selection weight which takes in consideration the number of competing physician locations at location i .
- B_j is the physician-to-population ratio at each physician location adjusted by the weighted average of star ratings from five internet review platforms.
- W_r is the Gaussian weight which captures the distance decay based on each individual location in accessing physician j.

The spatial access ratio (SPAR), which is the ratio between a census tracts SPAI and the average SPAI of all the census tracts, was used for it is less sensitive to changes in distance impedance (Wan et al., 2012b):

$$SPAR = \frac{A_i^F}{\overline{x}(\sum A_{P_k}^F)} \quad \text{(Eq 3.8)}$$

In Equation 3.8:

- i is each population location.
- A_i^F is the accessibility score of location i.
- $\overline{x}\sum(A_{P_k}^F)$ is the average SPAI of all of the census tracts.

Study Area and Data

The study area of the analysis is the City of San Antonio (COSA) in which 145,047 veterans reside and 22,869 are women veterans (U.S. Census Bureau, 2018). This makes up 15.8% of the veteran population which is above the national average of 9.7% (NCVAS, 2017). The study area was limited to mostly the COSA city limits as opposed to the San Antonio-New Braunfels Metropolitan Statistical Area which comprises of Atascosa, Bandera, Bexar, Cornal, Guadalupe, Kendal, Medina, and Wilson counties (U.S. Census Bureau, 2013).

Using ArcMap, a convex hull generated from the points of the clinic locations was created around the COSA city limits to capture the spatial outline of the data and at the same time, account for areas that are not in the city limits but are in close vicinity, such as unincorporated areas within the city limits. The population sites used in the AB-3SFCA were census block groups that was joined with population estimates from the American Community Survey 2013-2017 five-year estimates. The service sites that are used in the study was information on physicians, advanced practice nurses, and physician assistants that were listed as having their primary or secondary specialty being related to gender-specific care. This information was obtained from the Texas Medical Board's open database of health providers that are licensed in the state. Providers whose primary practice address is in the study area was only considered. The roads data came from the Texas Department of Transportation open data portal. Star ratings were collected from Google and four provider information portals which are Healthgrades, Vitals, WebMD, and ZocDoc.

Results

There are a total number of 22,869 women veterans and a total of 339 women's health providers in the City of San Antonio. Since the convex hull filter was used, 326 providers were considered for the scope of this study (Figure 3.1 and Tables 3.1 & 3.2). Most of the women's health providers practices OB/GYN followed by gynecology, and maternal and fetal medicine. Most of the women's health providers were physicians, while physician assistants made up the lowest number of women's health providers.

The AB-3SFCA that incorporates patient reviews shows increased accessibility scores in areas further out from the city center at the north and southwest parts of COSA. (Figure 3.2, right). Accessibility scores decreased in the western part of the city. There is also a pattern with the location of providers that corresponds with the accessibility scores. Most of the women's health providers are concentrated near the center of the city as indicated by the mean center and standard distance. This is also the location of the highest accessible areas.

The change in accessibility scores was calculated to observe the overall change in accessibility scores between the two methods (Figure 3.3). The change in accessibility scores decreased in the eastern and western part of the city and accessibility scores increased in the north and southwest part of the city. Areas with already high accessibility scores experienced a nominal change, but the most change of accessibility scores occurred in areas that had lower accessibility scores based on the unadjusted 3SFCA. Areas with few or no providers within the actual population location can experience a change in accessibility scores due to the AB-3SFCA not taking in consideration defined catchment sub-zones (i.e 10 minutes, 20 minutes). This means that physician-per-provider ratios were calculated between each provider location and population location as long as it is within the 30-minute catchment.

Discussion

This is the first known study of its kind to incorporate internet patient reviews into spatial accessibility modelling. An AB-3SFCA method is developed. Results indicate that overall accessibility scores increase at an increasing distance from the city center in the north and southwest sectors of the city when incorporating patient reviews in the 3SFCA. The main takeaway from the comparison of the two models is that providers with better reviews might lead to women veterans being willing to travel more time for gender-specific health care since these providers provide a better quality of service. Such results show the potential of incorporating the acceptability dimension in spatial accessibility modelling. Despite the promise of incorporating such reviews, there are limitations to this study.

While it can be assumed that the patient reviews come from women, it is uncertain how many women veterans were among the reviewers and there is no way to determine this information. Despite this, given half of women veterans utilize non-VA providers, there is a possibility that some of the reviewers were women veterans. Research does show that women are more likely to look up reviews of their provider than men and the reviews of the provider will influence whether they will see that provider or not (Burkle & Keegan, 2015; Fox & Duggan, 2013). However, women veterans are on average older than non-veterans and age has an influence in using the internet to look up health information (Burkle & Keegan, 2015; Fox & Duggan, 2013). Further studies on how women veterans use the internet to make heath decisions should be encouraged to better understand how internet reviews can influence decision making.

A second limitation of this study is that information about patient capacity per provider not being readily available. Because of this, in the second step, the capacity was based on each individual provider and was given the value of one. Having such information could provide a

more accurate calculation on accessibility. Finally, this study deviated from other studies that use the 3SFCA and calculated individual Gaussian weights based on each provider as opposed to sub-zone. Dividing the study area into sub-zones was deemed arbitrary and unnecessary given the size of the study area and the lack of rationale in doing so. Eliminating this step and using the continuous Gaussian function also allowed for a simpler calculation of accessibility. It is important to take in consideration the various characteristics of the study area when applying the 3SFCA, the rationale behind the decision whether to use sub-zones, and modify the method appropriately based on those characteristics.

Finally, it is not immediately apparent whether areas in which accessibility scores increased or decreased occurred in areas in which providers received higher star ratings. Areas with the lowest accessibility actually had providers with a higher average star rating (3.7) compared to the average star ratings of the areas with the highest accessibility (3.2), but the areas with the bigger increase of accessibility scores had a higher percentage of providers that were at or above the median of the star ratings compared to the areas with the biggest decrease of accessibility scores (70% vs 64%). In addition, the areas that experienced the biggest increase in accessibility scores had more providers than the areas that experienced the biggest decrease accessibility scores (60 vs 16 providers). Based on this, there are various factors to consider when interpreting these accessibility scores and one cannot assume that areas with increase accessibility occurs in areas with doctors with higher star ratings.

Conclusion

While many spatial accessibility models incorporate empirical measures such as distance and competition of other facilities, other measures that are not usually included, such as the

quality of service a provider gives, can also have an influence on accessibility. Acceptability of health providers in terms of the care they can provide can have an influence on the spatial accessibility of a provider; if a provider gives a high quality of care, then a patient might be willing to go a further distance to receive care. The study revised the existing 3SFCA through the creation of the AB-3SFCA by incorporating patient reviews as the acceptability measure. The results show that accessibility scores increased for farther areas in San Antonio due to higher ratings of providers, and areas with lower accessibility scores based on the unadjusted 3SFCA are more subject to change when integrating patient reviews in the decision-making process.

Also, this study addressed the need to better understand accessibility of women veterans to gender-specific care. Currently, there are no other known studies which incorporates spatial accessibility modelling to gauge accessibility of women veterans to health resources. These accessibility models identified areas in which women veterans experience a shortage of women's health providers. By knowing this information, policy makers can advocate for funding to increase the number of women's health providers and services in a specific area. In addition, women veteran stakeholders can use this information in order to better target their services to specific areas such as health fairs or mobile health clinics that provide gender specific services.

Many of the studies done on women veterans are qualitative studies and studies that look at the health needs of women veterans from a spatial standpoint can complement current studies. Having such studies complement each other would be beneficial to relevant stakeholders and policy makers in increasing the accessibility of women veterans to the health care they need in terms of both the quality and quantity of care. Stakeholders and policy makers will not only know where women veterans experience gaps in accessing gender-specific care, but also their

individual experience in accessing such care which will allow them to direct policy and programs to improve accessibility based on these measures.

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Tables

Table 3.1: Total number of women's health providers in the City of San Antonio.

Primary Specialty	**Number of Providers**
Family Medicine	8
General Practice	3
Genetics	1
Gynecologic Oncology	5
Gynecologic Surgery	1
Gynecology	24
Maternal and Fetal Medicine	12
OB/GYN	251
OB/GYN Surgery	8
Obstetrics	2
Reproductive Endocrinology and Infertility	7
Urogynecology	4
Total Number of Providers	326

Table 3.2: Total number of providers by type.

