PATIENT AND PROVIDER LEVEL PREDICTORS OF BREAST SURGEONS' PRACTICE STYLES AND MODALITY APPROACHES FOR MASTECTOMY PROCEDURES

by

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ABSTRACT

SARA SHAHBAZI. Patient and Provider Level Predictors of Breast Surgeons' Practice Styles and Modality Approaches for Mastectomy Procedures
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Background: Breast cancer surgery, including mastectomy and breast conserving surgery, is the primary treatment for non-metastatic breast cancer (stages 0 to III) to remove the tumor. Currently, mastectomy, like other types of breast surgical options can be performed on an inpatient or ambulatory basis. Outpatient procedures do not require an overnight hospital stay and patients may go home several hours after surgery. Although a patient's preferences and medical history should be taken into account during the decision-making process, physicians' preferences may also play a role. These preferences can give rise to a unique pattern of practice over time, which is called surgical modality signature/approach. As a result, some surgeons exclusively perform inpatient or outpatient procedures, however, some other surgeons perform both methods. No study, to date, has examined the factors that can influence a physician's choice of practice style and modality approach.

Objective: The purpose of this study was to evaluate patient and provider level factors contributing to a surgeon's choice of practice style [i.e. Inpatient Mastectomy (IM) versus Outpatient Mastectomy (OM)] and selection of modality approaches [i.e. exclusively inpatient, exclusively outpatient, or bimodality approach].

Methods: Using 2013 Florida HCUP-State Inpatient and State Ambulatory Surgical Databases, a cross-sectional study was performed among 6,413 patients who underwent a mastectomy in the state of Florida in 2013. Surgeons' choice of practice style and

modality tactics were assessed and the following predictor variables were considered: patient age, patient race, pay source, patient residency, patient comorbidities, median household income level, surgeon volume, hospital mastectomy and total discharge volumes, teaching and ownership status of the hospital, hospital bed-size, and hospital location. Multilevel mixed-effects logistic regression models were utilized to estimate odds ratios (ORs) and 95% confidence intervals (CIs) of the odds of surgeons' choice of practice styles and modality approaches while controlling for patient comorbidities, median household income level, hospital bed-size, and hospital location.

Results: In the adjusted analysis, African-Americans (OR=0.71, 95% CI: 0.59-0.85), Hispanics (OR=0.74, 95% CI: 0.63-0.88), and private insurance holders (OR=0.83, 95% CI: 0.71-0.98) had decreased odds of being operated on by OM style surgeons. In addition, high volume surgeons had decreased odds of being among OM style surgeons (OR=0.61, 95% CI: 0.52-0.72). High mastectomy volume hospitals were associated with decreased odds of having surgeries done by OM style surgeons (OR=0.75, 95% CI: 0.61-0.93). In contrast, non-teaching and for-profit hospitals were associated with increased odds of having surgeries performed by outpatient style surgeons (non-teaching: OR=2.74, 95% CI: 2.40-3.11 and for-profit: OR=1.44, 95% CI: 1.25-1.65). For the modality approach outcome, African-Americans had 1.53 times the odds of their mastectomies being performed by exclusively inpatient approach surgeons (95% CI: 1.02-2.28). High volume surgeons had decreased odds of choosing surgeons with exclusive modality approaches in their mastectomies (exclusive IM: OR=0.06, 95% CI: 0.04-0.09, and exclusive OM: OR:0.11, 95% CI: 0.08-0.14). However, high mastectomy volume hospitals had increased odds of having surgeries performed by exclusive OM surgeons:

(OR=1.50, 95% CI: 1.03-2.17). Non-teaching and for-profit hospitals had approximately two-fold increased odds of having surgeries performed by exclusive approach surgeons (exclusive IM non-teaching hospitals: OR=1.69, 95% CI:1.19-2.39, exclusive OM non-teaching hospitals: OR=1.89, 95% CI:1.51-2.37, exclusive IM for profit hospitals: OR=2.23, 95% CI:1.63-3.05, and exclusive OM for profit hospitals: OR=2.67, 95% CI:2.11-3.38).

Conclusion: The present study suggests that patient-level factors such as patient race, pay source, and age are associated with surgeons' practice styles and modality approaches for mastectomy procedure. Moreover, surgeon volume and institutional factors such as hospital characteristics were found to be associated with surgeons' choice of style and modality approach. Future studies are needed to investigate the extent of variations in practice styles. Findings from this study provide additional insight into understanding the need for patient education regarding mastectomy treatment options. The present study also highlights the need for specialized and focused training of breast surgeons to help surgeons get experience in both methods and to make decisions based on patient needs rather than their treatment style preferences. Furthermore, the findings suggest that greater attention should be paid to efforts to adopt policies at the hospital-level in order to optimize the use of both IM and OM modalities.

DEDICATION

I dedicate this dissertation to my father, my mother, my husband, and my sisters for their endless love and support.

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CHAPTER 1: INTRODUCTION

1.1 Background

1.1.1 Breast Cancer Incidence and Risk Factors

Cancer is a group of diseases that cause cells in the body to change and grow out of control. Most types of cancer cells eventually form a lump or mass called a tumor and are named after the part of the body where the tumor originates [1]. Breast cancer typically is detected either during a screening examination, before symptoms have developed, or after symptoms have developed, when a woman feels a lump [1]. Most masses seen on a mammogram and most breast lumps are benign and non-cancerous. However, when cancer is suspected based on clinical breast exam or breast imaging, microscopic analysis of breast tissue is necessary for a definitive diagnosis and to determine the extent of spread (in situ or invasive) and to characterize the pattern of the disease [1]. Although breast cancer is often referred to as one disease, there are many different types of breast cancer based on where in the breast the disease started (e.g., milk ducts, lobules), how the disease grows, the characteristics of cancer cells determined by pathology, and other factors [2]. The most common type of breast cancer is ductal carcinoma, which begins in the cells of the ducts. Breast cancer can also begin in the cells of the lobules and other tissues in the breast. Invasive breast cancer is breast cancer that has spread from where it began in the ducts or lobules to surrounding tissue [2].

One important risk factor for breast cancer is age. A woman's risk of developing breast cancer increases as she gets older. The risk of breast cancer, however, is not the same for all women in a given age group [3]. Research has demonstrated that women with the following risk factors have an increased chance of developing breast cancer: genetic alterations or inherited changes in certain genes, radiation therapy to the chest (including the breasts) before age 30, alcohol intake, never having a child or having first full-term pregnancy after age 30, physical inactivity, white race, obesity, personal and family history of breast cancer, and family history of ovarian cancer [4-15].

Breast cancer is the most common cancer among American women, except for skin cancer. About 1 in 8 (12%) women in the U.S. will develop invasive breast cancer during their lifetime [16]. In the U.S., after increasing for more than 20 years, breast cancer incidence rates in women began decreasing in 2000 and dropped by about 7% from 2002 to 2003 [17, 18]. This large decrease was thought to be due to the decline in the use of hormone therapy after menopause that occurred after the results of the Women's Health Initiative (WHI) were published in 2002. The WHI study linked hormone therapy use to an increased risk of breast cancer and heart diseases [19, 20]. In recent years, incidence rates have been stable in white women, but have increased slightly in African American women [21]. In 2017, there will be an estimated 252,710 new cases of invasive breast cancer, 63,410 new cases of carcinoma in situ (CIS) which is non-invasive and the earliest form of breast cancer, and 40,610 breast cancer deaths in the U.S [8].

The chance that a woman will die from breast cancer is approximately 1 in 36 (about 3%) [22]. Death rates from breast cancer have been decreasing since 1989. This

decrease is believed to be the result of finding breast cancer earlier through screening and increased awareness, as well as better treatments [22]. However, breast cancer still is the second leading cause of cancer death among women in the U.S. after lung cancer [23]. Breast cancer poses a substantial medical and economic burden for women and their families, and accounts for 15% to 20% of all cancer costs and 1% of the total healthcare expenditure in the US health care system [24].

1.1.2 Breast Cancer Treatment

Surgical treatment of breast cancer has been described for centuries. Historical analysis of this treatment reveals that the efficiency and the extent of surgery have always been a source of controversy [25]. The primary treatment for non-metastatic breast cancer (stages 0 to III) is surgery (breast conserving surgery [BCS] or mastectomy) to remove the tumor. BCS, also known as lumpectomy, involves removing only the breast lump and some normal tissue around it. In contrast, mastectomy refers to removal of the entire breast [26]. In some cases, mastectomy is performed prophylactically (to prevent cancer from occurring) in women with a high risk of developing breast cancer [26]. A mastectomy procedure includes any therapeutic excisions of breast tissue. However, there are many different mastectomy techniques. Listed below are the most commonly performed mastectomy procedures.

Partial Mastectomy (Lumpectomy)

Lumpectomy also called partial mastectomy is breast-conserving operations in which the surgeon removes the tumor together with some normal breast tissue surrounding it. Breast-conserving procedures can often be done with local anesthesia and sedation or under general anesthesia and is usually performed on an outpatient basis. A

partial mastectomy may also be known as a lumpectomy, quadrantectomy or segmental mastectomy [27].

Simple Complete Mastectomy

This procedure includes removal of all breast tissue, along with a portion of skin and nipple through an elliptical incision [27].

Subcutaneous Mastectomy

This mastectomy procedure is similar to the simple complete mastectomy except that the extent of the excision is different. For a subcutaneous mastectomy the breast is dissected from the pectoral fascia and the skin. The breast tissue is removed, but the skin and pectoral fascia remain [27].

Radical and Modified Radical Mastectomy

The most extensive of the mastectomy procedures, the radical mastectomy, involves dissection of the breast, overlying skin, the pectoralis major and minor muscles and the axillary lymph nodes, which are all removed as a single specimen. In a modified radical mastectomy, the structures listed above are excised, but the pectoralis major muscle (and possibly the pectoralis minor muscle) are spared [27].

When all or most of the breast tissue is removed, breast reconstruction surgery may be performed to rebuild the breast. Reconstruction may be performed at the time of the mastectomy or at a later time [26].

1.1.3 Breast Cancer Surgical Approaches

Currently, breast cancer surgeries (including BSC and mastectomy) can be performed on an inpatient or ambulatory basis. Outpatient procedures do not require an overnight hospital stay and patients may go home several hours after surgery. In general,

ambulatory surgery was initially limited to procedures performed under local or regional anesthesia, which required minimal postoperative monitoring. Anesthesia techniques and perioperative management have since evolved such that low-risk surgeries performed under general anesthesia can now also be performed in the ambulatory setting [28]. Patients undergoing breast cancer surgery seldom develop serious complications and most return to their preoperative function soon after the surgery, making them ideal candidates for ambulatory surgery [28]. However, many patients have been managed in the past as inpatients due to concerns about drain care and the lack of structured outpatient follow-up care. Currently, due to the adoption of sentinel lymph node biopsy (SLNB) as the standard of care and full axillary lymph nodal dissection (ALND), the use of surgical drains is less common. The decline in the use of drains together with the establishment of specialized breast units in many centers to provide continuity of care after hospital discharge has led to a greater push towards ambulatory breast cancer surgery [28]. Previous literature documents that breast cancer surgery, including quadrantectomies (removal of approximately one-fourth of the breast, including tissue surrounding a cancerous tumor), axillary lymphadenectomies (removal of the lymph nodes from the underarm or axill), simple or radical modified mastectomies, and sentinel lymph node biopsies, represents a good choice as an outpatient procedure “when it is superficial and does not imply any significant bleeding or electrolyte shifts” [29].

1.2 Significance

Previous studies show no evidence of differences in patient satisfaction between patients receiving outpatient mastectomy compared with those receiving inpatient surgery [30-32]. In addition, no differences between these two methods have been reported for

patient outcomes such as readmission rate and intraoperative complications [29, 33]. Previous studies cite psychological effects as one of the greatest benefits for 'Outpatient Mastectomy' (OM) procedure, suggesting that OM patients experience faster healing and recovery at home within the family milieu [32]. Studies also have confirmed the cost-effectiveness of OM vs inpatient procedures. In a study by McManus et al. [32], the outpatient cost was reported to be $1,572 compared with an average 3-day inpatient cost of $6,282, for a potential savings of $4,710, or 75%, per patient for modified radical mastectomy [32]. In contrast, there is some evidence of decreased use of breast reconstruction following OM, suggesting that patients receiving OM may not receive adequate post-mastectomy care [34]. These advantages and disadvantages of OM versus IM suggest that there is no best surgical approach for mastectomy and the decision about the appropriate hospital length of stay after the procedure should be made on an individual basis.

In the past, the suitability of patients for outpatient procedures was based on tradition rather than being evidence-based [35]. Currently, identifying a patient's suitability for an ambulatory procedure is considered a dynamic process that depends on the complex interplay between patient characteristics (e.g., coexisting medical conditions), physician characteristics, and system characteristics [24, 25, 33, 36]. During the 1990s, the efforts of managed care organizations to minimize hospitalizations costs resulted in a significant increase in the rate of OM procedure in the U.S. (from 0% in 1986 to 10.8% of total U.S. mastectomies in 1995) [33]. However, after development of the Breast Cancer Patient Protection Act, the pressures from managed care organizations and insurance companies have significantly decreased [34]. The Breast Cancer Patient

Protection Act prohibits insurance providers from limiting benefits for any hospital length of stay to less than 48 hours for a mastectomy or 24 hours for a lymph node dissection. The policy does not require that the patient stay in the hospital for the full 48 hours, only that the hospital stay be covered if deemed essential by the patient's surgeon [34]. Consequently, in almost all cases, the physician now decides if the patient needs to be admitted as an inpatient or outpatient for their mastectomy. Considering the role of physicians at the forefront of medical decision-making, policymakers are increasingly focused on physician decisions involving patient care, and recent research has attempted to understand why physicians might treat patients with a similar medical condition differently [37-39]. The present study extends prior research by examining patient and provider level factors that can influence breast surgeons' practice styles and modality approaches for mastectomy procedure.

CHAPTER TWO: LITERATURE REVIEW

2.1 Variations in Physicians' Practice Styles and Patterns

Differences in physicians' approaches in treating different patients with the same condition is called variation in treatment or practice pattern [40]. In other words, variation in treatment occurs when similar patients receive different treatments, or when in some hospitals or geographic areas patients are more likely to receive a certain procedure or treatment than in others. As a result, some patients may not get the treatment they need, or may get more than they need, which are both undesirable. Variations in physicians' practice styles have been found to be correlated with physician characteristics (e.g. age and specialty), practice organization and setting (e.g. hospital clinic and solo versus group practice), location (e.g. access to beds and technology), and patient characteristics (e.g. severity, insurance type, and race) [41-47]. Moreover, there has always been the suggestion that certain combinations of factors (clinical and non-clinical) are more likely than others to be associated with physicians' choice of treatment strategies. For example, physician residents in teaching hospitals have been shown to order more tests, across many diagnoses, than experienced physicians in the same specialty [48, 49].