Provider Type	**Number of Providers**
Advanced Practice Nurse (APN)	75
Physician's Assistant (PA)	10
Physician	241
Grand Total	326

Figures

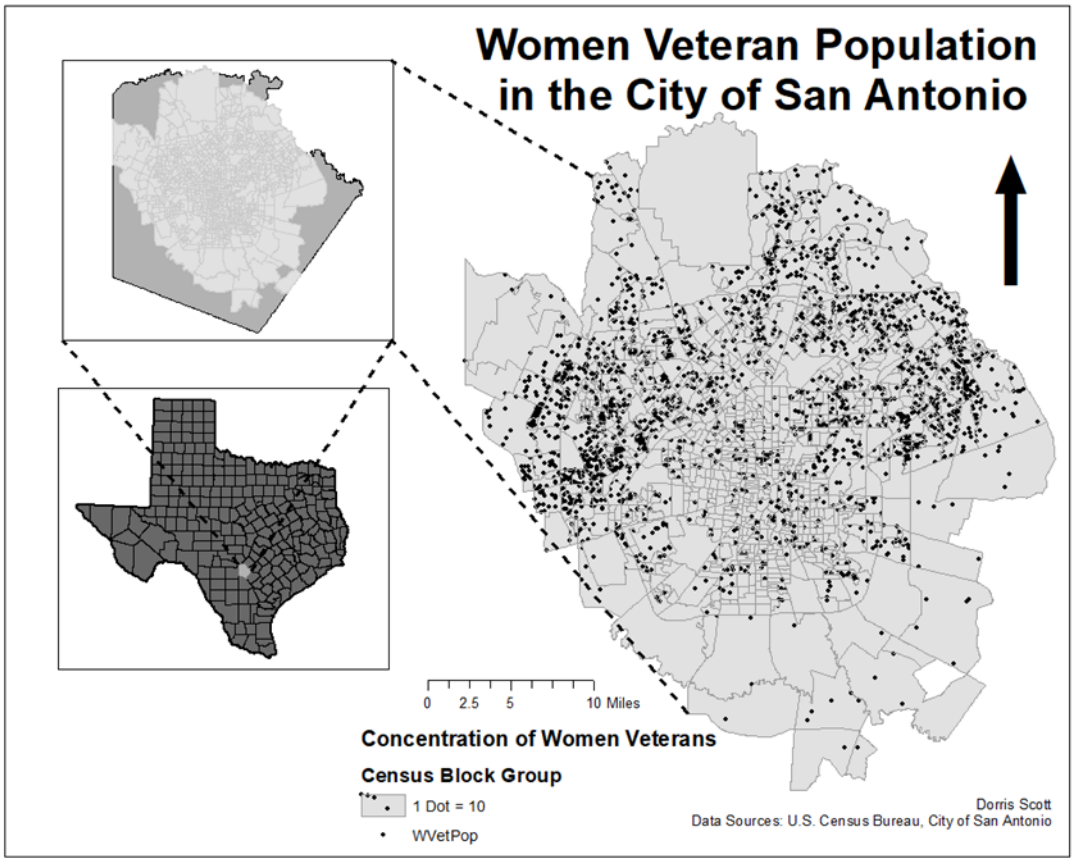

Figure 3.1: Women veteran population in the City of San Antonio.

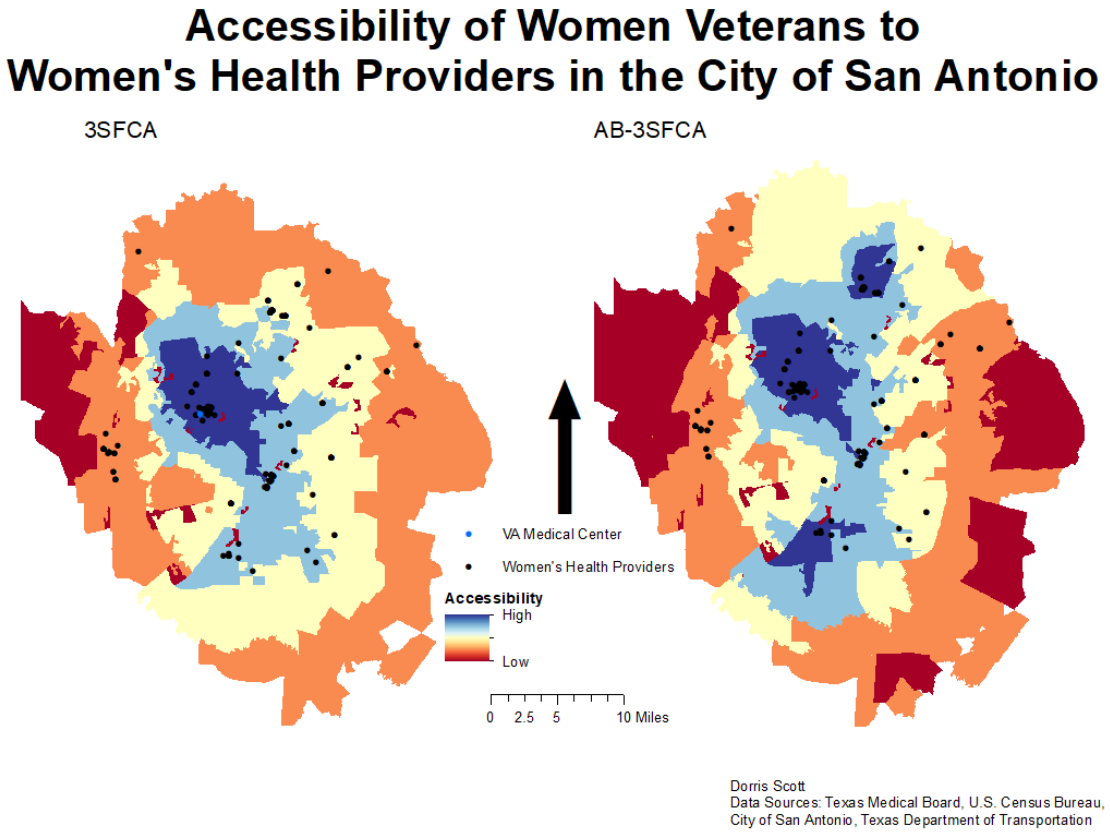

Figure 3.2: Accessibility results based on the crude (original) 3SFCA and the AB-3SFCA models.

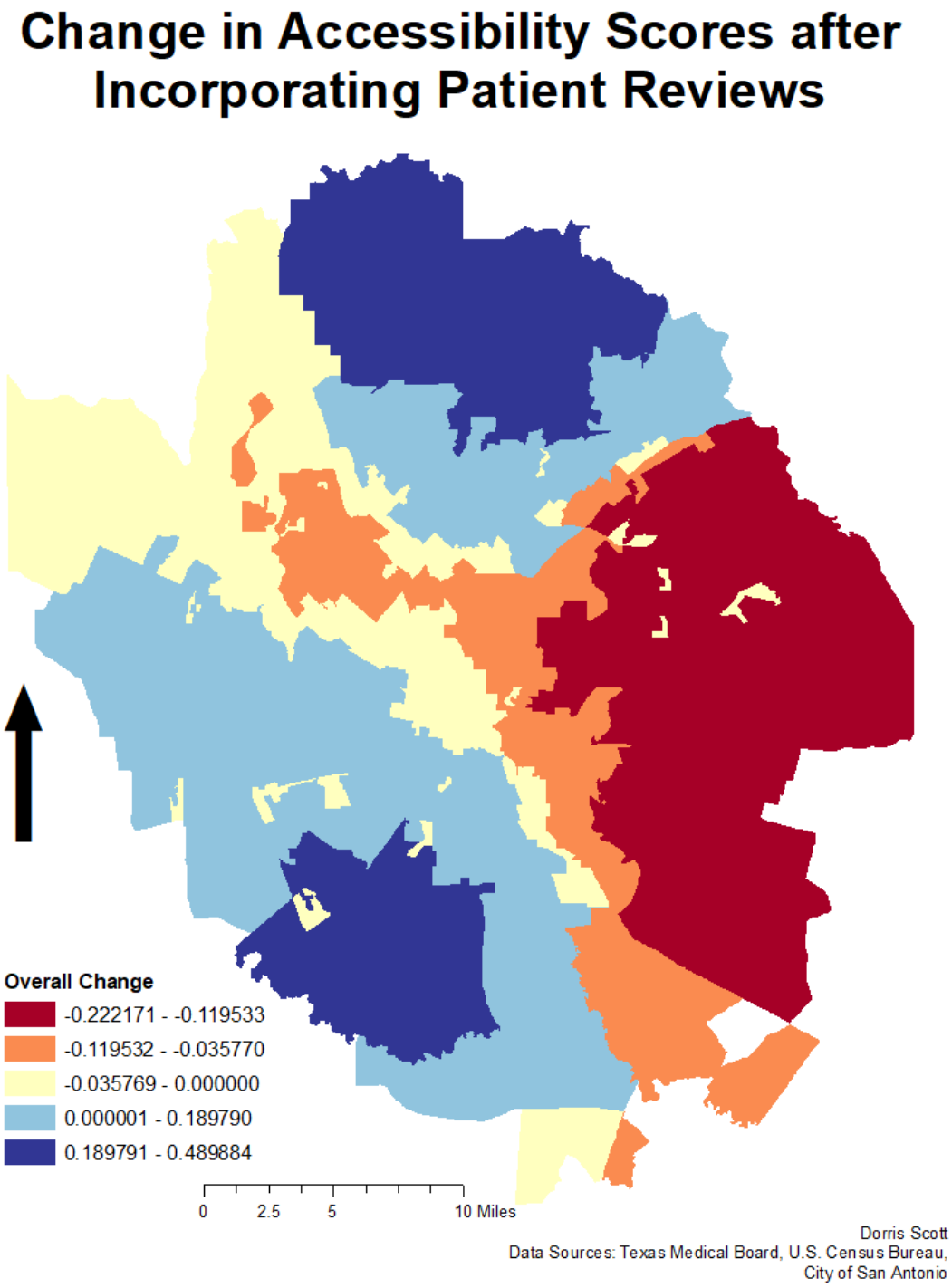

Figure 3.3: Change in Accessibility between the AB-3SFCA and 3SFCA models.

CHAPTER 4

HER MAP: DESIGNING GIS WEB AND MOBILE APPS FOR WOMEN VETERAN'S NEEDS [3]

[3] Scott, D. and Mu, L. To be submitted to *Women's Health Issues.*

Abstract

Even though there has been increased efforts to provide health and educational resources relevant to women veterans' needs, they still experience barriers in receiving such information which results in difficulty in accessing these resources. One reason has to do with a lack of a centralized source of information. The purpose of this study is to show how GIS web and mobile applications can be used as a means to address this barrier by being a centralized source of health and educational resources for women veterans. These applications were created based on combining elements of the OPT-In framework in public health and Public Participation GIS (PPGIS).