Several explanations for patterns of medical practice variation have been suggested in the literature and most of the existing explanations are based on the idea that differences in behavior between people are explained by differences in their preferences

for certain behaviors [50]. The “practice style hypothesis”, the most commonly accepted hypothesis, was generated by Wennberg and Gittelsohn in 1973 [51]. The hypothesis postulates that variations in utilization rates arise from differences in clinical judgment among physicians as to the appropriate forms of treatment [50]. According to the “practice style hypothesis”, the explanation of variations in medical procedures consists of two parts. The first part focuses on the micro-level problem of the origins of widely differing practice styles among individual physicians. The second part concerns the explanation of differences between macro-level units, such as geographical areas, hospitals or insurance plans. The first part of the practice style theory argues that physicians differ in the type of procedures they apply because they have somehow learned to value them differently, and consequently adhere to a different practice style [50]. According to Wennberg and Gittelsohn, differences in practice style emerge because of uncertainty about the value of a certain level of medical care and of individual procedures [51]. As a result, the larger the professional uncertainty, the more possibilities for individual beliefs, and the more variation in observed practice styles [51]. In situations of diagnostic uncertainty, physicians usually will try to reduce their uncertainty, for example, by ordering more tests [50]. However, in the therapeutic phase, “there is no general strategy, such as doing more, but only a situational strategy: do as your direct colleagues do. Eddy referred to this strategy as the tendency to follow the pack" [50].

The second part of the “practice style hypothesis” explains that the mechanism that grows differences in utilization of treatment options between areas or hospitals is the selective attraction or retention of physicians in the local medical system [50]. According

to Wennberg and Gittelsohn, “the rates of common surgical procedures” within an area (referred to hospitals) “constitute a `surgical signature' that tends to be consistent over many years, unless physicians leave the area or enter it" [51]. The present study measures the ability of both aspects of “practice style” theory, hospitals and surgeons, in addition to patient-level non-clinical factors to explain the variations in surgeons’ practice styles and patterns.

2.2 Selection of Surgical Style for Breast Cancer Patients

Over the past 15 years, guidelines have been developed by consensus conferences at the National Institute of Health (NIH) to advise physicians about the vast literature on the treatment of breast cancer and variations in the use of different mastectomy or BCS techniques by patient and provider characteristics. However, there is no structured guideline to direct physicians on selecting inpatient versus outpatient breast cancer surgeries. To improve breast cancer treatment in community practice, it is essential to understand which types of patients may not be receiving a particular mastectomy treatment method with respect to modality (inpatient versus outpatient) and which types of providers (hospitals and physicians) may not be delivering such care. Most previous breast cancer studies have primarily investigated variations in physicians’ practice patterns within specific diagnoses rather than across treatment decisions. In addition, studies with a focus on procedure decisions have investigated contributors to patient’s choice of mastectomy or BCS procedures. However, no studies, to date, examined surgeons’ practice styles and patterns and associated factors at the patient, physician, and system-level for mastectomy procedure. This study examines variations in breast surgeons’ practice styles and patterns by patient and provider characteristics. In this

section, several patient-level, non-clinical factors related to the surgeons' choice of practice style for mastectomy procedure are discussed.

2.3 Patient-level Predictors of Surgeon's Choice of Surgical Style

The number of outpatient breast surgeries continues to increase in the U.S. For most breast procedures, both inpatient and outpatient modalities have demonstrated nearly equal rates of re-hospitalization for surgery-related complications, wound complications, 30-day readmission, and reoperation [30]. As a result, physicians' choice of style varies; however, patient characteristics can influence the surgeons' decision on selection of surgical modality.

Cancer stage is the most important clinical factor influencing the type of surgical procedure patient receives for all types of cancer including breast cancer. For women with early-stage breast cancer, undergoing a lumpectomy is as effective as having a mastectomy, and is usually performed as an outpatient procedure. In a study by Case et al., investigating the influence of payer and state on the use of OM, cancer stage was an important determinant. The authors found that the adjusted likelihood of receiving an OM was significantly lower if a woman had metastases [52]. Bian et al.[34] also postulated that patients with a more advanced stage of cancer at diagnosis were more likely to receive inpatient surgery. Moreover, cancer stage is an indicator of the severity of illness and can influence surgeons' decisions about selection of the appropriate method of surgery. On the other hand, cancer stage can shape surgeons' practice style and signature gradually as it is possible that certain group of surgeons tend to see the sicker patients and those at more advanced stage of cancer. Based on previous studies, physicians who oversee a higher proportion of severe cases may be more vigilant,

experienced, and hence, comfortable with a particular method of treatment [53]. In addition, a high proportion of severely ill patients may affect physician's attention span and their ability to discuss medical information and treatment options with patients efficiently [54].

However, part of the variation in medical practice is due to non-medical factors [55-60]. Patient characteristics, such as patient preference, demographics, and socio-economic status are considered the primary non-clinical predictors of patient choice of different surgical modality options [34]. However, no study has investigated non-clinical patient-level predictors of surgeons' choice of inpatient or outpatient style for mastectomy procedure.

Patient Age

Breast cancer studies have provided consistent evidence of the existence of disparities in receiving treatment by patient age [61]. In general, older women are less likely than younger women to receive optimal local or surgical treatment for breast cancer [62]. Samet and colleagues conducted a study to examine the relationship between patient age and the use of potentially curative therapy for cancers of selected sites and acute leukemias using data on 22,899 cancer cases collected by the New Mexico Tumor Registry from 1969 through 1982. The researchers found that women age 75 and over were significantly less likely than younger women to receive definitive treatment for local-stage breast cancer [63]. In another study by Greenfield and colleagues conducted among 374 women in southern California who were diagnosed with stage I or II breast cancer from 1980 through 1982, 17% of patients aged 70 or older did not receive appropriate treatment compared with only 4% of patients under age 70 [64]. In their

study, increasing age was significantly associated with greater comorbidity and mortality among women with breast cancer. However, the researchers suggested physicians may be using age to limit treatment inappropriately, particularly among older adults who are otherwise healthy [64].

Contradictory results have been reported in the literature regarding the association between patient age and selection of surgical modality for mastectomy. According to a 2003 Agency for Healthcare Research and Quality's (AHRQ) report, an OM generally is recommended for young women [36]. However, some previous studies have reported higher rates of OM procedure among women age 65 and over [34]. Ferrante et al. [58] used state discharge abstracts and the state tumor registry data to identify patients who had been diagnosed with breast cancer and treated with mastectomies in Florida in 1994, and found that OMs were more likely to be performed on women age 65 and over as compared to women younger than 65 years of age. Warren et al. [33] conducted a large population-based study to explore utilization trends and outcomes after OM in the U.S. Their study included all women aged 65 and older in the fee-for-service Medicare program between 1986 and 1995. These researchers found no significant association between patient age (75-84 and ≥85 versus 65-74 years of age) and the likelihood of undergoing OM in their study. However, as previously mentioned, this study only included older women. Given higher rates of breast cancer incidence among younger women (<65 years of age) [65, 66], it is possible that age differences in relation to the type of treatment may occur in these younger women. However, more studies of younger patients are needed to confirm this possible association.

Patient Race

Variations in treatments have been found to be correlated with patient race [41-46]. For many clinical conditions, African-Americans are less likely than whites to receive newer or more technologically intensive medical services [67]. Racial differences in treatment can be due to subtle biases of physicians as well as racial cultural differences in patients' health beliefs and preferences [68]. A study of racial patterns of breast cancer treatment by McWhorter and Mayer reported that African-American women were less likely than white women to receive any surgical treatment for breast cancer [69]. Analyzing the care of 36,905 women in the SEER Program from 1978 through 1982, the authors reported that African-American women were 40% more likely than white women to receive non-surgical treatment and 70% more likely to receive no treatment [69].

Studies suggest that nonwhites are less likely to receive OM than their white counterparts [34]. Salasky et al. [70] examined differences in the use of OM based on patient race using data from 47,318 patients enrolled in the American College of Surgeons National Surgical Quality Improvement Program Participant Use File who had undergone a mastectomy during the years 2007 to 2010. The authors indicated that more than half (62.6%) of mastectomies were performed in the outpatient setting. All racial minorities had lower rates of OM, with 63.8% of white patients, 59.1% of African-American patients, 57.4% of Asian, Native Hawaiian, or Pacific Islander patients, and 43.9% of American Indian or Alaska Native patients having had an OM. After adjusting for multiple factors, African-American patients, American Indian or Alaska Native patients, and those of unknown race were all less likely to undergo OM compared with white patients [70]. According to Warren et al.,[33] nonwhite patients were also much

less likely to undergo outpatient modified radical mastectomy (removal of both breast tissue and lymph nodes) than white patients. There is little empirical literature examining the effect of ethnicity on OM utilization. In most previous studies on OM, patients who were classified as black Hispanic, white Hispanic, or unknown Hispanic were collapsed into the black, white, and unknown categories, respectively.

Of note, studies of racial variations in medical care, including treatment of breast cancer, have often had limited ability to control for socioeconomic factors such as income and insurance coverage. Such factors can be critical mediators of racial variations in care [71, 72].

Income Level

No studies have examined a patient's educational and income level as predictors for the likelihood of undergoing OM or Inpatient Mastectomy (IM). There is a possibility that patients with low educational and income levels are more likely to undergo outpatient procedures, as they usually have a higher likelihood of being uninsured compared to patients with advanced educational attainment [58]. Nevertheless, it is impossible to conclude this from the limited available research.

Patient Residency

Access to health care services in rural versus urban areas has been explored by health services researchers for decades. However, there is limited empirical literature examining the relationship between patient residency and the likelihood of having an OM. Previous studies have demonstrated that rural residents are, on average, poorer, older, and less likely to be insured than persons living in urban areas [73, 74]. Rural Americans also report more chronic conditions and describe themselves in poorer health

than urban residents [75]. According to these findings, it could be suggested that patients in rural areas are more likely to undergo OM than IM. However, more evidence is needed to confirm this association as there is a possibility that ambulatory settings or hospitals in rural areas are not prepared with facilitated operating rooms and specialized personnel for such a major procedure being performed as an outpatient.

Comorbid Conditions

Comorbidity refers to the presence of diseases or conditions other than the one currently being treated. Most previous studies suggest that the patients' medical conditions greatly influence the type of procedure they receive [33]. In general, the decision on outpatient or inpatient care should be made on an individual basis. For every patient, the nature of any pre-existing condition, its stability (whether it is stable or degenerative), and the patient's functional limitations, needs to be evaluated [76]. Researchers emphasize that patients with a high burden of comorbidities (such as hypertension or diabetes) or advanced and/or metastatic cancer are more likely to have inpatient surgery whereas patients without these conditions are more likely to undergo outpatient procedures [33, 34]. However, no study, to date, has examined comorbidities as a predictor of surgeons' practice style for mastectomy.

Health Insurance

Health insurance, especially managed care, is considered an increasingly important influence on the type of health care and services that patients receive and may in part explain some of the observed variation in breast cancer treatment and outcomes [77]. Most studies have found that patients who lack health insurance and those who are insured by Medicaid are less likely to receive the surgical treatment they need and have

worse survival rates than patients who have commercial insurance [68, 78]. Moreover, some studies have found that patients who belong to an HMO may be less likely to receive surgical treatments and might have worse survival rates than those patients who have Medicare fee-for-service (FFS) forms of health insurance [77]. Insurance payer also has been shown to vary substantially by race and could possibly explain in part racial differences observed in the care and outcomes for women with breast cancer [79].

Although it is well established that the OM procedure is medically safe and feasible, it may not be appropriate for some patients. However, cost-conscious insurance companies may limit a patient's choice to OM procedures to lower hospital costs,[33] although, for some women, an overnight stay is not enough to begin their physical and emotional healing. In a study conducted by the AHRQ, the authors examined medical records from five US states (Colorado, Connecticut, Maryland, New Jersey, and New York) between 1990 and 1996, and concluded that women without health insurance or those who were Health Maintenance Organization members were 30% to 60% more likely to undergo OM procedures than women with health insurance, Medicare, or Medicaid coverage [52]. The researchers also examined the trends and patterns for OM in the five states and found a significant increase in the rate of OM in the late 1990s, in part because of pressures from insurance companies during those years to make OMs mandatory [52]. In contrast, Ferrante et al. [58] did not find any association between health insurance type and having an OM among patients who had been diagnosed with breast cancer and treated with mastectomies in Florida in 1994. However, their findings were consistent with other studies in demonstrating higher rates of OM among women without health insurance [58].

2.4 Provider-level Predictors of Surgeon's Choice of Surgical Style

Although patient demographics, health conditions, and patient preference play an important role in determining the suitability of surgical modality, physicians are increasingly recognized as critical contributors to the observed variation in the use of different treatment options. Physicians make key decisions about admitting and discharging patients, ordering imaging and diagnostic tests, and referring for procedures. Physicians can also indirectly influence the decision on surgical modality by the time they spend on consulting patients regarding surgical options [80]. Therefore, it is important to examine the physician characteristics that influence the use of different procedure options.

Moreover, most existing findings from health services research confirm that utilization of various treatments or procedures for a similar patient population varies widely between hospitals [81]. According to previous studies, characteristics of hospitals are often viewed as proxy measures of hospital practice patterns [82]. In a study by Kowalski and colleagues, the researchers investigated the variations in information provision to breast cancer patients by hospital characteristics. The authors used data from 5,024 newly-diagnosed breast cancer patients treated in 111 breast center hospitals in Germany in 2010 to examine variations in information provided by hospital characteristics [83]. The researchers found that differences between the hospitals characteristics account for some of the variations in information provision to patients. In hospitals that provide patient-specific information material as well as those that were non-teaching or had lower patient-volume, patients were less likely to report unmet information needs [83].

Previous studies have found that variations in a physician's medical practice are indeed related to the hospital in which physicians practice. According to Eddy [84], physicians will adapt to the usual practice in the hospital in which they treat patients, in order to avoid being criticized. Characteristics of the hospital or ambulatory setting, such as free-standing versus hospital-based ambulatory surgery center, teaching versus nonteaching, and for-profit versus nonprofit, deserves special attention as they influence physicians' ability to manage complex patients based on the availabilities of personnel and equipment. In addition, characteristics of the surgical setting can be associated with surgeons' practice styles as different settings have different recruitment policies [85]. Recruitment policies may be in favor of hiring physicians with particular practice style and preference. Warren et al. indicated that OMs were more likely to be performed in for-profit or nonteaching hospitals. Women treated in for-profit hospitals were 56% more likely to have OM than women treated in nonprofit hospitals [33]. A study by Case et al. [52] indicated that the likelihood of receiving an OM was 60% lower in a publicly funded hospital, however, this rate did not differ between private nonprofit and for-profit hospitals. In addition, Case et al. [52] found that women were less likely to receive an OM in a teaching hospital as compared to a nonteaching hospital. Further research is needed to assess such discrepancies in findings and the impact of hospital characteristics on the utilization of OM.

Decisions on the utilization of treatment options are ultimately made by frontline clinicians and not by hospitals [86]. However, the degree to which utilization decisions by individual physicians vary between hospitals, and the clinical implications of that variation, are unknown. To improve access, we need a better understanding of why

variations exist and whether hospitals can influence shaping physicians' practice style or signature. In this section, several provider-level factors related to the surgeons' choice of practice style and modality approached for mastectomy procedure are discussed.

Surgeon Volume

According to volume-outcome studies, surgeon volume is defined as the number of procedures performed by the surgeon in a given timeframe (in most cases, annually) [87-90]. The impact of surgeons' volume on their practice styles and patterns can be viewed from three different perspectives. First, surgeon volume is an indicator of his/her experience. The more mastectomy cases are performed, the more experienced the surgeons become. However, higher experience can lead to surgeon's comfort with one particular surgical approach and shape surgeon's practice style/signature toward that method [53]. The second view concerns the time that surgeons spend with their patients to discuss different treatment options. Spending more time educating patients helps surgeons make their decisions primarily based on patient need and preference rather than their own experience, expertise, or comfort with one surgical approach [91]. Previous studies have demonstrated that the variation in time spent with patients is determined more by the individual physician characteristics such as demographics, experience, and volume of patients than by patient factors [92]. However, higher volume of patients can result in shorter visits and time spent with patients. Thirdly, previous studies on physician experience and patterns of service provision have revealed a trend towards greater provision of more comprehensive services with increasing patient numbers [93]. Highly experienced physicians are more likely to provide complex supportive services, basic clinical follow-up care such as regular tests, more specialized therapeutic care, and

palliative and home-based care [61]. Presumably, these groups of physicians are less likely to discharge patients the same day after a major surgery such as mastectomy. However, more evidence is needed to confirm this association.

A considerable body of research has explored the association between surgeon volume and patient outcomes (i.e., mortality, surgical complications) for many surgical procedures [94-98]. However, there is limited empirical literature examining the relationship between the likelihood of performing an OM or IM and surgeon volume. Using 1997 to 1998 data from Florida inpatient and outpatient settings, Luther and Studnicki [99] found that the mastectomy rate was higher among patients of low-volume surgeons compared with those of high-volume surgeons, largely because high-volume surgeons were more likely to perform BCS rather than mastectomy. However, their study did not demonstrate any significant results for the relationship between surgeon volume and likelihood of performing an OM or IM [99].

Hospital Teaching Affiliation

A teaching hospital is a hospital or medical center that provides clinical education and training to future and current health professionals. Teaching hospitals are often affiliated with medical schools and work closely with medical students throughout their period of matriculation, and especially during their internship years [100]. Every year, over 50% of all patients admitted to hospitals in the U.S. are admitted to a teaching facility even though teaching hospitals constitute only 24 % of all American Hospital Association registered hospitals [101]. In most cases, teaching hospitals also offer Graduate Medical Education (GME)/ physician residency programs, where medical school graduates are trained under a supervising (attending) physician to assist with the

coordination of care. In addition to offering medical education to medical students and physician residents, many teaching hospitals also serve as research institutes [100]. In teaching hospitals, surgical residents and students participate in operations and, to varying degrees, care for the patients in the postoperative period [100].

Some studies using patient satisfaction surveys have demonstrated that in teaching hospitals, patients in need of complex procedures are concerned that having surgical residents or medical students involved in their care may result in adverse outcomes [102-104]. On the other hand, studies have shown that for common conditions, teaching hospitals offer a lower quality of care than do nonteaching hospitals [68]. Besides, substantial involvement of inexperienced trainees and the attenuated role of senior physicians in teaching hospitals can result in more fragmented and less appropriate care [68]. In contrast, patient outcome studies have reported better care and outcomes associated with teaching hospitals for many complex procedures including breast cancer surgeries due to: a) a higher volume of cases, b) more advanced technology, c) the expanded role of specialists, or d) the greater availability of resident physicians for a more timely assessment of severely ill patients [68]. Moreover, the standard of care in a teaching hospital is often considered to be superior to non-teaching hospitals as they attract the very best of teaching staff [68].

Differences in hospital teaching status have been reported to impact physician's treatment choices [105, 106]. Teaching hospitals are expected to focus on providing the "right" treatment without considering the insurance type of the patient or other patient-level factors. In addition, residents who train at hospitals that emphasize patient preferences and shared decision-making learn to give patients the information they need

to make the best decisions based on patient needs rather than their own preferences [106]. However, teaching hospitals have their own style and culture of practice that represents a training curriculum. As a result, teaching status of the hospital can influence a physician's practice signatures as in teaching hospitals, residents/students learn from their mentors and model their mentors' practice behaviors or judgemnts [106]. Hence, they are influenced by the practice styles of mentors and peers.

However, regardless of where physicians train, young physicians must strive to elicit the preferences of patients in order to always perform the right procedure on the right patient at the right time. Moreover, understanding the relation of hospital teaching status to the utilization of different treatment options can help guide efforts to improve access to both types of hospitals. To date, there is a paucity of literature examining the influence of teaching status of the hospital on surgeons' choice of mastectomy surgical approaches.

Hospital Ownership Status

The U.S. hospital industry includes a mix of ownership forms. Non-profit hospitals are the most common type, but for-profit and government hospitals also play substantial roles in the industry [107]. A non-profit hospital, or not-for-profit hospital, is a hospital which is organized as a non-profit corporation. Non-profit hospitals are mostly funded by charity, religion or research/educational funds [107]. Non-profit hospitals do not pay federal income, state, or local property taxes, and in return they benefit the community. For-profit systems benefit from investors' money and have more flexibility about which services they offer, often seeking more profitable ones [107]. Generally, the opponents of the for-profit facilities are concerned that for-profit hospitals focus mostly

on financial metrics such as improving payer mix and increasing volume, shunning disadvantaged patients and paying less attention to the provision of high-quality care [108].

The majority of hospitals in the U.S. operate as nonprofit organizations. In 2003, of the roughly 3,900 nonfederal, short-term, acute care general hospitals in the U.S., about 62% were nonprofit. The rest included government hospitals (20%) and for-profit hospitals (18%) [109]. Between 1992 and 2007, for example, not-for-profit hospitals controlled, on average, 59.26% of all hospital beds in the country [109]. Ownership of hospitals in the U.S. has been trending away from not-for-profit or government ownership and towards increased for-profit ownership over the last fifty years. For example, between 1970 and 2005 approximately 7% of the roughly 5,000 not-for-profit hospitals in the U.S. converted to for-profit ownership [109]. Not only are hospitals changing ownership status, for-profit hospitals are growing in size relative to not-for-profits. In the past, the average not-for-profit hospital used to operate three times as many beds as the average for-profit hospital, however, as of 2000 this gap has decreased to the extent that not-for-profits operate only 32% more beds than their for-profit competitors [110].

Studies have found some differences between nonprofit and for-profit hospitals in patient outcomes and type of services the hospitals provide, although it is not always clear if the distinctions are related to the ownership type or other factors. A study by Aiken and colleagues in 2000 reported higher mortality rates among elderly patients with heart disease in for-profit centers than nonprofit hospitals [111]. However, according to the authors, much of the difference appeared to be related to location, rather than the type

of ownership. The relationship between hospital ownership and patient access, morbidity, and satisfaction has also received considerable attention during the last decades [112-114]. However, researchers have not previously looked broadly at whether any hospital type is more or less likely to accord different treatments given patient's insurance type and other characteristics. According to previous studies, physicians in for-profit hospitals see fewer numbers of patients on hospital rounds compared to non-profit hospitals [115]. According to these findings, it could be suggested that lower patient volume can be attributed to spending more time with patients and greater provision of information, hence making decisions based on patient needs rather than physician preference. On the other hand, it could also be argued that low volume surgeons who tend to work at for-profit hospitals do not have the experience or confidence in performing different methods of surgeries. However, even with these contradictory evidence, the relationship between the differences in physicians' practice styles and patterns and the characteristics of their practice settings remain poorly understood and the policy implications of this relationship are widely disputed and unclear.

Hospital Size and Case Volume

Hospital size usually is measured by its number of beds. An oversupply of beds makes it easier to admit and readmit patients [116]. Although admission to hospitals depends primarily on physicians' opinions about necessity and the available supply of beds, the probability of being hospitalized or admitted to the hospital is significantly related to the capacity of the hospital compared to the size of the population it serves [117]. The more hospital beds there are per capita, the greater the likelihood the patient will be admitted.

Contradictory results have been reported regarding the association between hospital size and patient outcomes and quality of services provided by hospitals. Callaway and colleagues examined whether patient survival after cardiac arrest was related to hospital characteristics [118]. The researchers performed a secondary analysis of data from a randomized, prospective, multicenter, intention-to-treat, Out-of-Hospital Cardiac Arrest (OHCA) clinical trial. The study results showed that a total of 4,087 OHCA subjects were treated at 254 hospitals, and 32% survived to hospital discharge. Survival was not associated with hospital bed number, teaching status or trauma center designation [118]. Another study, a meta-analysis of 21 empirical studies by Lee and Xia found that organizational size influence diffusion and innovation adoption [119]. This study found that Information Technology (IT) innovation adoption was slower in smaller organizations because of their lack of capital to invest in information technology. However, it is hypothesized that smaller hospitals can more quickly diffuse and implement more innovative and effective process standards across their organization compared to the lag of diffusion within larger system-owned hospitals [119]. It is also reported that smaller and rural hospitals have a closer relationship with the population within its medical service area which causes higher consumer satisfaction [120]. As a result, it is possible to assume that in smaller hospitals, physicians' decisions on treatment options are more likely to be made based on patient preference, however, more evidence is needed to confirm this assumption. In addition, hospital size can be considered as an indicator of hospital volume and, therefore, can influence the practice styles of physicians. However, like most hospital characteristics, its influence on shaping physicians' practice signatures remains poorly understood.

Previous cancer studies have revealed that patients undergoing complex cancer operations in low-volume hospitals tend to have increased perioperative and long-term morbidity and mortality [121]. This phenomenon has been documented in malignancies of the colon [122], pancreas [123], esophagus [124], lung [125], stomach, breast, soft tissues, and rectum [126]. Elixhauser and colleagues studied the case volume, mortality, and associated hospital and staffing characteristics of ten complex procedures in U.S. hospitals using the 2000 Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample. The researchers found that mortality rates were significantly higher at low-volume hospitals for five procedures (CABG, coronary angioplasty, pancreatic and esophageal cancer surgery, and cerebral aneurysm surgery) [127]. Some other studies have demonstrated that volume may be a proxy for other explanatory variables, such as other organizational characteristics (teaching and profit status, hospital location, processes of care, the expertise of staff, and ratios of staff to patients) [128]. According to these studies, some low-volume hospitals have outcomes comparable to those of high-volume hospitals and some high-volume hospitals have poor outcomes. Therefore, hospital volume is not the sole explanatory variable [129].

Hospital case volume can influence surgeons'/physicians' practice styles as it can decrease time spent with patients to discuss their different treatment options. High volume hospitals also tend to admit more complex cases or patients with higher cancer stages, which may result in shaping a particular modality approach among surgeons within those hospitals. However, the impact of hospital volume on shaping physicians' practice styles and patterns has received little attention.

Hospital Location

It has been reported that 72 million Americans live in rural areas and depend upon the hospital serving their community as an important, and often only, source of care [130]. The nation's nearly 2,000 rural community hospitals frequently serve as an anchor for their region's health-related services, providing the structural and financial support for physician practice groups, health clinics and post-acute and long-term care services. In addition, these hospitals often provide essential, related services such as social work and other types of community outreach [131].

Rural hospitals usually tackle challenges due to their often remote geographic location, small size, limited workforce, and constrained financial resources. Moreover, rural hospitals' low-patient volumes make it difficult for these organizations to manage the high fixed costs associated with operating a hospital [132]. This in turn makes them particularly vulnerable to policy and market changes, and to Medicare and Medicaid payment cuts [132]. Rural hospitals typically are much smaller than their urban and suburban counterparts; nearly half have 25 or fewer beds [131]. Although rural hospitals make up half of all hospitals, they only represent about 12% of spending on hospital care. Despite a smaller size and smaller base of patients to draw from, rural hospitals still have to maintain a broad range of basic services to meet the health care needs of their communities [131]. But with fewer patients over which to spread fixed expenses, costs per case tend to be higher [132]. Rural hospitals have seen a dramatic shift from inpatient to outpatient care as technology and practice patterns have changed and specialized inpatient services have remained concentrated in urban areas [132]. Since rural hospitals are often the sole site for patient care in the community, they also are more likely to offer

additional services that otherwise would not be accessible to residents. For example, many rural hospitals provide hospice, home health services, skilled nursing, adult day care, and assisted living [132]. Often, rural hospitals step in to offer these services out of a sense of community responsibility, as stand-alone providers may have trouble keeping their doors open in low-volume, isolated areas of the country [132].

The location of physician practice is a significant predictor of physician practice style as it relates to the supply of health care resources [133]. Physicians practicing in geographically isolated environments face a number of organizational problems which may influence their ability to provide appropriate treatments: (1) shortages of health professionals, especially specialists; (2) limited available technology; (3) insufficient patient volume; and 4) inadequate continuing education [134]. According to previous studies, medical services provided in rural areas is substantially lower than those provided in urban regions, and the disparities in the availability of hospitals and physicians are the main contributors to such urban rural differences in accessing health care services [135]. In a study by Weiner and colleagues conducted to examine the factors associated with better attainment of quality standards for elderly patients with diabetes, the authors found that even after adjustment for patient mix and physician characteristics, patients of rural hospitals were less likely to receive ambulatory services that met recommended quality criteria than patients of urban hospitals [136].

2.5 Summary and Study Significance

For many decades, it has been understood that physicians treating similar patients often come to different conclusions about how to best treat the patient's condition [51]. This occurs most frequently when there are different treatment options available that lead

to a preferred patient outcome. This is known as the ‘variations in practice’ phenomenon and has several major policy and cost implications [57].