To create an app that were relevant to the needs of women veterans, surveys and interviews with women veterans were conducted to better understand what health and educational resources they need, the sources they use to get information on such resources, and the perception of various sources of information. Based on the surveys and interviews, women veterans used a variety of sources to get information on health and educational resources, were mostly neutral on the trustworthiness of both Veterans Affairs (VA) produced metrics and internet review data, and wanted information about support groups the most followed by information about women's health issues and providers.

Introduction

Geographic Information Systems (GIS) has been widely used in public health applications in analyzing and mapping health issues that are pertinent to various communities. One newer strength of GIS is the ability to create user-friendly web and mobile applications (app) in which users can have such information at their disposal. Such tools can be used for health communication purposes in terms of giving information about health resources that are pertinent to the needs of various communities. While information about various health resources might be available, barriers might exist to receive such information. This tends to be the case for women veterans when it comes to obtaining information about gender-specific care along with health and educational resources that are pertinent to them. The number of women joining the military along the number of women veterans are increasing each year; they currently make up around 20% of new recruits (Murphy & Hans, 2014) and make up 8.3% of the overall veteran population (U.S. Census Bureau, 2018).

While the male veteran population will decline by 2020, the number of women veterans is projected to increase to 11% (Murphy & Hans, 2014). Because of this, it has become increasingly important to provide information and care that is centered around women veterans. Even though the women veteran population is increasing and there has been an initiative to better provide care centered around women veterans, they still experience barriers in both receiving information and obtaining the services they need. While the Veterans Health Administration (VHA) has implemented policies to increase access and quality of health care for women veterans, only 50% of women veterans utilize the VHA (Mankowski and Everett, 2016). According to Sayer, Carlson, & Frazier (2014), 72% of women who do use the VA system do not use the nearest VA clinic for primary care. One reason for this is due to the lack of gender-

specific services and the feeling that the providers were not good (Sayer et al., 2014). Brooks, Dailey, Bair, & Shore (2016) mention that women veterans were unable to access nearby services and wanted gender-specific care, alternative medicine and therapy options. The purpose of this study is to create a web and mobile mapping application for health information and communication purposes based on the needs of women veterans. This app was created based on integrating the Organize, Plan, Test, and Integrate (OPT-In) framework along with the elements of Public Participation GIS (PPGIS).

The OPT-In framework was created in order to effectively communicate data for public health purposes to a lay audience (Nelson, Hesse, & Coyle, 2009). This framework was chosen because of its flexibility and it is also a framework that has been promoted by a public health entity, the National Cancer Institute, as a guideline for data communication. The four capital letters in OPT-In stands for the four phases of the framework. In the **O**rganization phase, it is important to become familiar with the data to know its limitations and to consider what data to include. In the **P**lanning phase, one comes up with a strategy in order to ensure that the storyline is effectively communicated to the target audiences. A storyline is a science-based conclusion on a certain issue that they want the lay audience to understand. In the **T**esting phase, the materials are exposed to a limited number of target audience members before beginning more massive efforts. Formative and usability assessments of the materials can be implemented through various means such as interviews and user experience surveys. This is done to make sure that message and format of the message is appropriate for the intended audience. In the final phase, messages should be **I**ntegrated based on communication efforts and integrations of messages upon a broader context based on the current understanding of the topic. This can be accomplished by ensuring the findings are communicated in a way that is easily understood and

providing more information about a topic. Not all specific elements were used in the OPT-In framework due to time constraints and appropriateness given the scope of the project, but it provided a framework in which to create the app.

This project also integrates some elements of PPGIS which is GIS that is used in decision-making in terms of public participation. This can happen on various levels; from GIS being a tool in informing local government, policy making, or furthering the goals of non-profit organizations, community-based groups, and grassroot organizations. PPGIS is based on four themes which are "place and people, technology and data, process, and outcome and evaluation" (Seiber, 2006). One element of PPGIS that will be integrated in this project is increasing accessibility of GIS to groups who are usually excluded from the process (Elwood, 2006) and making GIS and spatial decision making accessible to policy stakeholders (Seiber, 2006).

Methods

Following the OPT-In framework, the organization phase was accomplished by conducting a literature review on women veterans' health issues in terms of accessibility in order to determine the type of data that will be presented in the GIS web application. According to Nelson et al. (2009), a literature review may be required in this type of phase to have a firm understanding of the topic and to see if there is consensus among scientists about the topic. There are very few studies done that uses GIS to gauge women veterans' accessibility to healthcare and there are no known studies on PPGIS with a focus on women veterans. The literature review results led to the decision to focus on women veterans' accessibility to women's health providers along with providing information about health and educational resources. In addition, a search

for apps for women veterans was conducted. The VA have two apps that revolves around women veterans' health care, Caring4WomenVeterans and PreconceptionCare (U.S. Department of Veterans, Affairs, 2017). These apps are meant for providers treating women veterans and not for women veterans themselves. In the state of the study area, an app exists for veterans in that state and there is a hotline for women veterans. However, there is not a link that directly connects women veterans to resources. Both the literature review and search for existing apps for women veterans identifies a strong need for a web mapping app that identifies resources that would be useful to women veterans.

After doing a literature review, the next step is to establish a storyline. The storyline is the major conclusion based on review and synthesis that serves at the takeaway message for the audience. In the context of this study, there were two takeaway messages; one centered on a better understanding of spatial accessibility in the study area and the second storyline is to have an awareness of the number of health and educational resources that are available both in the study area and nationally. The storyline was more focused on giving information to inform health decision-making as opposed to modifying a specific behavior that could be beneficial or deleterious to one's health. The rationale of the storyline is that understanding the accessibility and availability of resources can give the target audience the ability to make more informative health decisions.

The planning phase involved analyzing the audience which defined the context and refining the design of the app so it can be best utilized for the target audience. To better understand the women veteran population and how they use online data, a survey was sent to various women veterans, women veteran groups, and women veteran stakeholders to be disseminated to their respective members. The survey gathered basic biographical information

and focused on questions regarding access to healthcare, information received on gender-specific services, perception of internet resources, and desired resources. At the end of the survey, women veterans were asked if they would be willing to be contacted for a follow-up interview. In order to do human subjects research that complies with state and federal laws, a proposal was sent to the Institutional Review Board (IRB) was sent on 07/24/2018 and was approved on 08/06/2018 (IRB Study 000055556).

Also, women veterans and women veteran stakeholders were consulted to give more insight on women veteran health issues to develop the context. Interviews were conducted with survey respondents who agreed to do an interview. Questions were asked about receiving information about gender-specific services during the Transition Assistance Program, a program which assists with the transition to civilian life. Questions were also asked about various online data sources that can be used for seeking information about providers and clinics, along with information they would find most useful in a web mapping application. Both the interview and survey questions were sent to the Institutional Review Board and were approved to be disseminated to women veterans and women veteran stakeholders.

Based on the surveys, interviews, and consultation with women veteran stakeholders, it was decided to create a web mapping app that centered around identifying health and educational resources for women veterans in San Antonio. The reason San Antonio was chosen was because of the large veteran population that is present in the city. The City of San Antonio (COSA) has a veteran population of 145,047 and 22,869 are women veterans (U.S. Census Bureau, 2018). This makes up 15.8% of the women veteran population which is above the national average of 9.7% (National Center for Veterans Analysis and Statistics [NCVAS], 2017).

Building off the previous steps, a strategy was devised to introduce and disseminate the app to a wide audience of target users. One part of the strategy was engaging in outreach to women veteran stakeholders. The app was showcased at individual and group meetings with women veteran stakeholders. Dissemination occurred on multiple platforms such as word of mouth, social media channels, and printed materials. Testing will be an informal process and will involve a user experience survey that will be available on the app landing page. In addition, the survey will be disseminated through various social media channels and through women veteran stakeholders. In the Integration phase, the app also provides the website links and phone numbers of the health and education resources so users can find out more information about their resource of interest. In addition, the landing page of the website will have additional information on VA quality metrics. As a goal to increase public scholarship, the results of research done on accessibility modelling of women veterans to women's health providers will be made available to the public through a story map. The creation of the web GIS app shows the potential in using GIS spatial accessibility modelling to better understand women veterans' access to healthcare. This information can be useful to policy makers and stakeholders for HER Story Map identifies areas with a shortage of women's health providers which can direct policy and programs to increase accessibility in areas that experience such a shortage. Finally, these apps can be integrated with the organizational missions of various women veteran stakeholders to increase support, awareness, and advocacy of women veterans' issues along with increasing the utilization of services that are available.

Results

Surveys and Interviews

92 individuals responded to the survey. The number responses varied on question being asked (See Table 4.1). 23 individuals decided to do a follow-up interview which allowed them to elaborate on some of the topics mentioned in the survey, such as their opinions of various internet sources. Both the interviews and surveys gave the opportunity for the respondents to give input of what kind of health and wellness resources would be good to be included in a web mapping app designed to provide health and wellness resources.

Only six interview respondents mentioned that they received information about gender-specific services during the Transition Assistance Program, a program designed to help outgoing members of the military to transition to a civilian life. 74 survey respondents mentioned that they did not receive such services. Based on the interviews, one barrier for women veterans when it comes to getting information about health and wellness resources has to do with accessing information on the VA website. Three interview respondents mentioned difficulty in accessing information on the site; they stated that the information was outdated, and the links were broken. Others mentioned that the information was being too generic and felt that there should be more information targeted for women. One interview respondent felt that there was a lot of information to go over, but little time to do it. This can cause a sense of anxiety for some given they have a short amount of time to figure out what they are eligible for:

> *You're trying to cram in a lot of requirements the army gives you but in a short amount of time. We don't have any time to get any information during a normal drill weekend. Time and opportunity are the biggest issues.*

Others echoed the lack of information specific to women and attributed it to the VA being male-centric. In addition, there was a sentiment that male doctors felt uncomfortable with giving such information. Because of this, there can be a lack of awareness of what's available for women.

> *The biggest barrier is that most of the resources are allocated for male type of outreach programs or for wellness programs or for…. their…anything having to do with males. So a lot of it takes away from the female focus.*

Distance also provided to be a barrier for some, since some live far away from the nearest VA.

Survey responses varied on the sources that women veterans use to get information about health and wellness resources (See Figure 4.1). A little less than half the respondents indicated that they looked up information about health and wellness services specific to women veterans online. Some indicated that they use specific sites such as myhealthcare.com or a state specific internet portal. Three respondents indicated that they used the VA website. On the other hand, three people mentioned that they receive such information through paper correspondence such as pamphlets, flyers, and mailings. There were several responses indicating word of mouth being a source of information. Respondents who said they received information via word of mouth indicated that they received the information from other women veterans and friends who work at the local clinic. In addition to word of mouth, a portion of female veterans indicated that they received information through their provider or at a clinic.

When asking if women veterans look up the quality of their health service provider online, most survey respondents indicated that they did not use the internet to look up the quality of their health provider. Only 21 survey respondents did so. Out of those who did so, most used one internet

source when looking up information. In the interviews, one respondent elaborated how they found the process of looking up a provider online to be trial and error:

> *When I'm trying to find a doctor whether it was for my specialty, or for my kids, or for my husband or for myself, I try to Google their name or I try to look online to see certain websites and see what their "rating" is, but I find that kind of arbitrary….It doesn't always say a whole lot to me in terms of what kind of doctor they are…so honestly it's kind of a trial and error. This guy got some decent reviews off a couple of websites, let's go try this one… okay we don't like him, let's go to someone else. I find the online ratings kind of exhausting and not that helpful.*

Over half of the survey respondents (50 respondents) were neutral regarding the trustworthiness of the data on the quality of health providers on social media or internet review platforms (Figure 4.2). The number of respondents that found this data to be trustworthy was slightly above the number of respondents that found this data to be untrustworthy. An interview respondent mentioned how she found qualitative measures more valuable than quantitative measures:

> *Most of it is based on the person so I look at it and see if there's a lot of negative or a lot of positive, but I don't necessarily take it for face value because it could be one person's bad experience, but I do read the comments and that's more helpful highlighting stars or whatever. Sometimes comments tell a lot.*

Regarding the star ratings, one respondent did feel that the more ratings a provider had, the more credence once can give the ratings:

> *Well…that's a real quantitative question. The more people that put their experience and their ratings and the higher we can say that's reliable, but…I think for facilities, it pretty much holds true. I think*

> *if you look at a lot of the qualitative comments of individuals who are either happy or disgruntled, that it reflects how that facility is operating or how that individual conducts business such as the care providers.*

Survey respondents were less neutral about the trustworthiness of government produced data on the quality of VA facilities (Figure 4.3). While 50 respondents were neutral about social media or internet reviews, only 31 respondents were neutral about the trustworthiness of government produced data. More survey respondents found government produced data to be untrustworthy than trustworthy. Out of those interviewed, over half of the respondents (13 respondents out of 23) found the data to not be trustworthy because they felt there would be a bit of bias, given the VA is producing data on itself:

> *If the reviews are produced by the VA, it kind of sends a red signal to my head, like okay if the review is put there by the VA, how honest is the review. You get a lot of mixed stories, but I have a core perspective on the VA how they operate. I think if there was a third-party system it would be more beneficial than something that is produced by the VA.*

A few respondents felt that the data was trustworthy due to having worked at the VA or being familiar with the VA organizational chain:

> *I would probably give that a lot of credence, a lot of legitimacy… If someone at the bottom who was assigned to do like the dirty work of data collection…they're going to have…there's a chain of command that is answerable to those results and that's one of the things I respect about the military that you can go all the way up and down a chain of command.*

When asked about health and wellness resources they would like to have, survey and interview respondents felt that they needed information about support groups the most (Figure 4.4). They felt that they needed information about support groups for Post-Traumatic Stress Disorder and Military Sexual Trauma (PTSD/MST), female combat veterans, and for women who are trying to juggle various responsibilities. One survey respondent mentioned having issues finding resources for PTSD/MST:

> *Such treatment strategies have been removed at my local VA hospital because they don't consider support groups treatment. So now there is no MST class or support group, despite the posters all over the hospital saying they support female vets and MST.*

The second highest resource that was requested was more information about women's health such as aging and menopausal issues. One interview respondent mentioned the importance of providing this type of information given how women's bodies changed when they start and leave military service:

> *I think we only comprise 15% of the military so when we come back from deployments…when we are out processing from the military, they're not thinking about women who have been in for ten years…they're getting out, they're maybe dealing with menopausal issues, they're maybe dealing with…everybody thinks about men being in combat zones but a lot of women have been there.*

Examples of other resources that were mentioned was information about pelvic physical therapy (PT), knowledge about female sexual dysfunction, and information about menopause. The third highest resource that was requested was resources on mental wellness. Respondents also indicated that they would like information about counseling, such as rape counseling. Several

survey and interview respondents indicated that they wanted information about holistic health. Examples of this include yoga classes for veterans or outdoor therapy such as equine therapy or surfing:

> *More holistic mental instead of taking 30 pills a day. I requested a weighted blanket and was turned down. Would like equine therapy, but I can't afford to pay, I would like to do yoga or an activity, some kind of arts and crafts. A get together with a woman's group activity.*

Respondents also wanted information on social groups and peer groups. One survey respondent desired more information about resources that was not focused on the negative aspects of women veterans and focused on camaraderie and building each other up:

> *I love taking a group yoga class, breast cancer awareness month, get us all together and do something active like what well…painting, drawing, food, movie day, nail day, spa day etc. there are so many things we all can do together...The one thing that get me, why is the health care so so so focus on the negative stuff. When I was in college working on my thesis paper I was thinking what is the best way to heal and it came to me. Lets hang out and laugh stuff our face with food. ENJOY life and celebrate it not relive our painful and most darkest days of ourlives.*

Some of the desired resources were not necessarily health related. One respondent indicated that she wanted information on education, healthcare, and housing while another respondent wanted information about benefits. Some respondents mentioned that availability and access to such information is important and felt that such information isn't readily available. In addition, one survey respondent mentioned while such information is important, knowing where to go and what to do get such information was just as important:

> *We need information but mostly it's about the resources and the people we would come into contact to get those things regardless if it's about health, fitness or mental health.*

In the interviews, respondents mentioned that they would also like to know whether the providers take their insurance, phone contacts, the location of women veterans and the services they provide, and female providers.

HER Map Apps

HER (Health and Educational Resources) Map apps were created using ArcGIS Online and ESRI AppBuilder as a result of the interviews and surveys. HER Map currently consists of three components: HER Map: San Antonio, HER Map: Women Veterans Groups and Advocates, and HER Story Map. HER Map: San Antonio (Figures 4.5 & 4.6) shows detailed information about health and educational resources for the City of San Antonio (COSA). HER Map: San Antonio contains two sets of information: information about women's health providers and information about health and educational resources specific to San Antonio. In the dataset about women's health providers, the user can filter the information based on such criteria as women providers, providers that accept Tricare, and specialty (Table 4.2). HER Map: Women Veteran Groups and Advocates is a nationwide listing of women veteran groups, advocates, and women veteran state program managers (Figures 4.7 & 4.8, Table 4.3). HER Story Map (Figures 4.9 & 4.10) shows the results of spatial accessibility modelling on women veterans' access to women health providers in San Antonio. This app was created to publicly disseminate academic resource that could be useful to women veterans.

Since the app's official launch on April 1, 2019 up until June 1, 2019, the landing page of HER Map has had 161 users. Out of the 161 users, 22 users were returning users which

represents 12% of all users. Most of the users were from Athens, GA (22 users), followed by Atlanta (12 users), Washington D.C. (6 users), and San Antonio (6 users). 12% of users were from Texas. The apps are currently view only. Due to functionality issues with the ESRI AppBuilder, users are not directly able to add information. However, within the apps, there is a Google form in which users can add information about resources that they found useful. Also, users are encouraged to contact the creator of the app if there are any discrepancies or errors in the information displayed on the app.

Feedback

A user-experience survey was created in order to see if the information in the app was relevant to the needs of women veterans and was easy to use. Currently, there are only a few responses and responses will continue to be collected for the rest of the year. In addition, interviews are currently being conducted with women veteran stakeholders to also see if the app is relevant to the mission of their organizations and to see how such an app can be integrated within their organizational goals. Currently, only one stakeholder who works with women veteran entrepreneurs was interviewed and found the app to be user friendly. This stakeholder suggested to expand the organizations that are listed on the app to organizations that help women regardless of veteran status:

> *I wonder there wouldn't be some benefit to maybe breaking that out and having a separate group for women advocates or women's groups. They might not be specifically for women veterans. But the thing to consider is that as we are trying to re-assimilate back into the civilian population, there comes a point where you know we still have that connection with veterans, right? With people that we served with, with male and female veterans, and with veteran's organizations.*

> *But we also have an interest in expanding our circle outside of the veteran organizations.*

The stakeholder also felt that both veteran and non-veteran organizations such as the Small Business Association (SBA) can benefit from using this app for some organizations might not have a women veteran centered focus for their mission. In addition, the stakeholder mentioned how starting a successful business depending on having a good state of health:

> *So like for us, we're not just interested in helping women entrepreneurs, we're interested in helping women get health and healing mentally and physically. Right? Because…as a business owner, if you're not well, how are you going to focus on your business?*

Based on the preliminary feedback from the surveys, respondents found the user friendliness of the app and the zoom functionalities to be the two things that they liked the most about the app. For improvements to the app, there were suggestions to add the locations of VA hospitals and putting the title of the office or building to help users easily find locations downtown. The HER Map apps can be accessed on the apps' landing page (http://hermap.netlify.com) (Figures 4.11 & 4.12).