It is widely acknowledged that variations in medical practice exist. It is within this context that variations in primary care with regard to diagnoses, ordering of diagnostic tests, referral rates, and drug prescribing [137, 138], as well as in secondary care (hospital admissions, decisions on surgery, diagnostic procedures, and length of stay) [139, 140] has received special attention. The literature demonstrates that variations in physicians’ practice styles are not random and clear patterns of variation in styles exist [60, 141]. Previous studies highlight an association between patient needs and preferences, physician demographic and experience, and hospital characteristics and utilization of different treatment options [30]. However, all these factors may be influenced by surgeon preference of practice style. There is evidence that most women follow surgeons' recommendations, their primary source of information about treatment options. For example, in a study by Kotwall and colleagues [142], the authors examined clinicopathologic factors and patient perceptions associated with surgical breast-conserving treatment versus mastectomy and found that 93% of the patients said their surgeon was the primary source of information regarding treatment options. Their study findings also indicate that surgeons recommended a specific treatment option in 69% of cases; in 89% of these cases they suggested mastectomy and in 11% BCS. The rates of compliance with these recommendations were reported to be 93% and 89%, respectively [142].

Variations in physicians’ practice styles and patterns can be explained by differences in the characteristics of the patients they treat, characteristics of physicians

themselves, and the characteristics of the hospital in which physicians treat their patients. In the case of mastectomy surgery, some surgeons may perform exclusively ambulatory procedures which require less postoperative monitoring while others may prefer inpatient surgical style due to concerns about post-operative complications. There are also surgeons who perform both types of modalities for mastectomy. Surgeons who choose an exclusive approach obtain more experience and specialization in that particular method. However, with an exclusive approach, it is possible that surgeons make their decisions on treatments based on their comfort and experience with that particular approach regardless of patient preference and needs. The optimal treatment requires good communication between patient and provider and making decisions on the appropriate method based on patient need and preference, and not surgeon's preference, expertise, or comfort with one particular style. With following an exclusive method of treatment or surgery, physicians may automatically alter patients' decision toward that particular choice. No single study has ever investigated a surgeon's preference of surgical modalities for mastectomy procedures. Most researchers in the field have concentrated on inpatient and outpatient BCS procedures rather than mastectomy. However, the current study will focus exclusively on mastectomy procedures as almost all BCS surgeries are now being performed on an ambulatory basis. The present study investigates the non-clinical factors associated with surgeons' styles or "surgical signatures*"* for mastectomy procedures (inpatient versus outpatient). The current study also examines the non-clinical predictive factors of each practice modality including: exclusive approaches of IM and OM and bimodal approach (performing both inpatient and outpatient) for mastectomy procedures at the patient, physician, and system level.

2.6 Objectives and Hypotheses

The overall objective of the study is to examine 1) non-clinical predictive factors of practice style selected by surgeons in mastectomy cases and 2) the patient, surgeon, and system level non-clinical factors associated with a surgeon's choice of exclusive inpatient and outpatient versus bimodality approach for mastectomy procedures.

The specific objectives and hypotheses are:

Objective 1: To evaluate patient characteristics to predict surgeon's practice style and modality approaches for mastectomy procedure

H1.1: Patients with minority race and patients who have private insurance have higher odds of having their mastectomy performed by surgeons with outpatient mastectomy preference.

H1.2: Older, rural, and racial minority patients, and patients who have private insurance have higher odds of having their mastectomy performed by 'exclusive outpatient' or 'exclusive inpatient' surgeons.

Objective 2: To explore the relationship between surgeon volume and selection of practice style for mastectomy procedure

H2.1: High volume surgeons are less likely to use the outpatient mastectomy approach compared to low volume surgeons.

H2.2: High volume surgeons have lower odds of being among 'exclusive outpatient' or 'exclusive inpatient' surgeons.

Objective 3: To examine hospital characteristics to predict surgeon's choice of mastectomy surgical style

H3.1: Non-teaching and for-profit hospitals, and hospitals with high-volume (total discharges and mastectomy volume) have higher odds of having mastectomies performed by surgeons who prefer to use an outpatient approach.

H3.2: Non-teaching and for-profit hospitals have higher odds of having mastectomies performed by 'exclusive outpatient' or 'exclusive inpatient' surgeons.

CHAPTER THREE: METHODS

3.1 Conceptual Framework

I hypothesize that patients with different demographic and clinical characteristics can have different choices of surgeons with different surgical styles. Moreover, surgeons with different case volume can have different preferences for modalities. In addition, hospitals with different organizational characteristics may hire, work, or collaborate with surgeons with different style preferences. The first part investigates the non-clinical factors associated with surgeon's choice of surgical style/signature. The second part explores the non-clinical predictive factors associated with surgeons' modality approaches in choosing bimodality versus exclusive inpatient or outpatient approaches for mastectomy cases.

The physician propensity framework developed by O'Neill and Kuder [40] (Figure 2.1) has served as a foundation for the conceptual framework for this study. The framework demonstrates that there are three sets of variables that are likely to influence variations in physicians' clinical decisions about treatment approaches (Figure 2.1). In the original framework, stage 1 refers to physician characteristics and "general or baseline heuristic decision structure" for clinical cases of the same type. These general heuristic factors such as physician's philosophical perspective, strategic style, and perceived role regarding the patient's problem form the clinical basis for decisions regardless of the setting or the specific characteristics of the patient. For example,

because of experience and educational differences, some physicians may be more inclined to choose a particular method of treatment. This baseline heuristic decision is presumed to largely reflect the physician's medical training, experience, and personal preferences. Stage 2 of the model refers to environmental characteristics of the physician practice setting. According to the physician propensity framework, the environment can influence practice-specific decisions as the organizational structure and the availability of resources can be expected to cause adjustment to the baseline heuristic decision. For example, a group practice setting with consultations between physicians is likely to develop different treatment styles than a solo practice [143]. Stage 3 refers to individual patients as contributors to variations in physicians' practice patterns. Here physicians are likely to adjust their strategy on the basis of the specific clinical condition of the patient (severity of the signs and symptoms, comorbidities, patient demographics, and patient preference).

The modified version of the propensity framework used for the purpose of the current study (Figure 2.2) incorporates the following elements: patient characteristics, operating surgeon characteristics, and hospital characteristics. The interactions and interrelationships between these patient and provider characteristics lead to certain outcomes of surgical care, in this case defined as 1) surgeon's choice of practice style (inpatient versus outpatient) for mastectomy procedure and 2) variations in surgeons' modality approaches in mastectomy cases (exclusive inpatient, exclusive outpatient, and mixed method). Figure 2.2 provides a succinct view of the framework and highlights the areas of research to be examined by the current study to provide better understanding of

the non-clinical factors that predict surgeons' practice styles and patterns for mastectomy procedure.

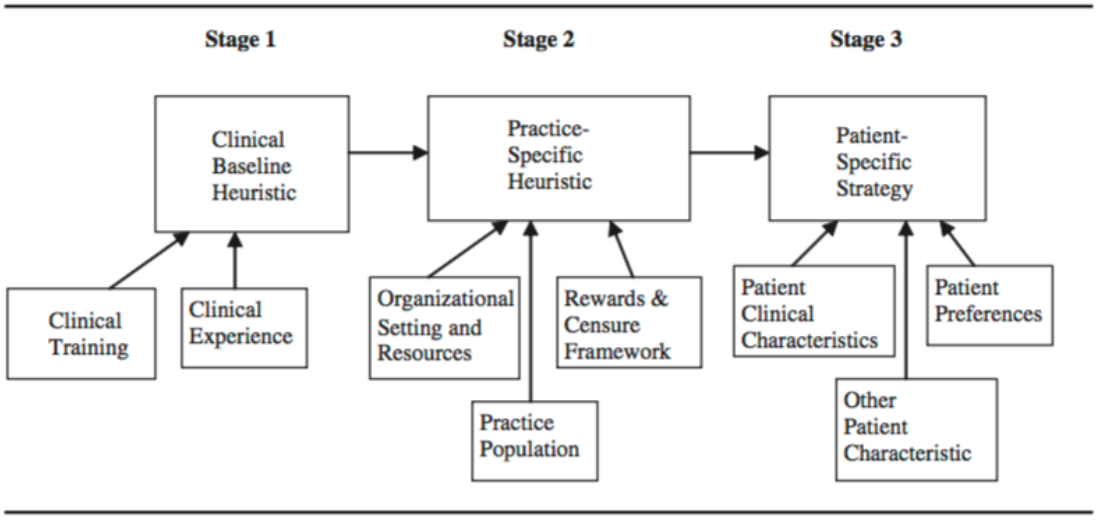

Figure 2.1. Physician pathway to patient care strategy developed by O'Neil and Kudar (2004)

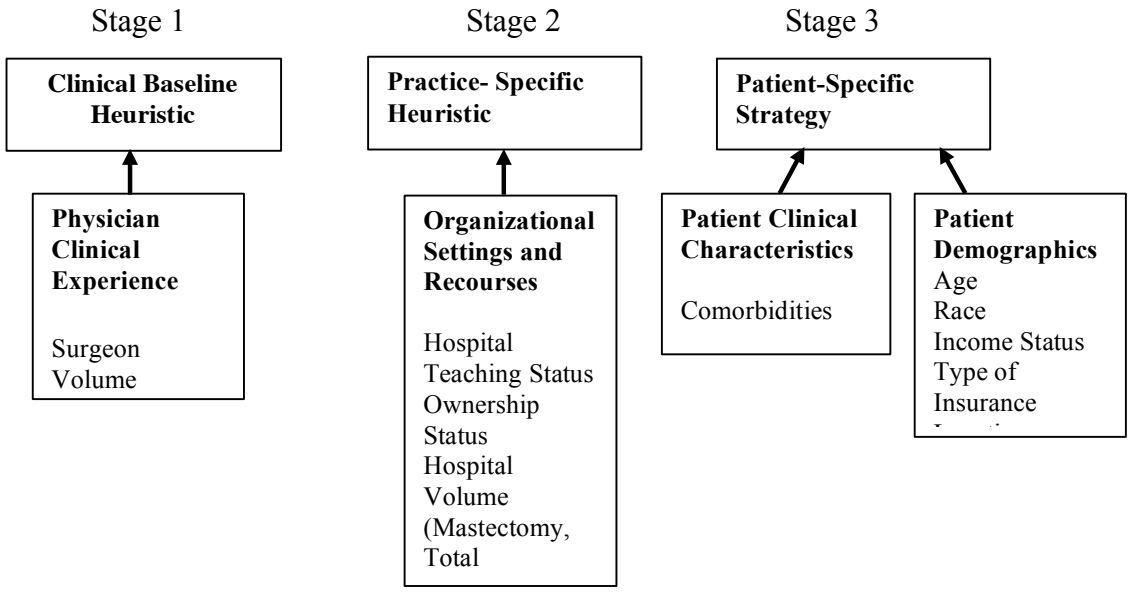

Figure 2.2. Conceptual Framework: The relationship between patient, surgeon, and hospital characteristics and surgeon's choice of surgical style and pattern for mastectomy procedure

3.2 Data Sources

This pooled cross-sectional study used several sources of retrospective administrative data to examine the research questions:

1. 2013 Florida Agency for Healthcare Research and Quality's (AHRQ) Healthcare Cost and Utilization Project (HCUP)-State Ambulatory Surgery Database (SASD)
2. 2013 Florida Agency for Healthcare Research and Quality's (AHRQ) Healthcare Cost and Utilization Project (HCUP)-State Inpatient Data (SID)
3. Agency for Health Care Administration (AHCA) Database

A common physician and/or hospital identifier contained in all data files listed above allowed these various sources to be linked. Detailed descriptions of the data files are given below.

State Inpatient Data

State Inpatient Data (SID) is part of the Healthcare Cost and Utilization Project (HCUP) sponsored by the Agency for Healthcare Research and Quality (AHRQ). Data contained in the HCUP databases are collected through a variety of sources that include state and federal data collection agencies along with hospital and other private data [144]. The HCUP databases including, SID, SASD, and State Emergency Department Databases (SEDD), provide complete information on all hospital discharges, ambulatory surgeries, and Emergency Room (ER) visits. Each record contains patient demographic information, hospital and county identifier, diagnoses, procedures, discharge status, length of stay, total charges and payment source. HCUP is a family of health care databases and related software tools developed through a federal-state-industry partnership to build a multistate health data system for health care research and decision

making [144]. SID is a set of hospital databases from data organizations in participating states. The SID encompasses about 97% of all U.S. community hospital discharges (Table 3.1). For the purpose of this research, 2013 Florida HCUP-SID data were used to identify IM procedures [145].

State Ambulatory Surgery Database

The State Ambulatory Surgery Database (SASD) is also a part of HCUP databases, and captures 100% of ambulatory procedures performed on the same day in which patients are admitted and released [145] (Table 3.1). For the purpose of this study, 2013 Florida HCUP-SASD were used to identify OM records.

The mastectomy procedures were identified using calendar year 2013 Florida combined HCUP SID and SASD discharge records. The procedure codes in the dataset were based on ICD-9-CM coding.

Table 3.1: List of Variables Obtained from SID/SASD Databases

Variable name	Variable description	Code/values
Patient age	Patient's age in years at admission	Numeric, continuous
Patient race	Race of patient	Numeric, nominal 1. White 2. Black 3. Hispanic 4. Asian or Pacific Islander 5. Native American 6. Other
Pay source	Principal pay code	Numeric, nominal 1) Medicare 2) Medicaid 3) Private insurance 4) Self-Pay 5) No charge 6) Other

Table 3.1 (continued)

Variable name	Variable description	Codes/values
Patient residency	Patient location	Numeric, nominal 1) Urban 2) Large rural town 3) Small rural town 4) Isolated rural
Patient income	Quartile classification of the estimated median household income of residents in the patient's ZIP Code	Numeric, ordinal 1) 0-25th percentile 2) 26th to 50th percentile 3) 51st to 75th percentile 4) 76th to 100th percentile
Diagnosis code	A code representing a condition that is related to the services provided during the hospitalization excluding external cause of injury codes. ICD-9-CM code	Alphanumeric
Procedure code	The ICD-9-CM code identifying all significant procedures other than principal procedure.	Alphanumeric
DRG	Diagnosis Related Group (DRG) from federal (CMS)Grouper	Numeric
MD operating	Unique operating or performing physician identification number. The Florida license number of the medical doctor, osteopathic physician, dentist, podiatrist, chiropractor, or advanced registered nurse practitioner who had primary responsibility for the procedure	Alphanumeric
Hospital identifier	Unique HCUP hospital identification number. The same identification codes as defined by the American Hospital Association Annual Survey of Hospitals	Alphanumeric

Agency for Health Care Administration

The Agency for Health Care Administration (AHCA) routinely collects administrative data from hospitals and ambulatory (outpatient) surgery centers and is a national leader in providing health care data and information [146]. The Florida AHCA created the Florida Health Finder website to provide Florida residents, professionals, and researchers with healthcare service information and data. The website includes comparisons of hospitals, ambulatory (same-day) surgery centers, healthcare plans, nursing homes, and prescription drug prices. The website also provides information on

hospital profiles which include ownership, number of beds, hospital healthcare services/characteristics, mortality rates for inpatient procedures and conditions, and the number of procedures done in each area [146] (Table 3.2). Unique hospital identifiers from the combined SID/SASD data were matched with AHCA number, and hospital characteristics information were verified through the AHCA online database for final accuracy and data validation.

Table 3.2: List of Hospital Characteristics Variables Obtaining from SID/SASD & AHCA Databases

Variable name	Variable description	Code/values
Hospital identifier	Unique HCUP hospital identification number	Alphanumeric
Institution name	Name of hospital	Character
Institution type	Whether a hospital or free standing or ambulatory surgery center	Character
Institution address	Address (street and unit number)	Character
Institution county	Address (name of the county)	Character
Institution zip code	Address (zip)	Numeric
Ownership status	Type of hospital's ownership	Numeric, nominal 0) Not-for-profit 1) For-profit
Teaching status	Whether the hospital is a teaching hospital	Numeric, nominal 0) Teaching 1) Non-teaching
Total discharges	Total number of discharges from each hospital as an indicator for volume	Numeric, nominal
Bed size	Assesses the number of short-term acute beds in a hospital	Numeric, continuous

3.3 Human Subject Protection

Although the study uses de-identified data, approval of the UNC Charlotte Institutional Review Board (IRB) was obtained (Protocol # 16-1040).

Study Population

Using the Current Procedural Terminology (CPT) codes and International Classification of Diseases, Ninth Revision (ICD-9-CM), the study population were restricted to patients who underwent a mastectomy (inpatient or outpatient) procedure in 2013 (CPT codes for OM: 19303,19304, 19305, and 19307) (ICD-9-CM codes for inpatient mastectomy: 8540, 8541, 8542, 8543, 8544, 8545, 8546, 8547, and 8548). Previous studies have examined the validity of the above coding for mastectomy procedures [147]. The Florida 2013 HCUP-SID and SASD datasets were combined and commercial software from Ingenix, Inc. was used to cross-reference the ICD-9-CM codes from the inpatient data source with the CPT-4 codes from the outpatient database in order to have clinically homogenous categories for various types of mastectomy procedures (Table3.3). Operating surgeons were identified using the unique physician identification number contained in the "MD-operating" field of the SASD and SID data. Previous research has indicated the reliability of this approach in identifying operating surgeons [148, 149].

Table 3.3: Mastectomy Procedure ICD-9 code to CPT Mapping

Procedure	Procedure Description	CPT	ICD9
Simple complete mastectomy	Removal of all entire breast tissue, along with a portion of skin and nipple through an elliptical incision.	19303	85.41 85.42
Subcutaneous mastectomy	The breast tissue is removed, but the skin and pectoral fascia remain.	19304	85.33 85.34 85.35 85.36
Radical mastectomy	Dissection of the breast, overlying skin, the pectoralis major and minor muscles and the axillary lymph nodes, which are all removed as a single specimen.	19305	85.45 85.46
Urban radical mastectomy	Radical mastectomy + removal of both axillary and internal mammary lymph nodes. For an inpatient visit, an Urban type of complex mastectomy is considered an "extended radical mastectomy	19306	85.47 85.48
Modified radical mastectomy	This procedure is less extensive than radical mastectomy. This procedure involves removal of entire breast tissue (skin, areola, nipple), and axillary lymph nodes. The pectoralis minor muscle may or may not be removed; however, the pectoralis major muscle is not removed. For an inpatient visit, a modified radical mastectomy is considered an extended simple mastectomy.	19307	85.43 85.44

3.4 Dependent Variables/Outcome Measures

There are two main outcomes for this study. The first outcome is surgeon's choice of practice style, inpatient versus outpatient for mastectomy procedure. Modality approaches selected by breast surgeons is the second outcome variable of the study.

Combined data from 2013 Florida SID and SASD were used to identify both outcomes. The first outcome is a dichotomous variable with the 'inpatient vs 'outpatient' practice style categories. In order to construct the surgeon practice style variable, surgeons initially were categorized into four groups: 1) surgeons who performed 100%

OM 2) those who operated 100% IM, 3) those who performed predominantly OM (>50% of their procedures were OM), and 4) those who predominantly did IM (>50% of their procedures were IM). Surgeons with the exact same number of IM and OM (50% each) (62 surgeons, n=312) and those with only one procedure on their record were excluded (surgeons n=213 and procedure n=213) to allow creation of the above four groups. In the next step, surgeons were classified into two groups of style preference: IM and OM style surgeons. Those surgeons who performed 100% IM or mostly performed IM were categorized into the 'IM style preference' group and those who chose 100% OM or mostly OM in their mastectomies were grouped into the 'OM style preference' category.

To obtain the second outcome, surgeons were categorized into three groups based on their modality approaches: 1) 'exclusive IM' surgeons who exclusively perform inpatient mastectomy, 2) 'exclusive OM' surgeons who exclusively operate mastectomies as outpatient, and 3) 'bimodal' surgeons who use both styles for mastectomy procedure. Surgeons with the exact same number of IM and OM were initially included for the second outcome. However, since the magnitude of the findings did not differ when this same group of surgeons was excluded from the analyses, these surgeons (n=62) and procedures (n=312) were ultimately removed from consideration to allow for the same sample population to be studied across the two outcomes.

Figure 3.1 illustrates the surgeon group categorization. The 'only inpatient' surgical modality group consists of surgeons who only performed mastectomies on an inpatient basis and did not have any records of OM in 2013. The 'only outpatient' modality group includes surgeons who performed mastectomies only on an outpatient basis. The group 'bimodal' consists of surgeons who used both methods (IM and OM) in

their surgeries, however, their style preferences may lean toward one method.

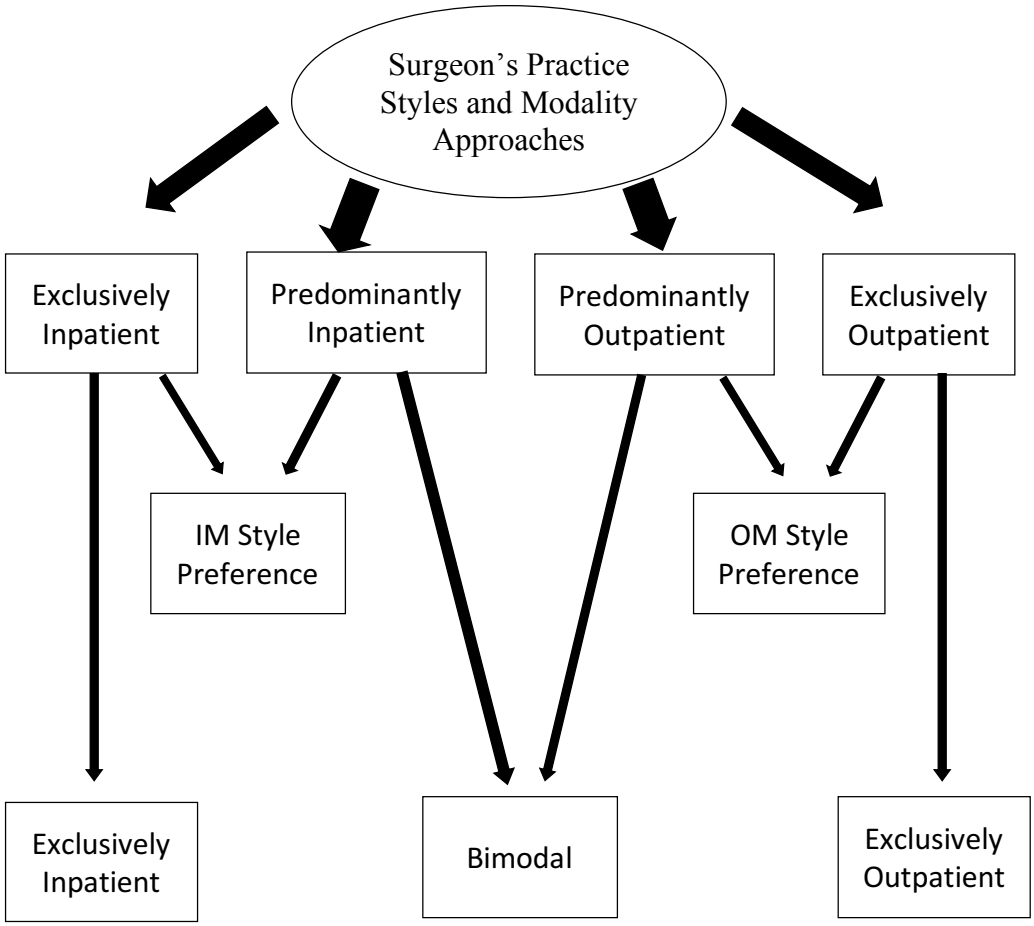

Figure 3.1 Surgeon's Choice of Surgical Modality

3.5 Independent/Predictor Variables

Patient Characteristics

Patient characteristics of interest in this study include: demographic factors such as age (categorical), race/ethnicity (categorical), pay source (categorical), median household income (categorical), urban vs. rural residency (dichotomous) and binary indicators for 30 comorbidities (Table 5).

All of the above listed variables are included in both the SID and SASD datasets except comorbidities. To generate comorbidities, the Elixhauser comorbidity software, version 3.5 developed by Elixhauser and colleagues were obtained from the AHRQ [150]. The extensive body of literature has examined the adequacy of administrative data for measurement of comorbidity and risk adjustment [151]. Only some of the 30 comorbidities were included in the analysis based on their clinical relevance. These comorbidities were: congestive heart failure (CHF), valvular disease, peripheral vascular disease, hypertension, neurological disorders, chronic pulmonary disease, diabetes, hypothyroidism, renal failure, deficiency anemias, rheumatoid arthritis, obesity, psychoses, and depression. All of these conditions were selected based on the chronicity of their nature and evidence for increased risk for surgery [18, 19, 152-154].

It is well-documented that the presence of comorbidities in patients with cancer is negatively associated with patients' health outcomes. Poorer survival from cancer also has been found in breast cancer patients with comorbidities compared to those without [155]. Furthermore, studies have found that the prevalence of comorbidities is higher among cancer patients than those individuals without cancer [156]. In most breast cancer studies, the most prevalent comorbidities associated with breast cancer were hypertension, chronic obstructive pulmonary disease (COPD), rheumatologic disease, decreased bone mass, diabetes mellitus, obesity, depression, and other psychiatric problems [155, 157]. Increased risk of development of comorbidities among cancer patients has been reported to be associated in part with the effects of cancer treatment [156].

Table 3.4 Patient Existing Comorbidities (Elixhauser Comorbidities Based on ICD-9-CM Codes)

Variable description	Codes/Values
Congestive Heart Failure	1= Yes, 0= No
Valvular Disease	1= Yes, 0= No
Peripheral Vascular Disease	1= Yes, 0= No
Hypertension	1= Yes, 0= No
Other Neurological Disorders	1= Yes, 0= No
Chronic Pulmonary Disease	1= Yes, 0= No
Diabetes	1= Yes, 0= No
Hypothyroidism	1= Yes, 0= No
Renal failure	1= Yes, 0= No
Deficiency anemias	1= Yes, 0= No
Rheumatoid Arthritis	1= Yes, 0= No
Obesity	1= Yes, 0= No
Psychoses	1= Yes, 0= No
Depression	1= Yes, 0= No

All patient characteristic variables were coded as categorical variables. As listed in Table 3.5, age was categorized into the following groups :<40 (referent), 40-59, and ≥ 60. The race variable further was categorized into four groups: white, African-American, Hispanic, and other races. Moreover, type of insurance was classified into four categories: Medicare, Medicaid, private insurance, and other types of pay sources. In the HCUP data, income level is categorized into quartiles ranging from the lowest income to the highest income based on median household income at the zip code level. This categorization was retained for this study. Patient location was classified as urban or rural residency. White race, lowest income level, Medicare, urban residency were the referent groups for these variables.

Surgeon Volume

Surgeon procedure volume was measured as the total number of mastectomy cases performed by each surgeon during the year 2013. Surgeons were categorized into three groups based on their total patient volume: low (<10), medium (10-19), and high

(≥20). This classification was selected based on the common surgeon volume categorization in previous volume outcome studies of breast cancer treatment [99, 158, 159].

Hospital Characteristics

Hospital characteristics of interest included teaching status, ownership status (not-for-profit and for-profit), bed size, hospital mastectomy volume, hospital total discharges volume, and hospital location (Table 7). Hospital-level data were obtained through linkage with the 2013 American Hospital Association survey database. Next, information was verified within the AHCA online database. To obtain the hospital mastectomy volume variable, the hospitals were sorted by their total mastectomy patient volume using the unique hospital identifiers in this database and by their caseload of mastectomy patients. The volume category cutoff points (high, medium, and low) were determined by sorting the 6,413 patients into 3 groups of approximately equal size: low, medium, and high volume categories. The same calculation was conducted for hospital total discharge volume and bed size. Hospital location (urban vs. rural) was verified using the Florida Rural Hospital Directory provided by the Florida Department of Health [160]. Previous research has indicated the reliability of this approach in identifying hospital location [161] . For hospital mastectomy and total discharge volume, the referent category was low volume hospital, for teaching status – teaching hospitals, for ownership status – not-for-profit hospitals, for bed size – small hospitals, and for location – urban hospitals.

Table 3.5: Definition of Variables and Coding

Variable	Definition
Patient age	<40 40- 59 ≥ 60
Patient race	White Black Hispanic Other
Pay source	Medicare Medicaid Private Insurance Other
Patient residency	Urban Rural
Patient median Household income	Quartile 1 Quartile 2 Quartile 3 Quartile 4
Patient comorbidities	Comorbid conditions identified by applying Elixhauser Comorbidity Algorithm based on ICD-9-CM codes 14 Individual comorbidities
Surgeon volume	Low Medium High
Hospital Mastectomy volume	Low Medium High
Hospital total discharges volume	Low Medium High
Hospital location	Urban Rural
Hospital bed size	Small Medium Large
Ownership status	Not-for-profit For-profit
Teaching status	Teaching Non-teaching

3.6 Data Analysis

Statistical analyses were conducted using STATA® version 14 (StataCorp, LP, College Station, Texas, USA). All tests were two-tailed, and the statistical significance was established at a two-sided α level of 0.05 ($p < 0.05$). Summary statistics were obtained to identify predictors of surgeons' practice style and to provide characteristics of each modality approach (i.e. 'only inpatient', 'only outpatient, or 'bimodal'). In addition, χ^2 tests were conducted to compare IM and OM styles as well as the three modality approaches by patient, physician, and hospital characteristics.