Discussion and Conclusion

Most women veterans do not get gender-specific information and want more information about gender-specific health care, counseling, and peer and social groups, but do not have a centralized source to obtain this type of information. In addition, they are rather neutral about internet and social media reviews of providers, but less neutral about government-produced data on the quality of VA health facilities. This study was the first of its kind in creating web mapping

applications for women veterans to utilize for health decision-making using PPGIS and the OPT-In framework. The strengths of the OPT-In framework is that it allows for flexibility with each step, which makes it easily adaptable to various contexts. PPGIS provides a basis for integrating feedback from women veterans and women veteran stakeholders in order to make sure the app provides relevant information. HER Map responded to the needs of women veterans and identified resources that would be useful for them along with information about the quality of women's health providers. In the future, there are plans to add more locations along with providing additional information about health fairs and the meetings of women veterans' groups.

Limitations

One limitation in the study is that most of the survey and interview respondents were from a variety of locations and not specifically from the area of interest. Traditionally, the sample size of women veterans for research studies have been small which is one obstacle in studies done on women veterans (Yano et al, 2010). In addition, the number of respondents for the user experience survey is still small. Another limitation of the study has to do with the combined internet review ratings for each provider. There is no way to tell whether the internet ratings were from women veterans. There are also no known studies on women veterans using the internet for health decision making. In addition, there is little information about VA women's health providers in the app since the information gathered was based on open and available resources. Having more information about VA women's providers would be insightful given 50% of women veterans use the VA (Mankowski & Everett, 2016). Finally, there was not an opportunity to talk with both VA and non-VA women's health providers to gain their insights in women veteran health issues, suggestions of what to include in the app, along with feedback regarding the app. Despite these limitations, this study gives some insight of how women

veterans use the internet for health decision making and how web mapping apps can be used to assist women veterans in finding health and educational resources.

Implications for Practice

HER Map shows how GIS can be leveraged to create useful apps for women veterans which will allow them to easily find information about the resources that they want and need. Many of the participants in the surveys and interviews mentioned that they had trouble finding information about such resources. Murphy and Hans (2010) recommended that there be a central directory along with mobile apps which contains information about programs and services for women veterans who are transitioning to civilian life. These apps show how this recommendation can be implemented through the creation and deployment of web mapping apps which is scalable on various devices. HER Map can fit in the organizational missions of many women veteran stakeholders and they can use these apps to give information about upcoming meetings, health fairs, or conferences. In addition, these apps give an opportunity for those who are women veteran stakeholders and advocates to not only connect to only women veterans, but stakeholders with similar missions.

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Tables

Table 4.1: Number of responses for key questions

Question	Number of responses
Did you get information about gender-specific VHA services during the Transition Assistance Program (TAP)?	68
What is your primary source of getting information about health and wellness services specific to women veterans and VA Health benefits?	81
Have you looked up the quality (ratings, scores, or patient feedback) of your health service provider on the internet?	81
What internet resources did you use to look up the quality of your health care service provider?	24
Have you left a comment about your experience at a health care provider on a social media or internet review platform such as Twitter or Google Reviews?	81
Have you ever visited the VA website to look up the quality of VA health facilities?	81
Why do you use or not use internet resources when it comes to searching for information about women veterans' health and wellness and VA health benefits?	77
How was your experience in using internet resources when it comes to finding out information about women veterans' health and wellness and VA benefits?	79

Have you observed or experienced barriers for women getting information about health and wellness resources?	79
What kind of information about health and wellness resources you feel that women veterans need the most? Examples of health and wellness resources include: healthy and active living, mental wellness, women's health, and support groups.	78
How trustworthy do you find data about the quality of health providers and facilities on social media or internet review platforms?	79
How trustworthy do you find government produced data on the quality of VA health facilities?	79

Table 4.2: Filtering Options and Choices for HER Map: San Antonio

Women's Health Providers	
FILTERING OPTIONS	CHOICES
Are you interested in only women providers?	Yes/No
Are you interested in clinics in which all the medical staff are women?	Yes/No
Ae you interested in seeing a provider who is also a veteran?	Yes/No
What kind of specialist are you interested in seeing?	Family Medicine, General Medicine, Genetics, Gynecologic Oncology, Gynecologic Surgery, Gynecology, Maternal and Fetal Medicine, OB/GYN, OB/GYN Surgery, Obstetrics, Reproductive Endocrinology and Infertility, Urogynecology
What secondary specialty are you interested in seeing?	Family Medicine, Family Practice, Genetics, Gynecologic Oncology, Gynecologic Surgery, Gynecology, Maternal and Fetal Medicine, Midwivery, OB/GYN OB/GYN Surgery, Obstetrics

Are you looking for providers that accept Tricare?	Yes/No
Health and Educational Resources	
FILTERING OPTIONS	CHOICES
What kind of resources are you looking for?	Advocacy, Alternative Therapy, Benefits and Claims Assistance, Community Service, Counseling and Mental Health, Education, Emergency Assistance, Employment and Career Assistance, General Assistance, Healthcare, Housing Assistance, Legal Assistance, Loan Information and Assistance, Medical Assistance, Mental Health and Counseling, Physical Therapy and Rehabilitation, Recovery and Support, Social and Emotional Support, Social Groups, Social Services, Support Groups, TBI, Transportation Assistance, Wellness
Are you looking for women veteran specific resources?	Yes/No
Are you looking for women specific resources	Yes/No

Table 4.3: Filtering Options and Choices for HER Map: Women Veteran Groups and Advocates

Women Veteran Groups	
FILTERING OPTIONS	CHOICES
Area of Interest	Advocacy and Support, Alternative Therapy, Coaching and Speaking, Counseling and Mental Health, Education and Awareness, Entrepreneurship and Small Business, General Support, Network and Support
States where groups or advocates reside	*List of states*
Women Veteran Program Coordinators	
State	*List of states*
Are you interested in states that have a women veteran coordinator?	Yes/No

Figures

Figure 4.1: Wordcloud of survey responses regarding where women veterans get information about health and wellness resources. Created on https://www.jasondavies.com/wordcloud/

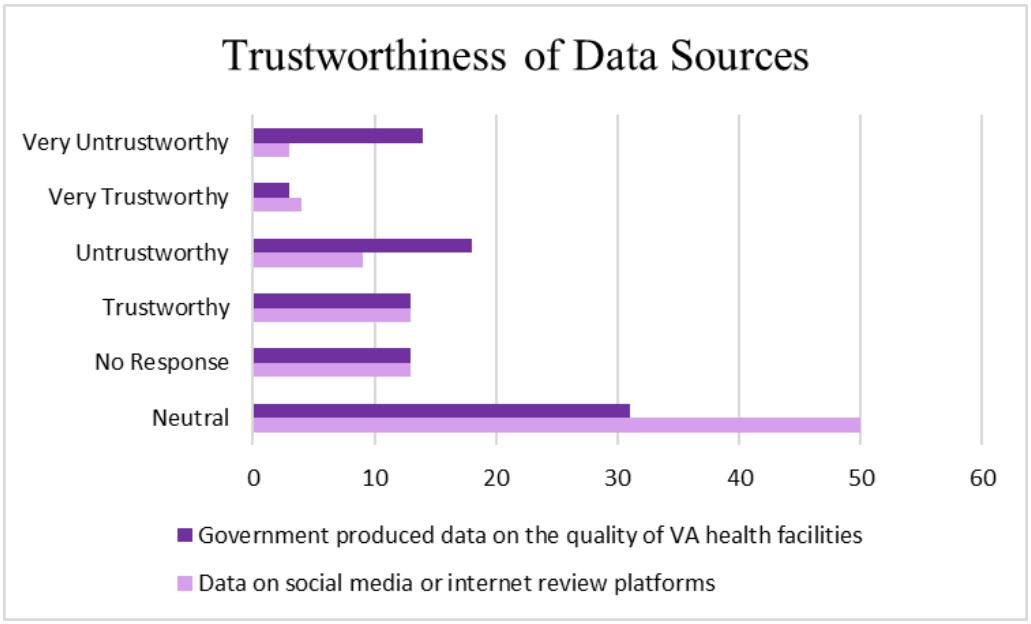

Figure 4.2: Number of responses regarding the trustworthiness of the quality of health providers on social media or internet review platforms.

Figure 4.3: Wordcloud of survey responses regarding desired health and wellness resources. Created on https://www.jasondavies.com/wordcloud/

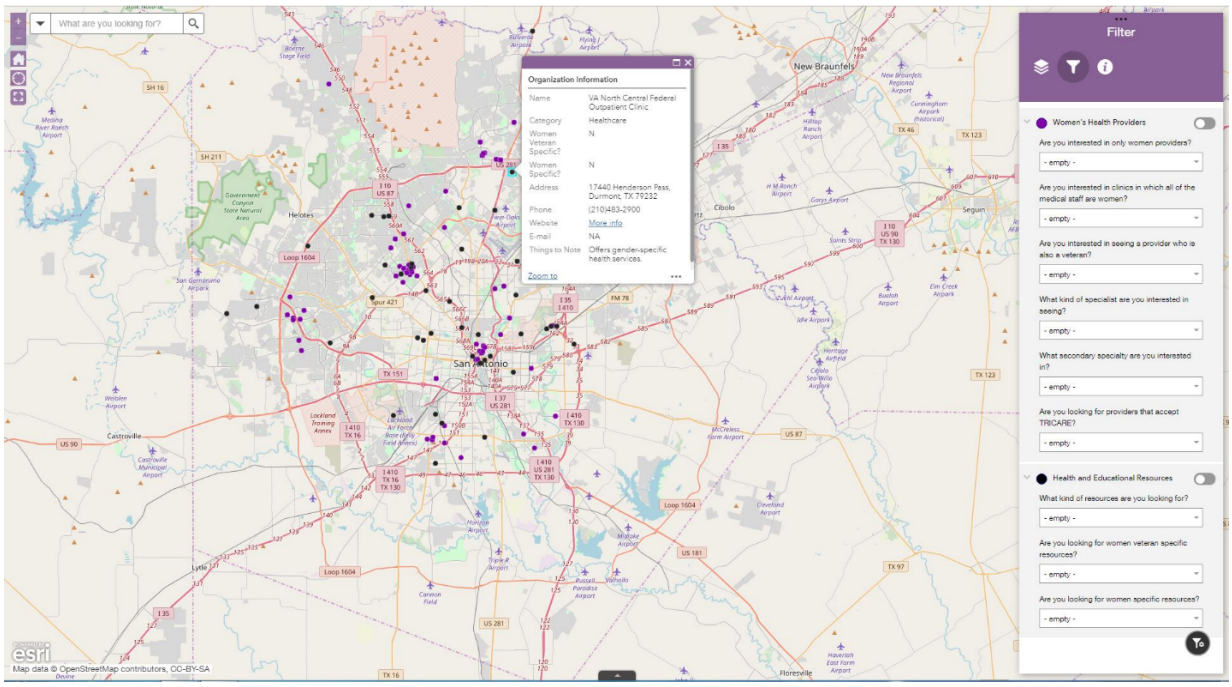

Figure 4.4: Desktop version of HER Map: San Antonio web mapping application.

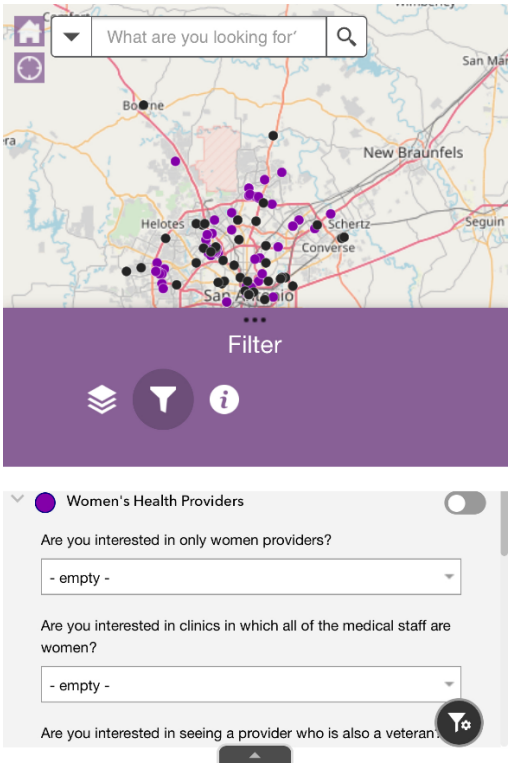

Figure 4.5: Mobile version of HER Map: San Antonio web mapping application.

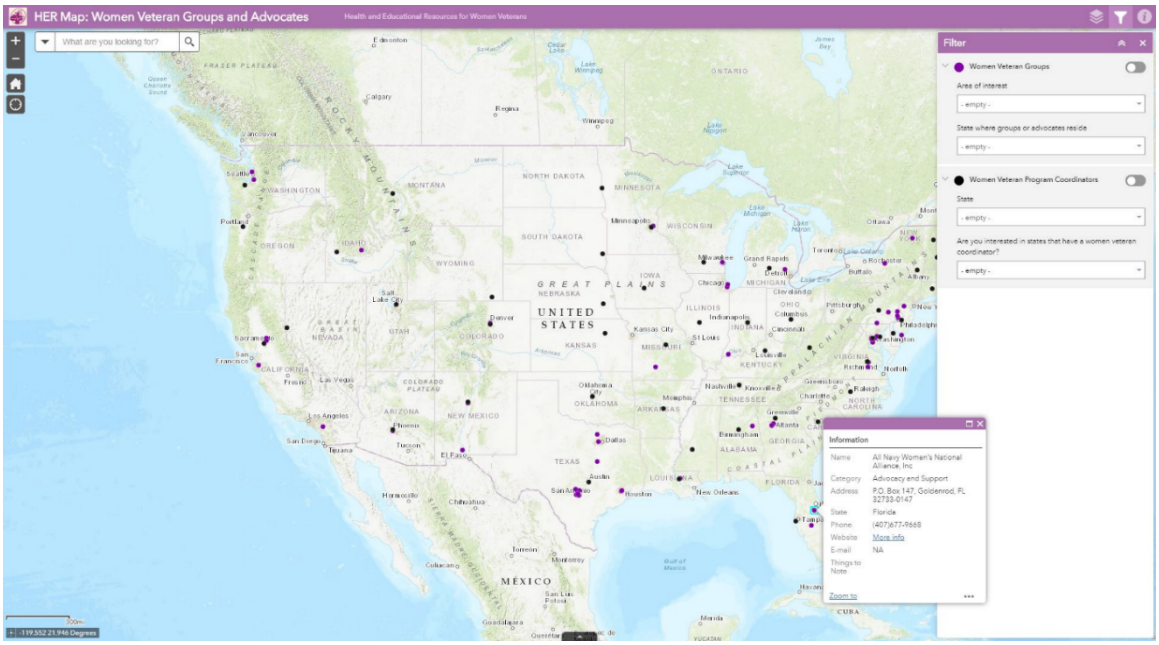

Figure 4.6: Desktop version of HER Map: Women Veteran Groups and Advocates web mapping application.

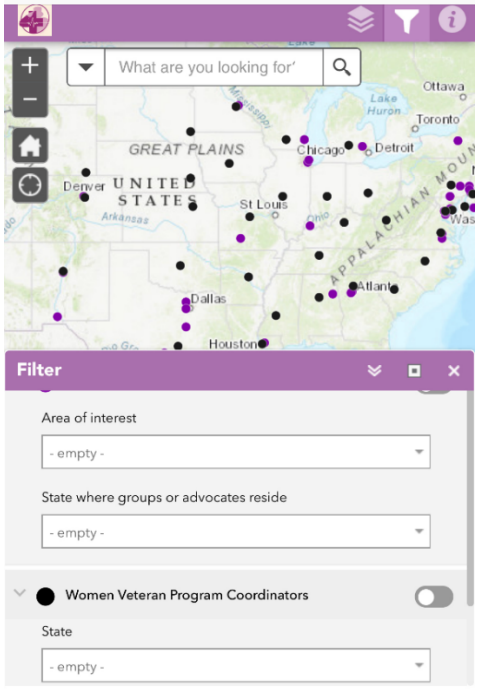

Figure 4.7: Mobile version of HER Map: Women Veteran Groups and Advocates web mapping application.

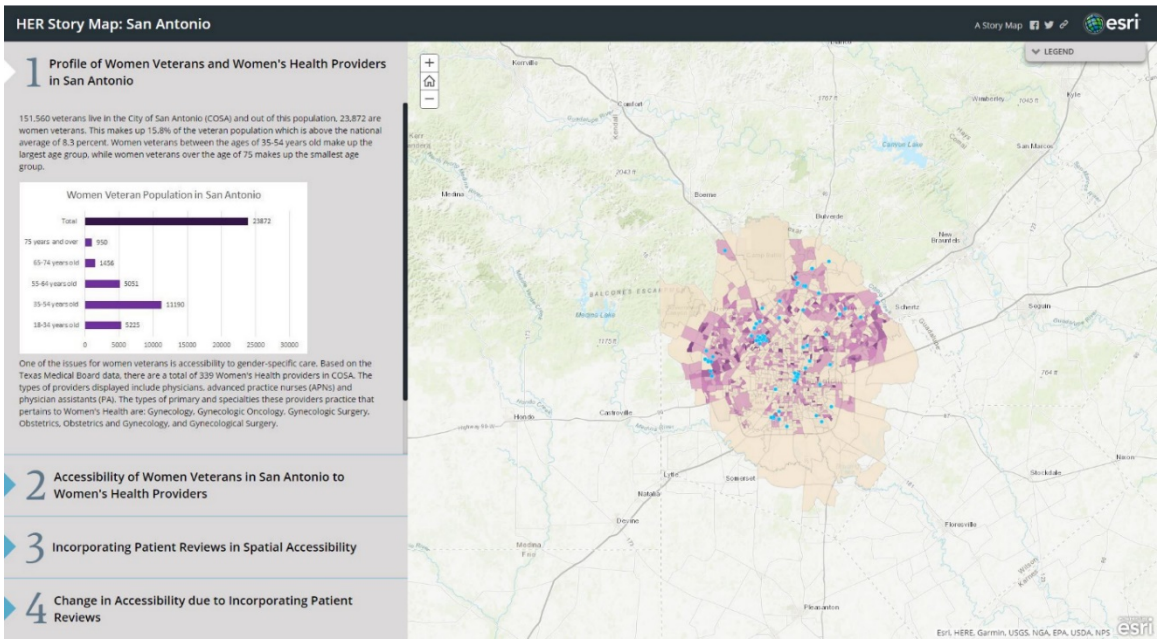

Figure 4.8: Desktop version of HER Story Map.