The data structure was hierarchical as it contained nesting of patients within surgeons and hospitals, and nesting of surgeons within hospitals. To address this issue of non-independence, multilevel modeling of hierarchical data was used for the present study. The method was selected as it enables to model variability at each level of hierarchy. The response is measured at the individual level, and includes both the effect of that individual and the effect of the context. Consequently, the regression coefficient is an estimate of how the outcome changes as a function of predictors conditional on the random effects [162] . The multilevel mixed-effects logistic regression and generalized structural equation models (Melogit and gsem modules in STATA software) used for the analysis incorporates random effects in the model thus allowing for subject-specific (conditional) and population averaged (marginal) inference. Predictor variables for the three levels of hierarchical data include: level 1 predictors, i.e. patient age, race, residence, and insurance type, and comorbidities; level 2 predictor, mastectomy volume; and level 3 predictors, i.e. hospital ownership and teaching status, total discharges, and total mastectomy volume, bed size, and hospital location. A separate model was fit to

assess the effect of patient, surgeon, and system level factors on the dichotomous outcome variable of surgeons' choice of IM vs. OM practice style. Similarly, for the second outcome, variations in surgeons' modality approaches with three mutually exclusive categories, a separate model was fit to assess the effect of patient, surgeon, and system level factors on the outcome. Ultimately, multivariate models were created by retaining all exposure variables of interest, regardless of statistical significance, as well as covariates that were statistically significant at the univariate level. Furthermore, separate sensitivity analyses were conducted to explore the potential impact of the exclusion of: 1) the group of surgeons with one record of mastectomy and 2) surgeons with the exact number of IM and OM procedures on their record.

CHAPTER 4: RESULTS

4.1 Descriptive Results

The study population included 6,413 patients who underwent a mastectomy in Florida hospitals in 2013. Overall, 3,353 (52.28%) of mastectomy procedures were performed as outpatient and 3,060 (47.72%) as inpatient. Patients in the study population were treated by 495 surgeons working at 211 facilities. Of the 495 surgeons, 54 performed exclusively IM procedures (n=283 total procedures), 105 performed only OM (n=618 total procedures), and 336 chose both inpatient and outpatient approaches in their surgeries (n=5,512 total procedures).

Overall, of the patients who underwent a mastectomy, the largest population of patients were 60 years and over (51.43%) followed by those in the 40-59 age category (41.4%). In addition, most women were white (69.47%), lived in urban areas (90.38%), had lower income levels (Q1 and Q2: 64.1%), and had private insurance (44.25%) (Table 4.1.a). A similar profile was observed when considering IM and OM modalities with respect to race, area of residence, and income (Table 4.1.a). However, a larger proportion of IM patients were in the 40-59 years of age group (46.96%) while a larger proportion of OM patients were older women (≥60 years old, 56.87%, $p<0.0001$). In addition, a greater proportion of IM patients were private insurance holders (50.88%) while a larger proportion of OM patients were Medicare beneficiaries (46.26%, $p<0.0001$).

The selected comorbid conditions for the patients included in the study are reported in table 4.1.b. The major comorbidities for mastectomy patients were diabetes (13.24%), hypothyroidism (10.04%), obesity (6.24%), chronic pulmonary disease (5.52%), and depression (5.75%). As table 4.1.a demonstrates, overall, a larger proportion of IM patients had comorbidities compared to those who underwent an OM procedure (Hypothyroidism: 11.80% vs. 8.44%, $p<0.0001$; obesity: 7.55% vs. 5.04%, $p<0.0001$; chronic pulmonary disease: 6.31% vs. 4.80, $p=0.008$; and depression: 7.03% vs. 4.59%, $p<0.0001$) (Table 4.1.a).

4.1.1 Patient Characteristics and Surgeons' Practice Styles

Table 4.2.a. exhibits the characteristics of patients by surgeons' practice style. Overall, 53.36% (n=3,422) of procedures were performed by surgeons who exclusively or predominantly chose OM style in their mastectomies while 46.64% (n=2,991) of procedures were performed by IM style surgeons. Compared to surgeons with IM preference, surgeons with OM style preference operated on a significantly higher proportion of older adults (55.58% vs. 46.67%, $p<0.0001$), Medicare beneficiaries (44.83% vs. 36.78%, $p<0.0001$), and patients with the lowest median household income level (35.18% vs. 30.29%, $p<0.0001$). Moreover, as Table 4.2.b. shows, no significant differences were observed between IM and OM practice style groups by most comorbid conditions (Table 4.2.b).

4.1.2 Patient Characteristics and Surgeons' Modality Approaches

Table 4.3.a. compares the characteristics of patients across surgeons with different modality approaches: exclusive IM, exclusive OM, and surgeons who perform both methods. Overall, the majority of mastectomy patients (85.95%, n=5,512) were operated

on by bimodal surgeons. Exclusive OM surgeons operated on 9.64% of patients (n=618) and 4.41% of patients (n=283) were operated on by exclusive IM surgeons (Table 4.2.a). Exclusive surgeons (IM and OM), compared to bimodal surgeons, operated on a higher percentage of Medicare beneficiaries (51.59% and 46.28% vs. 39.95% respectively, $p<0.0001$), older adults (61.48% and 60.36% vs. 49.91%, $p<0.0001$), and the lowest income patients (49.82% and 36.41% vs. 31.64%, $p<0.0001$). However, bimodal surgeons operated on a higher percentage of private insurance holders (45.34% vs. 34.28% and 39.16%, $p<0.0001$), middle-aged women (42.74% vs. 34.63% and 32.52%, $p<0.0001$), and patients with higher income level (Q3 income: 25.25% vs. 15.55% and 20.55%, $p<0.0001$ and Q4 income: 9.31% vs. 6.01% and 6.8%, $p<0.0001$). There were no significant differences observed with respect to race across the surgeons' practice modality groups (Table 4.2.a). In addition, exclusive IM surgeons operated on a significantly higher proportion of patients with most existing comorbidities (Table 4.3.b).

4.1.3 Provider Characteristics and Surgeons' Practice Styles

Table 4.4 presents surgeon and hospital characteristics for 495 surgeons and 211 facilities by surgeon style categories (IM and OM). The majority of procedures were performed by high volume surgeons (56.57%), at high total discharge volume (53.31%), non-teaching (58.63%), non-profit (70.90%), and urban hospitals (98.00%). As table 4.4 shows, among IM style surgeons, 66.60% of mastectomy surgeries were performed by high volume surgeons. In comparison, among OM style surgeons less than 50% (47.81%) of mastectomies were performed by high volume surgeons.

The hospital characteristics, including hospital mastectomy and total discharges volume, ownership and teaching status, location (urban vs. rural), and bed size for the

population used in the analyses are described below (Table 4.4). Surgeons with IM practice style were more likely to operate at high mastectomy volume centers compared with OM surgeons (36.38% vs. 24.61%, p<0.0001) who were more likely to operate at low and medium mastectomy volume hospitals (low volume: 36.44% vs. 30.79% and medium: 38.95% vs. 32.83%, p<0.0001). In addition, IM surgeons were more likely to operate at teaching hospitals (52.26% vs. 31.85%, p<0.0001) compared with surgeons with OM practice style. A higher proportion of procedures were performed by IM surgeons at small bed size hospitals compared to OM surgeons (40.15% vs. 28.67%), however, OM surgeons were more likely to operate at large bed size hospitals (37.32% vs. 28.35%, p<0.0001). Furthermore, OM style surgeons were more likely to operate at for profit hospitals compared to IM style surgeons (33.05% vs. 24.57%, p<0.0001).

4.1.4 Provider Characteristics and Surgeons' Modality Approaches

Table 4.5 exhibits the characteristics of surgeons and hospitals by modality approaches. In the exclusive IM and OM surgeon groups, a higher percentage of patients were operated by low volume surgeons when compared with bimodal surgeons (68.55% and 48.54% vs. 16.26%, p<0.0001). However, in the bimodal surgeon group, a greater proportion of patients were operated by high volume surgeons (62.39% vs. 9.89% for exclusive IM and 26.05% for exclusive OM, p<0.0001). Exclusive IM and OM surgeons operated on higher proportions of procedures at low mastectomy volume centers compared to bimodal surgeons (68.20% and 45.63% vs.30.71%, p<0.0001). In the bimodal and exclusive OM surgeon groups, a higher percentage of procedures were performed at high total discharge volume centers as compared to exclusive IM surgeons (53.07% and 54.83% vs. 24.38, p<0.0001). Exclusive surgeons were more likely to

operate at non-teaching hospitals (78.09% exclusive IM and 73.30% exclusive OM vs. 55.99% bimodal, p<0.0001). Similarly, a higher proportion of exclusive surgeons operated at for-profit centers compared with bimodal surgeons (59.01% and 54.21% vs. 24.75%, p<0.0001). Exclusive IM surgeons were more likely to operate at rural hospitals compared with exclusive OM and bimodal surgeons (10.95% vs. 0.97% and 1.65%, p<0.0001).

4.2 Unadjusted Associations between Patient and Provider Characteristics and Surgeons' Practice Styles and Modality Approaches

4.2.1 Unadjusted Results for Patient Characteristics and Surgeons' Practice Styles

Tables 4.6- 4.9 report unadjusted results for the independent variables and the outcomes of interest. Compared with younger patients, women ≥60 years of age had 32% increased odds of having their mastectomies done by surgeons with outpatient style preference (OR=1.32, 95% CI: 1.08-1.60) (Table 4.6). Hispanic patients had decreased odds of being operated by OM style surgeons (OR=0.86, 95% CI: 0.74-0.99). However, no significant association was observed between other race groups and choosing outpatient surgeons (African-Americans: OR=0.89, 95% CI: 0.77-1.05, other races: OR=0.98, 95% CI: 0.75-1.28). Compared to Medicare beneficiaries, private insurance holders had decreased odds of choosing outpatient surgeons for their mastectomies (OR=0.63, 95% CI: 0.57-0.70). The results for other pay sources were not statistically significant (Medicaid: OR=1.09, 95% CI: 0.89-1.33, other sources of payment: OR=1.01, 95% CI: 0.83-1.23). Compared to the lowest level income patients, patients with higher median household income had decreased odds of choosing outpatient style surgeons (Q2: OR=0.89, 95% CI: 0.78-1.00, Q3: OR=0.81, 95% CI: 0.71-0.92, Q4: OR=0.53, 95% CI: 0.44-0.64). Moreover, patients with comorbidities such as chronic pulmonary disease,

hypothyroidism, valvular Disease, deficiency anemias, obesity, and depression had statistically significant decreased odds of choosing outpatient style surgeons for their mastectomies (CPD: OR=0.70, 95% CI: 0.56-0.87, hypothyroidism: OR=0.74, 95% CI: 0.63-0.87, valvular disease: OR=0.56, 955 CI: 0.40-0.79, deficiency anemias: OR=0.77, 95% CI: 0.60-0.99, obesity: OR=0.68, 95% CI: 0.56-0.84, and depression: OR=0.80, 95% CI: 0.65-0.99) (Table 4.6).

4.2.2 Unadjusted Results for Patient Characteristics and Surgeons' Modality Approaches

Older women had increased odds of having their mastectomies done by exclusive surgeons than by bimodal surgeons. However, the results were not statistically significant for exclusive OM surgeons (exclusive IM: OR=2.33, 95% CI: 1.25-4.32 and exclusive OM: OR=1.25, 95 % CI: 0.90-1.73). African-Americans had higher odds of having their mastectomies performed by exclusive IM surgeons than bimodal surgeons (OR=1.46, 95% CI: 1.04-2.03) compared to whites (Table 4.7). However, the results were not statistically significant for other races (Hispanic: OR=0.86, 95% CI: 0.59-1.24 and other races: OR=0.93, 95% CI: 0.47-1.85). Private insurance holders compared to Medicare beneficiaries had decreased odds of choosing surgeons with exclusive modality preference relative to bimodal surgeons (exclusive IM: OR=0.59, 95 %CI: 0.45-0.76 and exclusive OM: OR=0.75, 95% CI: 0.62-0.89). However, the results were not statistically significant for patients with Medicaid and other sources of payment (Medicaid exclusive IM: OR=0.86, 95% CI: 0.55-1.35; Medicaid exclusive OM: OR=0.76, 95% CI: 0.54-1.08, other pay sources for exclusive IM: OR=0.63, 95% CI: 0.38-1.05, and other pay sources for exclusive OM: OR=0.94, 955 CI: 0.69-1.30). Compared to urban patients, rural residents had higher odds of having their mastectomies performed by exclusive IM

surgeons (OR: 2.86, 95% CI: 2.03-4.02), but lower by exclusive OM surgeons (OR=0.31, 95% CI: 0.18-0.56) relative to bimodal surgeons. Compared to patients with the lowest median household income, those from higher income quartiles had decreased odds of having their mastectomies performed by exclusive approach surgeons than bimodal surgeons (exclusive IM Q3 income: OR= 0.39, 95% CI: 0.28-0.55 and Q4: OR=0.41, 95 %CI: 0.25-0.68) and exclusive OM Q3 income: OR=0.71, 95% CI: 0.56-0.89 and Q4: OR=0.63, 95 % CI: 0.45-0.90). Patients with existing comorbidities such as diabetes, renal failure, rheumatoid arthritis, depression, and deficiency anemias had increased odds of being seen by exclusive IM surgeons than by bimodal surgeons. However, patients with chronic pulmonary disease, hypothyroidism, deficiency anemias, and obesity were less likely to have their mastectomies performed by exclusive OM surgeons than by bimodal surgeons (Table 4.7).

4.2.3 Unadjusted Results for Provider Characteristics and Surgeons' Practice Styles

Compared to low volume surgeons, medium volume surgeons had increased odds of choosing OM style (OR=1.86, 95 % CI: 1.59-2.18); however, high volume surgeons had decreased odds of choosing OM in their mastectomies (OR=0.62, 95% CI: 0.55-0.70) (Table 4.8). Moreover, high volume mastectomy hospitals had decreased odds of having their mastectomy cases done by OM style surgeons (OR=0.57, 95% CI: 0.5-0.65). Patients operated at medium and high total discharges volume hospitals had decreased odds of having their mastectomies performed by OM style surgeons compared to low volume centers (OR=0.43, 95% CI: 0.35-0.52, and OR=0.65, 95% CI: 0.53-0.79). Patients of non-teaching and for-profit hospitals had increased odds of being operated on by OM style surgeons compared to patients of teaching and not-for-profit centers (non-

teaching: OR=2.34, 95% CI: 2.12-2.59 and for profit: OR=1.52, 95% CI: 1.36-1.69). Furthermore, medium and large size hospitals had higher odds of having their mastectomy cases performed by OM style surgeons compared to small hospitals (medium bed size: OR=1.51, 95% CI: 1.34-1.71 and large bed size: OR=1.84, 95% CI: 1.63-2.08). Compared to patients of urban hospitals, patients of rural hospitals had lower odds of having their mastectomies done by OM style surgeons (OR=0.47, 95% CI: 0.32-0.67) (Table 4.8).

4.2.4 Unadjusted Results for Provider Characteristics and Surgeons' Modality Approaches

Compared to low volume surgeons, medium and high volume surgeons had lower odds of being an exclusive IM or OM surgeon than being bimodal (exclusive IM surgeons: medium volume: OR=0.24, 95% CI: 0.18-0.32 and high volume: OR=0.04, 95% CI: 0.03-0.06 and exclusive OM surgeons: medium volume: OR=0.40, 95% CI: 0.32-0.49 and high volume: OR=0.14, 95% CI: 0.11-0.17) (Table 4.9). In addition, compared to low volume mastectomy hospitals, patients of medium and high volume centers had decreased odds of having their mastectomies done by exclusive surgeons than bimodal surgeons (medium volume exclusive IM: OR=0.26, 95% CI: 0.2-0.35; high volume exclusive IM: OR=0.14, 95% CI: 0.09-0.21; medium volume exclusive OM: OR=0.47, 95% CI: 0.39-0.58; and high volume exclusive OM: OR=0.59, 95% CI: 0.48-0.72). The same pattern was observed for total discharge hospital volume except for the medium total discharge volume and exclusive IM surgeons. That particular association was not statistically significant (medium volume exclusive IM: OR=1.13, 95% CI: 0.75-1.71; high volume exclusive IM: OR=0.30, 95% CI: 0.19-0.46; medium volume exclusive OM: OR=0.26, 95% CI: 0.20-0.33; and high volume exclusive OM: OR=0.34,

95% CI: 0.27-0.43) (Table 4.9). In contrast, patients of non-teaching and for-profit hospitals had higher odds of being seen by exclusive surgeons than by bimodal surgeons (exclusive IM at non-teaching: OR=2.80, 95% CI: 2.1-3.73, exclusive OM at non-teaching: OR=2.16, 95% CI: 1.79-2.6, exclusive IM at for-profit: OR=4.38, 95% CI: 3.43-5.59, and exclusive OM at for-profit: OR=3.6, 95% CI: 3.04-4.27). Compared to small hospitals, patients of larger hospitals had lower odds of being operated by exclusive IM or OM surgeons than by bimodal surgeons (exclusive IM: OR=0.27, 955 CI: 0.20-0.38 and exclusive OM: OR=0.67, 95% CI: 0.54-0.83). Moreover, patients of rural hospitals had significantly higher odds of being seen by exclusive IM surgeons compared to bimodal surgeons (OR=7.33, 95% CI: 4.78-11.23). However, the results were not statistically significant for exclusive OM surgeons (OR=0.58, 95% CI: 0.25-1.34) (Table 4.9).

4.3 Adjusted Associations between Patient and Provider Characteristics and Surgeons' Practice Styles and Modality Approaches

4.3.1 Adjusted Results for Patient and Provider Characteristics and Surgeons' Practice Styles

Two separate models were fit to examine risk-adjusted surgeons' practice styles and modality approaches for mastectomy procedure. These analyses included 495 surgeons performing IM and/or OM modalities. These analyses were adjusted for patient comorbidities, median household income level, hospital bed-size, and hospital location. Tables 4.10 and 4.11 presents adjusted results for OM practice style compared to IM style as well as for exclusive modality approaches (exclusive IM or OM) compared to bimodality surgical tactic. As table 4.10 demonstrates, after adjustment, the association between older age and having a procedure by an OM style surgeon was attenuated and

did not retain its statistical significance (OR=1.23, 95% CI: 0.95-1.58). However, the associations between African-American race and Hispanic ethnicity and having a mastectomy by an OM style surgeon both increased in magnitude and were statistically significant (OR=0.71, 95% CI: 0.59-0.85 and OR=0.74, 95% CI: 0.63-0.88, respectively). Likewise, the adjusted association between Medicaid coverage and surgeries being performed by OM style surgeons also emerged as statistically significant and increased in magnitude (OR=1.43, 95% CI: 1.10-1.85). However, the association between private insurance coverage and having a mastectomy done by an OM surgeon was attenuated after adjustment (OR=0.83, 95% CI: 0.71-0.98) (Table 4.10).

In the adjusted analysis, the association between high total discharge volume and the surgeon's practice style outcome did not retain its significance (OR= 0.88, 95% CI: 0.65-1.20). After adjustment for the study covariates, the associations between high mastectomy volume centers and for profit hospitals and having mastectomies done by OM style surgeons were attenuated (high mastectomy volume hospital: OR=0.75, 95% CI: 0.61-0.93 and for-profit: OR=1.44, 95% CI: 1.25-1.65). In contrast, the associations of non-teaching status of the hospital with having mastectomies by OM style surgeons increased in magnitude (OR=2.74, 95% CI: 2.40-3.11).

4.3.2 Adjusted Results for Patient and Provider Characteristics and Surgeons' Modality Approaches

After adjustment for patient comorbidities, median household income level, hospital bed-size, and hospital location, the association between private insurance coverage and having mastectomies done by exclusive approach surgeons, although crossed the null and was no longer statistically significant (exclusive IM: OR=1.46, 95%CI: 0.98-2.17 and exclusive OM: OR=1.28, 95% CI: 0.98-1.69) (Table 4.11). In

addition, the associations between older age and rural residency and having mastectomies performed by exclusive IM surgeons were no longer statistically significant after adjustment (older age: OR=2.00, 95% CI: 0.95-4.19 and rural residency: OR=1.49, 95% CI: 0.92-2.42).

The adjusted association between hospital teaching status and ownership status and having mastectomies performed by exclusive surgeons were attenuated in magnitude (exclusive IM non-teaching hospitals: OR=1.69, 95% CI:1.19-2.39, exclusive OM non-teaching hospitals: OR=1.89, 95% CI:1.51-2.37, exclusive IM for profit hospitals: OR=2.23, 95% CI:1.63-3.05, and exclusive OM for profit hospitals: OR=2.67, 95% CI:2.11-3.38). The adjusted association between high mastectomy volume and mastectomies being performed by surgeons with exclusive IM modality approach became non-significant (OR=0.67, 95% CI: 0.37-1.20). However, the adjusted association between high mastectomy volume hospitals and mastectomies done by exclusive OM surgeons changed direction and remained significant (OR=1.50, 95% CI: 1.03-2.17). Likewise, the association between high total discharge volume hospitals and the outcome crossed the null but did not retain its significance for exclusive OM surgeons (exclusive IM: OR=3.04, 95% CI: 1.39-6.68 and exclusive OM: OR=1.21, 95% CI: 0.75-1.95).

4.4 Sensitivity Analysis Results

Sensitivity analyses were conducted to explore the potential impact of the exclusion of: 1) the group of surgeons with one record of mastectomy and 2) surgeons with the exact number of IM and OM procedures on their record. The results of the sensitivity analyses remained unchanged after excluding both surgeons with one record of mastectomy and those with exact number of IM and OM (Appendix A and B).

Table 4.1.a: Characteristics of Patients Undergoing Mastectomy by Type of Procedure, 2013 Florida HCUP-SASD/SID

	N	% [a]	IM		OM		p-value
			n	%	n	%	
Surgical Procedures, Patient	6,413	100	3,060	47.72	3,353	52.28	
Patient age							<.0001
<40	460	7.17	232	7.58	228	6.80	
40-59	2,655	41.4	1,437	46.96	1,218	36.33	
≥60	3,298	51.43	1,391	45.46	1,907	56.87	
Patient Race							0.037
White	4,455	69.47	2,087	68.20	2,368	70.62	
Black	739	11.52	380	12.42	359	10.71	
Hispanic	945	14.74	462	15.10	483	14.41	
Other	225	3.51	101	3.30	124	3.70	
Primary Payer							<.0001
Medicare	2,634	41.07	1,083	35.39	1,551	46.26	
Medicaid	466	7.27	223	7.29	243	7.25	
Private Insurance	2,838	44.25	1,557	50.88	1,281	38.20	
Other	475	7.41	197	6.44	278	8.29	
Patient Residency							0.008
Urban	5,796	90.38	2,733	89.31	3,063	91.35	
Rural	384	5.99	295	6.37	189	5.64	
Median Household Income							<.0001
Quartile 1	2,110	32.90	952	31.11	1,158	34.54	
Quartile2	2,001	31.20	919	30.03	1,082	32.27	
Quartile3	1,563	24.37	767	25.07	796	23.74	
Quartile4	672	8.92	330	10.78	242	7.22	

IM=Inpatient Mastectomy, OM=Outpatient Mastectomy, N=total number of patients, n=IM or OM patients

[a] Percentages may not total 100 due to missing values

Table 4.1.b: Patients Comorbidities (Elixhauser Comorbidities Based on ICD-9-CM Codes) by Type of Mastectomy, 2013 Florida HCUP-SASD/SID

Individual Comorbidities	N	%	IM		OM		p-value
			n	%	n	%	
Congestive Heart Failure	51	0.80	29	0.95	22	0.66	0.189
Valvular Disease	142	2.21	90	2.94	52	1.55	0.000
Peripheral Vascular Disease	40	0.62	21	0.69	19	0.57	0.543
Hypertension	2,303	35.91	1,130	36.93	1,173	34.98	0.105
Other Neurological Disorders	105	1.64	56	1.83	49	1.46	0.245
Chronic Pulmonary Disease	354	5.52	193	6.31	161	4.80	0.008
Diabetes	849	13.24	395	12.91	454	13.54	0.456
Hypothyroidism	644	10.04	361	11.80	283	8.44	0.000
Renal failure	113	1.76	69	2.25	44	1.31	0.004
Deficiency anemias	257	4.01	166	5.42	91	2.71	0.000
Rheumatoid Arthritis	81	1.26	50	1.63	31	0.92	0.011
Obesity	400	6.24	231	7.55	169	5.04	0.000
Psychoses	59	0.92	35	1.14	24	0.72	0.073
Depression	369	5.75	215	7.03	154	4.59	0.000

IM=Inpatient Mastectomy, OM=Outpatient Mastectomy, N=total number of patients, n=IM or OM patients

Table 4.2.a: Characteristics of Patients by Surgeons' Practice Style (Choice of IM versus OM), 2013 Florida HCUP-SASD/SID

			IM Style		OM Style		
	N	% [a]	n	%	n	%	p-value
Surgical Procedures, Patient	6,413	100	2,991	46.64	3,422	53.36	
Patient Age							0.000
<40	460	7.17	226	7.56	234	6.84	
40-59	2,655	41.40	1,369	45.77	1,286	37.58	
≥60	3,298	51.43	1,396	46.67	1,902	55.58	
Patient Race							0.042
White	4,455	69.47	2,035	68.04	2,420	70.72	
Black	739	11.52	358	11.97	381	11.13	
Hispanic	945	14.74	468	15.65	477	13.94	
Other	225	3.51	104	3.48	121	3.54	
Primary Payer							0.000
Medicare	2,634	41.07	1,100	36.78	1,534	44.83	
Medicaid	466	7.27	185	6.19	281	8.21	
Private Insurance	2,838	44.25	1,509	50.45	1,329	38.84	
Other	475	7.41	197	6.59	278	8.12	
Patient Residency							0.415
Urban	5,796	90.38	2,695	90.10	3,101	90.62	
Rural	384	5.99	185	6.19	199	5.82	
Median Household Income							0.000
Quartile 1	2,110	32.90	906	30.29	1,204	35.18	
Quartile2	2,001	31.20	918	30.69	1,083	31.65	
Quartile3	1,563	24.37	753	25.18	810	23.67	
Quartile4	572	8.92	336	11.23	236	6.90	

[a] Percentages may not total 100 due to missing values
Surgeons n=495, hospitals n=211, Patients n=6,413

Table 4.2.b: Patients Comorbidities by Surgeons' Practice Style (Choice of IM Versus OM), 2013 Florida HCUP-SASD/SID

	N	%	IM Style		OM Style		p-value
			n	%	n	%	
Individual Comorbidities							
Congestive Heart Failure	51	0.80	20	0.67	31	0.91	0.372
Valvular Disease	142	2.21	86	2.88	56	1.64	0.001
Peripheral Vascular Disease	40	0.62	21	0.70	19	0.56	0.019
Hypertension	2,303	35.91	1,079	36.07	1,224	35.77	0.144
Other Neurological Disorders	105	1.64	52	1.74	53	1.55	0.210
Chronic Pulmonary Disease	354	5.52	195	6.52	159	4.65	0.000
Diabetes	849	13.24	377	12.60	472	13.79	0.173
Hypothyroidism	644	10.04	344	11.50	300	8.77	0.000
Renal failure	113	1.76	46	1.54	67	1.96	0.368
Deficiency anemias	257	4.01	136	4.55	121	3.54	0.056
Rheumatoid Arthritis	81	1.26	44	1.47	37	1.08	0.334
Obesity	400	6.24	222	7.42	178	5.20	0.000
Psychoses	59	0.92	34	1.14	25	0.73	0.119
Depression	369	5.75	191	6.39	178	5.20	0.047

Table 4.3.a: Characteristics of Patients by Surgeons' Modality Approaches (Choice of Bimodality versus Exclusive Inpatient or Outpatient), 2013 Florida HCUP-SASD/SID

			Exclusive IM		Exclusive OM		Bimodal		
	N	% [a]	n	%	n	%	n	%	p-value
Surgical Procedures, Patient			283	4.41	618	9.64	5,512	85.95	
Patient Age									0.000
<40	460	7.17	11	3.89	44	7.12	405	7.35	
40-59	2,655	41.40	98	34.63	201	32.52	2,356	42.74	
60 and over	3,298	51.43	174	61.48	373	60.36	2,751	49.91	
Patient Race									0.337
White	4,455	69.47	191	67.49	439	70.87	3,826	69.41	
Black	739	11.52	46	16.25	60	9.71	633	11.48	
Hispanic	945	14.74	35	12.37	93	15.05	817	14.82	
Other	225	3.51	9	3.18	23	3.72	193	3.50	
Primary Payer									0.000
Medicare	2,634	41.07	146	51.59	286	46.28	2,202	39.95	
Medicaid	466	7.27	23	8.13	40	6.47	403	7.31	
Private Insurance	2,838	44.25	97	34.28	242	39.16	2,499	45.34	
Other	475	7.41	17	6.01	50	8.09	408	7.40	
Patient Residency									0.000
Urban	5,796	90.38	234	82.69	581	94.01	4,981	90.37	
Rural	384	5.99	44	15.55	12	1.94	328	5.95	
Median Household Income									0.000
Quartile 1	2,110	32.90	141	49.82	225	36.41	1,744	31.64	
Quartile2	2,001	31.20	80	28.27	204	33.01	1,717	31.15	
Quartile3	1,563	24.37	44	15.55	127	20.55	1,392	25.25	
Quartile4	572	8.92	17	6.01	42	6.80	513	9.31	