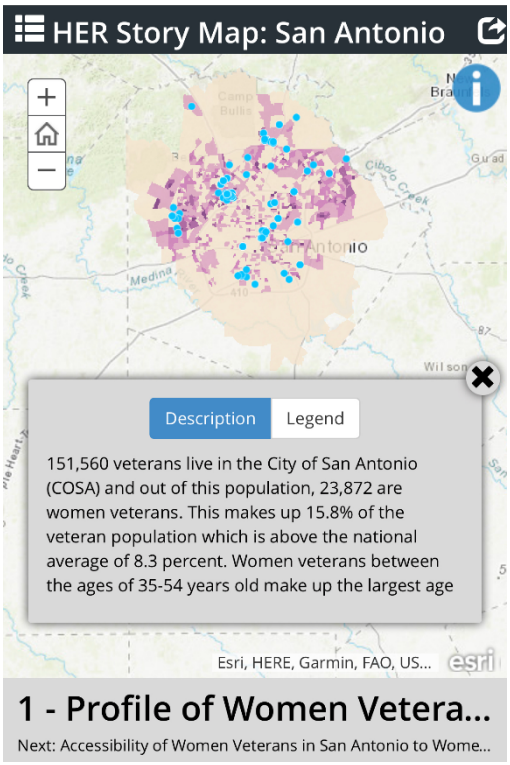

Figure 4.9: Mobile version of HER Story Map.

Figure 4.10: Desktop Version of HER Map Landing Page.

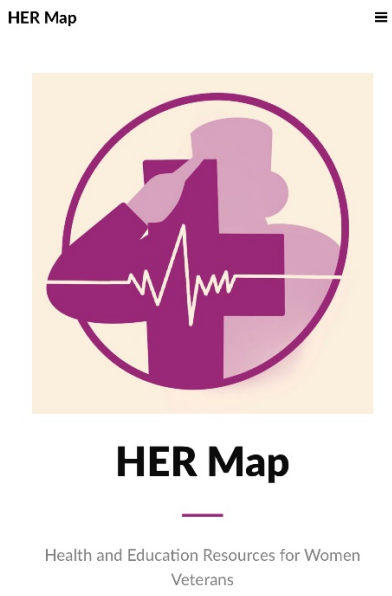

Figure 4.11: Mobile Version of HER Map Landing Page.

CHAPTER 5

CONCLUSION

The purpose of this research is to attempt to answer the overarching question of how online patient reviews can be used for GIS applications for public health when it comes to better understanding accessibility of women veterans to health care (Figure 1.1). In order to answer this question, three specific objectives were sought: 1) Validation: How do online patient reviews compare to government metrics of VA facilities? 2) Integration: How do you integrate patient reviews in spatial accessibility modeling? 3) Application: How can online patient reviews be applied in GIS web applications that can be useful to women veterans and women veteran stakeholders? These three objectives responded to this overarching research question on various scales; while the first objective explores online patient reviews on a national level, the second and third objectives examine online patient reviews on a more local level.

The first research objective of validation compares online patient reviews about Veteran's Affairs (VA) Heath facilities on various internet platforms such as Facebook and Google reviews to government produced quality metrics about the same VA Health facilities. The rationale behind this first objective was the decrease in public trust in the VA due to the data integrity controversies that occurred within the past years with the Veteran's Health Administration (VHA). Results show that both Facebook and Google star ratings have some correlation with various measures related to fulfilling appointments in a timely manner and with the SAIL hospital star ratings. There were more statistically significant correlations between the Facebook data and various VA hospital measures than the Google Reviews data and the VA

hospital measures. In terms of patient satisfaction, ratings were higher with both Facebook and Google star ratings by health facility and by Veterans Integrated Service Network (VISN). By using Facebook and Google star ratings in conjunction with VA hospital metrics, veterans who use the VA can be more informed on the quality of VA facilities by geographic location and health care service area and provide policy makers more robust feedback on the quality of VA Health facilities.

While the first study gave a broad overview of patient satisfaction in the VHA, the second study on integration was more specific and was focused on women veterans' accessibility to gender-specific care in the City of San Antonio, a city with a high number of women veterans. Both VA and non-VA Health facilities with known women's health providers were included given only around 50% of women utilize the VA. The objective of the second study is to compare spatial accessibility to gender-specific care based on a modified version of the three-step floating catchment area method (3SFCA), AB-3SFCA, which integrated the star ratings.

Results show that incorporating star ratings in the 3SFCA increased accessibility scores farther away from the city center than in the 3SFCA which did not incorporate star ratings. Some areas farther out such as the north and southwest part of the city experienced an increase in accessibility scores. These results can indicate that women veterans might be willing to drive farther out for higher quality gender-specific care. While there is no way to tell whether the reviewers are women veterans, this study was the first of its kind, for it highlights gender-specific reviews. Given the women veteran population is increasing, this study highlights the need to better understand how women veterans perceive women's health providers and creating internet platforms specific to women veterans so they can get information about health providers.

The third study is the application of such data which builds off the previous studies and attempts to answer the question on how patient reviews can be applied in GIS web applications in such a way that it can be useful to women veterans and women veteran stakeholders. This was accomplished by combining elements of PPGIS and the OPT-In framework such as soliciting information from women veterans through surveys and interviews. The surveys and interviews focused on women veterans' experiences in accessing gender-specific care, how they get information on gender-specific care, perceptions on the trustworthiness of various data sources about the quality of providers, and the kinds of information on health and educational resources that they would like to have.

Based on the surveys and interviews, women veterans did not get gender-specific health information when transitioning to a civilian life and they received information about health resources from a variety of sources which ranges from the internet to word of mouth. Due to these experiences, it is no surprise that women veterans wanted information about support groups and gender specific care the most. The respondents were also rather neutral on the trustworthiness of both government-produced data and internet review data on the quality of health providers, but found government produced data to be less trustworthy.

This study also culminated in the creation of a suite of web apps called HER Map that is tailored to women veterans. HER Map is made up of three components: HER Map: San Antonio, HER Map: Women Veteran Groups and Advocates, and HER Story Map. HER Map: San Antonio identifies health and educational resources and basic information about women's health providers. This information about women's health providers also includes star rating based on a weighted average of several internet review portals to give a more robust star rating. In addition, other information about the provider was given such as the phone number of the clinic and the

website. This was done in order to give provide women veterans as much information as possible in order to make decisions regarding their health care. HER Map: Women Veteran Groups and Advocates is a nationwide listing of women veteran groups, advocates, and state women veteran program managers. Finally, HER Story Map contains the results of the accessibility modeling done in Chapter 3. Since this app is a prototype, feedback is still being gathered regarding the user experience of this app. This study was the first of its kind, for it focused on creating GIS web applications for women veterans and on better understanding how women veterans perceive internet review data. The results of this study can prove useful to women veteran stakeholders and can serve as a blueprint on how to create web application tailored to women veterans.

This research highlighted integrated acceptability into accessibility from various dimensions. Acceptability is not only a spatial measure, but also based on perception, and availability of information. We explored multiple dimensions of accessibility in order to better understand patient reviews of both VA and non-VA providers along with how access to information can prove to be a barrier itself to accessibility to health resources. It This study also highlighted women veterans in terms of better understanding spatial accessibility along with their health needs. Given the women veteran population is increasing, it is of the utmost importance that there is a multi-disciplinary effort in understanding accessibility issues. It is also important to note that women veterans underutilize VHA services which results in a selection bias of VHA patients in terms of women veteran VHA patients not being entirely representative of the population of women veterans. Some of the reasons that women veterans underutilize VHA services is due to a lack of information on such services along with the absence of needed services. A perspective from geography contributes to better understanding the health needs of women veterans due to the discipline seeing spatial relations as multi-dimensional as opposed to

occurring in a single dimension. This study not only looked at accessibility from a spatial standpoint, but also from a standpoint of better understanding access to information about health and educational resources. Given there are very few studies regarding veterans in the discipline, especially women veterans, this research is contributing to increasing the body of research of veteran's health issues within the discipline.

This research hopes to raise awareness of women veterans' health issues, within and beyond the discipline and to provide academics and stakeholders interested in women veterans' health a framework in using GIS applications which incorporate patient review metrics for accessibility. Through this research, there is a hope that there will be increased efforts to better understand the accessibility of women veterans along with more efforts to increase various mobile and web applications that are tailored towards this population. By doing so, women veterans will have increased access to the health and education information they need which could result in an increase in the accessibility of these resources.

Appendices

Appendix A: List of acronyms used in dissertation.

- 2SFCA - Two Step Floating Catchment Area (method)
- 3SFCA - Three Step Floating Catchment Area (method)
- AB-3SFCA - Acceptability Based Three Step Floating Catchment Area (method)
- COSA - City of San Antonio
- ES2FCA - Enhanced Two Step Floating Catchment Area (method)
- FCA - Floating Catchment Area (method)
- GIS - Geographic Information Systems
- GIS&T - Geographic Information Science & Technology
- HER Map - Health and Educational Resources Map
- OPT-In - Organization, Plan, Test, Integrate (framework)
- MAUP – Modifiable Areal Unit Problem
- MST – Military Sexual Trauma
- PPGIS - Public Participation GIS
- PTSD – Post Traumatic Stress Disorder
- SAIL - Strategic Analytics for Improvement and Learning
- SPAI - Spatial Access Index
- SPAR - Spatial Access Ratio
- VA - U.S. Department of Veteran Affairs
- VAMC - Veteran Affairs Medical Center
- VFW - Veterans of Foreign Wars
- VHA - Veteran's Health Administration
- VISN - Veteran's Integrated Service Network
- WVHSHG - Women Veteran's Health Strategic Health Care Group

Appendix B: Survey questions about women veteran's accessibility to health resources.

BASIC INFORMATION

Q1 What is your geographic location(City, State)? If you prefer not to answer, please respond with "N/A".

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Q2 What is your age range? If you prefer not to answer, please select "N/A".

- 18 - 24 years old (1)
- 25 - 34 years old (2)
- 35 - 54 years old (3)
- 55 -64 years old (4)
- 65+ years old (5)
- N/A (6)

Q3 In what branch of the military did you serve? If you prefer not to answer, please select "N/A".

- ☐ Air Force (1)
- ☐ Army (2)
- ☐ Coast Guard (3)
- ☐ Marine Corps (4)
- ☐ Navy (5)
- ☐ N/A (6)

ACCESS

Q4 What is your primary care provider?

- ○ VA health provider (1)
- ○ Non-VA health provider (2)
- ○ I do not have a primary care provider. (3)

Q5 Have you ever been seen at a VA health facility?

- ○ Yes (1)
- ○ No (2)

Q6 If you have not been seen at a VA health facility, please explain why. If you prefer not to answer or this question does not apply to you, please respond with "N/A".

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Q7 If you have used the VA as a health provider, how long does it take to get to the VA health facility that you receive services from?

- Less than 15 minutes (1)
- 15 - 30 minutes (2)
- 30 - 45 minutes (3)
- 45 minutes - 1 hour (4)
- Over one hour (5)
- I do not utilize VA health facilities. (6)

Q8 If you have used the VA as a health provider, what modes of transportation did you use to get to the VA facility? If you prefer not to answer or this question does not apply to you, please select "N/A".

- ☐ Private vehicle (1)
- ☐ Public transportation (2)
- ☐ Hospital shuttle or shuttle provided by a non-profit organization (3)
- ☐ Uber/Lyft (4)
- ☐ Taxi (5)
- ☐ Given a ride by a friend, family member, or co-worker (6)
- ☐ Other (7)
- ☐ N/A (8)

Q9 If you chose "Other", please state what mode of transportation you use to get to the VA facility. If this question is not applicable, please respond with "N/A".

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Q10 If you have used a non-VA health provider, how long does it take to get to the health facility that you receive services from?

- ○ Less than 15 minutes (1)
- ○ 15 - 30 minutes (2)
- ○ 30 - 45 minutes (3)
- ○ 45 minutes - 1 hour (4)
- ○ Over one hour (5)
- ○ I do not utilize non-VA health facilities (6)

Q11 If you have used a non-VA health provider, what modes of transportation did you use to get to the VA facility? If you prefer not to answer or this question does not apply to you, please select "N/A".

- ☐ Private vehicle (1)
- ☐ Public transportation (2)
- ☐ Hospital shuttle or shuttle provided by a non-profit organization (3)
- ☐ Uber/Lyft (4)
- ☐ Taxi (5)
- ☐ Given a ride by a family member, friend, or co-worker (6)
- ☐ Other (7)
- ☐ N/A (8)

Q12 If you chose "Other", please state what mode of transportation you use to get to the non-VA facility. If this question is not applicable, please respond with "N/A".

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INFORMATION

Q13 Did you get information about Veteran's Health Administration (VHA) eligibility during the Transition Assistance Program (TAP)?

- ○ Yes (1)
- ○ No (2)

Q14 Did you get information about gender-specific VHA services during the Transition Assistance Program (TAP)?

- ○ Yes (1)
- ○ No (2)

Q15 What is your primary source of getting information about health and wellness services specific to women veterans and VA Health benefits? If this question is not applicable, please respond with "N/A".

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Q16 Have you looked up the quality(ratings, scores, or patient feedback) of your health service provider on the internet?

- ○ Yes (1)
- ○ No (2)

Q17 What internet resources did you use to look up the quality of your health care service provider?

- ☐ Google Reviews (1)
- ☐ Yelp (2)
- ☐ Facebook (3)
- ☐ Twitter (4)
- ☐ Website with provider reviews (e.g. RateMDs.com, healthgrades.com, Hospital Compare) (5)
- ☐ N/A (6)

Q18 Have you left a comment about your experience at a health care provider on a social media or internet review platform such as Twitter or Google Reviews?

- ○ Yes (1)
- ○ No (2)

Q19 Have you ever visited the VA website to look up information about benefits?

- ○ Yes (1)
- ○ No (2)

Q20 Have you ever visited the VA website to look up the quality of VA health facilities?

- ○ Yes (1)
- ○ No (2)

Q21 Why do you use or not use internet resources when it comes to searching for information about women veterans' health and wellness and VA health benefits? If this question is not applicable or you prefer not to answer, please respond with "N/A".

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Q22 How was your experience in using internet resources when it comes to finding out information about women veterans' health and wellness and VA benefits? If this question is not applicable or you prefer not to answer, please respond with "N/A".

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Q23 Have you observed or experienced barriers for women getting information about health and wellness resources? If so, what are the primary barriers? If this question is not applicable or you prefer not to respond, please respond with "N/A".

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Q24 What kind of information about health and wellness resources you feel that women veterans need the most? Examples of health and wellness resources include: healthy and active living, mental wellness, women's health, and support groups. If this question is not applicable or you prefer not to respond, please respond with "N/A".

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PERCEPTIONS AND EXPERIENCES

Q25 Perceptions and Experiences of Health Care

Please rate your perceptions and experiences of the VA along with VA and non-VA providers.

	Very Positive (1)	Positive (2)	Neutral (3)	Negative (4)	Very Negative (5)
What is your perception of VA services overall? (1)	○	○	○	○	○
If you have gone to a VA health facility, what was your overall experience? (2)	○	○	○	○	○
If you have gone to a non-VA health facility, what was your overall experience? (3)	○	○	○	○	○

Q26 Trustworthiness of Health Information

Please rate your trustworthiness of these various data sources.

	Very Trustworthy (1)	Trustworthy (2)	Neutral (3)	Untrustworthy (4)	Very Untrustworthy (5)
How trustworthy do you find data about the quality of health providers and facilities on social media or internet review platforms? (1)	○	○	○	○	○
How trustworthy do you find government produced data on the quality of VA health facilities? (2)	○	○	○	○	○

Page Break

FOLLOWING UP

Are you willing to be contacted to further talk about your experience of being a woman veteran and accessing health and wellness resources?

○ Yes (1)

○ No (2)

Please provide an e-mail address in which you can be reached.

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Appendix C: Interview questions about women veteran's accessibility to health resources.

1. What do you think are the barriers for women veterans getting information about health and wellness resources?

2. What kind of information you feel that women veterans need the most?

3. Did you get information about VHA eligibility and gender-specific VHA services during the Transition Assistance Program? (TAP)

4. What is your primary source of getting information about health and wellness services specific to women veterans?

5. Have you looked up the quality of your healthcare service provider via an internet review outlet such as Google Reviews, Yelp or Facebook reviews?

6. Have you ever visited the VA website to look up information about benefits?

7. Have you ever visited the VA website to look up the quality of VA health facilities?

8. How trustworthy do you find data about the quality of health providers and facilities on social media or internet review platforms?

9. How trustworthy do you find data on the quality of VA Health facilities produced by the VA?

10. Do you find government produced data (VA, Center of Medicare and Medicaid services) more or less reliable than internet review and social media data when it comes to better understanding the quality of VA health facilities? How about non-VA health facilities?

11. The application I will be making will identify health and wellness resources that would be beneficial to women veterans. What kind of health and wellness resources would be beneficial to women veterans and should be included in the web mapping app?

Appendix D: HER Map user experience survey questions

1. Are you a woman veteran based in San Antonio?

-Yes

-No

-Prefer not to answer

Will skip to #4 if the answer is yes.

2. Where are you based? Please include the city and state. If you do prefer not to answer, then reply with "N/A"

3. Which app did you use?

- HER Map: San Antonio
- HER Map: Women Veteran Groups and Advocates
- HER Story Map

If the answer is HER Map: San Antonio or HER Map: Women Veteran Groups and Advocates

4. Which format of the app did you use?

- Web app on the computer.
- Web app on a mobile device.
- Downloadable app from Google Play Store
- Downloadable app from the Apple Store.

5. How easy was it to use this app?

- Very Difficult to Use
- Difficult to Use
- Neither Easy or Difficult to Use
- Easy to Use
- Very Easy to Use

6. From a scale of one (being not very effective) to five (being very effective), how effective was this app in providing relevant health and education resources for women veterans?

7. What do you like most about the app?

8. What suggestions do you have for improvement?

9. Any other comments?

10. Please provide your e-mail to receive the gift certificate.

If the answer is HER Story Map

4. Which format of the app did you use?

- Web app on the computer.
- Web app on a mobile device.
- Downloadable app from Google Play Store
- Downloadable app from the Apple Store.

5. How easy was it to use this app?

- Very Difficult to Use
- Difficult to Use
- Neither Easy or Difficult to Use
- Easy to Use
- Very Easy to Use

6. From a scale of one(being not very effective) to five (being very effective), how effective was the app in better understanding accessibility of women veterans in San Antonio to Women's Health providers?

7. What do you like most about the app?

8. What suggestions do you have for improvement?

9. Any other comments?

10. Please provide your e-mail to receive the gift certificate.

Appendix E: HER Map user experience interview questions

1. Which app did you use?

2. What do you like about the app?

3. What suggestions do you have with improving the app?

4. What kind of organizations would benefit from using this app?