[a] Percentages may not total 100 due to missing values

Mastectomy, Surgeons n=495, hospitals n=211

Table 4.3.b: Patients Comorbidities by Surgeons' Modality Approaches (Choice of Bimodality versus Exclusive Inpatient or Outpatient), 2013 Florida HCUP-SASD/SID

	N	%	Exclusive IM		Exclusive OM		Bimodal		p-value
			n	%	n	%	n	%	
Individual Comorbidities									
Congestive Heart Failure	51	0.80	4	1.41	4	0.65	43	0.78	0.459
Valvular Disease	142	2.21	10	3.53	11	1.78	121	2.20	0.244
Peripheral Vascular Disease	40	0.62	4	1.41	2	0.32	34	0.62	0.153
Hypertension	2,303	35.91	138	48.76	199	32.20	1,966	35.67	0.000
Other Neurological Disorders	105	1.64	6	2.12	10	1.62	89	1.61	0.807
Chronic Pulmonary Disease	354	5.52	12	4.24	19	3.07	323	5.86	0.010
Diabetes	849	13.24	51	18.02	90	14.56	708	12.84	0.026
Hypothyroidism	644	10.04	33	11.66	35	5.66	576	10.45	0.001
Renal failure	113	1.76	11	3.89	12	1.94	90	1.63	0.018
Deficiency anemias	257	4.01	21	7.42	15	2.43	221	4.01	0.002
Rheumatoid Arthritis	81	1.26	7	2.47	11	1.78	63	1.14	0.071
Obesity	400	6.24	26	9.19	21	3.40	353	6.40	0.002
Psychoses	59	0.92	4	1.41	4	0.65	51	0.93	0.532
Depression	369	5.75	32	11.31	29	4.69	308	5.59	0.000

Table 4.4: Provider Characteristics by Surgeons' Practice Styles, 2013 Florida HCUP-SASD/SID

	N	% [a]	IM Style n	IM Style %	OM Style n	OM Style %	p-value
Surgical Procedures, Providers	6,413	100	2,991	46.64	3,422	53.36	
Surgeon Mastectomy Volume							0.000
Low	1,390	21.67	597	19.96	793	23.17	
Medium	1,395	21.75	402	13.44	993	29.02	
High	3,628	56.57	1,992	66.60	1,636	47.81	
Hospital Mastectomy Volume							0.000
Low	2,168	33.81	921	30.79	1,247	36.44	
Medium	2,315	36.10	982	32.83	1,333	38.95	
High	1,930	30.10	1,088	36.38	842	24.61	
Hospital Total Discharge Volume							0.000
Low	506	7.89	168	5.62	338	9.88	
Medium	2,488	38.80	1,339	44.77	1,149	33.58	
High	3,419	53.31	1,484	49.62	1,935	56.55	
Teaching Status							0.000
Teaching	2,653	41.37	1,563	52.26	1,090	31.85	
Non-teaching	3,760	58.63	1,428	47.74	2,332	68.15	
Ownership							0.000
Not-for-profit	4,547	70.90	2,256	75.43	2,291	66.95	
For-profit	1,866	29.10	735	24.57	1,131	33.05	
Hospital Bed Size							0.000
Small	2,182	34.02	1,201	40.15	981	28.67	
Medium	2,106	32.84	942	31.49	1,164	34.02	
Large	2,125	33.14	848	28.35	1,277	37.32	
Hospital Location							0.000
Urban	6,285	98.00	2,908	97.23	3,377	98.68	
Rural	128	2.00	83	2.77	45	1.32	

[a] Percentages may not total 100 due to missing values

Table 4.5: Provide Characteristics by Surgeons' Modality Approaches, 2013 Florida HCUP-SASD/SID

	N	% [a]	Exclusive IM		Exclusive OM		Both		p-value
			n	%	n	%	n	%	
Surgical Procedures, Providers	6,413	100	283	4.41	618	9.64	5,512	85.95	
Surgeon Mastectomy Volume									0.000
Low	1,390	21.67	194	68.55	300	48.54	896	16.26	
Medium	1,395	21.75	61	21.55	157	25.40	1,177	21.35	
High	3,628	56.57	28	9.89	161	26.05	3,439	62.39	
Hospital Mastectomy Volume									0.000
Low	2,168	33.81	193	68.20	282	45.63	1,693	30.71	
Medium	2,315	36.10	63	22.26	165	26.70	2,087	37.86	
High	1,930	30.10	27	9.54	171	27.67	1,732	31.42	
Hospital Total Discharge Volume									0.000
Low	506	7.89	28	9.89	116	18.77	362	6.57	
Medium	2,488	38.80	186	65.72	174	28.16	2,128	38.61	
High	3,419	53.31	69	24.38	328	53.07	3,022	54.83	
Teaching Status									0.000
Teaching	2,653	41.37	62	21.91	165	26.70	2,426	44.01	
Non-teaching	3,760	58.63	221	78.09	453	73.30	3,086	55.99	
Ownership									0.000
Not-for-profit	4,547	70.90	116	40.99	283	45.79	4,148	75.25	
For-profit	1,866	29.10	167	59.01	335	54.21	1,364	24.75	
Hospital Bed Size									0.000
Small	2,182	34.02	168	59.36	221	35.76	1,793	32.53	
Medium	2,106	32.84	66	23.32	239	38.67	1,801	32.67	
Large	2,125	33.14	49	17.31	158	25.57	1,918	34.80	
Hospital Location									0.000
Urban	6,285	98.00	252	89.05	612	99.03	5,421	98.35	
Rural	128	2.00	31	10.95	6	0.97	91	1.65	

[a] Percentages may not total 100 due to missing values

Table 4.6: Unadjusted Association between Patients Characteristics and by Surgeons' Practice Styles, 2013 Florida HCUP-SASD/SID

	OM style		
	OR	95% CI	p-value
Patients Characteristics			
Patient Age			
<40	1.00	Referent	
40-59	0.91	0.74-1.11	0.335
≥60	1.32	1.08-1.60	0.006
Patient Race			
White	1.00	Referent	
Black	0.89	0.77-1.05	0.163
Hispanic	0.86	0.74-0.99	0.031
Other	0.98	0.75-1.28	0.873
Primary Payer			
Medicare	1.00	Referent	
Medicaid	1.09	0.89-1.33	0.405
Private Insurance	0.63	0.57-0.70	0.000
Other	1.01	0.83-1.23	0.907
Patient Residency			
Urban	1.00	Referent	
Rural	0.93	0.76-1.15	0.523
Median Household Income			
Quartile 1	1.00	Referent	
Quartile 2	0.89	0.78-1.00	0.058
Quartile 3	0.81	0.71-0.92	0.002
Quartile 4	0.53	0.44-0.64	0.000
Individual Comorbidities			
Congestive Heart Failure	1.36	0.77-2.39	0.288
Valvular Disease	0.56	0.40-0.79	0.001
Peripheral Vascular Disease	0.79	0.42-1.47	0.457
Hypertension	0.99	0.89-1.09	0.799
Other Neurological Disorders	0.89	0.60-1.31	0.551
Chronic Pulmonary Disease	0.70	0.56-0.87	0.001
Diabetes	1.11	0.96-1.28	0.161
Hypothyroidism	0.74	0.63-0.87	0.000
Renal failure	1.28	0.88-1.87	0.203
Deficiency anemias	0.77	0.60-0.99	0.040
Rheumatoid Arthritis	0.73	0.47-1.14	0.165
Obesity	0.68	0.56-0.84	0.000
Psychoses	0.64	0.38-1.08	0.092
Depression	0.80	0.65-0.99	0.043

Table 4.7: Unadjusted Association between Patient Characteristics and Surgeons' Modality Approaches, 2013 Florida HCUP-SASD/SID

	Exclusive IM			Exclusive OM		
	OR	95% CI	p-value	OR	95% CI	p-value
Patients Characteristics						
Patient Age						
<40	1.00	Referent		1.00	Referent	
40-59	1.53	0.81-2.88	0.186	0.79	0.56-1.11	0.167
≥60	2.33	1.25-4.32	0.007	1.25	0.90-1.73	0.187
Patient Race						
White	1.00	Referent		1.00	Referent	
Black	1.46	1.04-2.03	0.027	0.83	0.62-1.10	0.190
Hispanic	0.86	0.59-1.24	0.415	0.99	0.79-1.26	0.962
Other	0.93	0.47-1.85	0.845	1.04	0.67-1.62	0.859
Primary Payer						
Medicare	1.00	Referent		1.00	Referent	
Medicaid	0.86	0.55-1.35	0.516	0.76	0.54-1.08	0.129
Private Insurance	0.59	0.45-0.76	0.000	0.75	0.62-0.89	0.001
Other	0.63	0.38-1.05	0.076	0.94	0.69-1.30	0.721
Patient Residency						
Urban	1.00	Referent		1.00	Referent	
Rural	2.86	2.03-4.02	0.000	0.31	0.18-0.56	0.000
Median Household Income						
Quartile 1	1.00	Referent		1.00	Referent	
Quartile2	0.58	0.43-0.76	0.000	0.92	0.75-1.13	0.421
Quartile3	0.39	0.28-0.55	0.000	0.71	0.56-0.89	0.003
Quartile 4	0.41	0.25-0.68	0.001	0.63	0.45-0.90	0.010
Individual Comorbidities						
Congestive Heart Failure	1.82	0.65-5.12	0.254	0.83	0.30-2.32	0.720
Valvular Disease	1.63	0.85-3.15	0.143	0.81	0.43-1.51	0.501
Peripheral Vascular Disease	2.31	0.81-6.55	0.116	0.52	0.13-2.18	0.374
Hypertension	1.72	1.35-2.18	0.000	0.86	0.72-1.02	0.088
Other Neurological Disorders	1.32	0.57-3.04	0.515	1.00	0.52-1.94	0.995
Chronic Pulmonary Disease	0.71	0.39-1.28	0.257	0.51	0.32-0.82	0.005
Diabetes	1.49	1.09-2.04	0.012	1.16	0.91-1.47	0.229
Hypothyroidism	1.13	0.78-1.64	0.517	0.51	0.36-0.73	0.000
Renal failure	2.44	1.29-4.61	0.006	1.19	0.65-2.19	0.570
Deficiency anemias	1.92	1.21-3.05	0.006	0.60	0.35-1.01	0.055
Rheumatoid Arthritis	2.19	1.00-4.83	0.051	1.57	0.82-2.99	0.173
Obesity	1.48	0.97-2.24	0.066	0.51	0.33-0.80	0.004
Psychoses	1.54	0.55-4.28	0.412	0.70	0.25-1.94	0.489
Depression	2.15	0.47-3.17	0.000	0.83	0.56-1.23	0.355

Table 4.8: Unadjusted Associations between Provider Characteristics and Surgeons' Practice Styles, 2013 Florida HCUP-SASD/SID

	OM Style		
	OR	95% CI	p-value
Provider Characteristics			
Surgeon Mastectomy Volume			
Low	1.00	Referent	
Medium	1.86	1.59-2.18	0.000
High	0.62	0.55-0.70	0.000
Hospital Mastectomy Volume			
Low	1.00	Referent	
Medium	1.00	0.89-1.13	0.966
High	0.57	0.5-0.65	0.000
Hospital Total Discharge Volume			
Low	1.00	Referent	
Medium	0.43	0.35-0.52	0.000
High	0.65	0.53-0.79	0.000
Teaching Status			
Teaching	1.00	Referent	
Non-teaching	2.34	2.12-2.59	0.000
Ownership			
Not-for-profit	1.00	Referent	
For-profit	1.52	1.36-1.69	0.000
Hospital Bed Size			
Small	1.00	Referent	
Medium	1.51	1.34-1.71	0.000
Large	1.84	1.63-2.08	0.000
Hospital Location			
Urban	1.00	Referent	
Rural	0.47	0.32-0.67	0.000

Table 4.9: Unadjusted Associations between Provider Characteristics and Surgeons' Modality Approaches, 2013 Florida HCUP-SASD/SID

	Exclusive IM			Exclusive OM		
	OR	95% CI	p-value	OR	95% CI	p-value
Provider Characteristics						
Surgeon Mastectomy Volume						
Low	1.00	Referent		1.00	Referent	
Medium	0.24	0.18-0.32	0.000	0.40	0.32-0.49	0.000
High	0.04	0.03-0.06	0.000	0.14	0.11-0.17	0.000
Hospital Mastectomy Volume						
Low	1.00	Referent		1.00	Referent	
Medium	0.26	0.20-0.35	0.000	0.47	0.39-0.58	0.000
High	0.14	0.09-0.21	0.000	0.59	0.48-0.72	0.000
Hospital Total Discharge Volume						
Low	1.00	Referent		1.00	Referent	
Medium	1.13	0.75-1.71	0.561	0.26	0.20-0.33	0.000
High	0.30	0.19-0.46	0.000	0.34	0.27-0.43	0.000
Teaching Status						
Teaching	1.00	Referent		1.00	Referent	
Non-teaching	2.80	2.10-3.73	0.000	2.16	1.79-2.60	0.000
Ownership						
Not-for-profit	1.00	Referent		1.00	Referent	
For-profit	4.38	3.43-5.59	0.000	3.60	3.04-4.27	0.000
Hospital Bed Size						
Small	1.00	Referent		1.00	Referent	
Medium	0.39	0.29-0.52	0.000	1.08	0.89-1.31	0.456
Large	0.27	0.20-0.38	0.000	0.67	0.54-0.83	0.000
Hospital Location						
Urban	1.00	Referent		1.00	Referent	
Rural	7.33	4.78-11.23	0.000	0.58	0.25-1.34	0.204

Table 4.10: Adjusted Association between Patients and Provider Characteristics and by Surgeons' Practice Styles, 2013 Florida HCUP-SASD/SID

	OM style		
	OR	95% CI	p-value
Patient Age			
<40	1.00	Referent	
40-59	1.03	0.82-1.29	0.820
≥60	1.23	0.95-1.58	0.111
Patient Race			
White	1.00	Referent	
Black	0.71	0.59-0.85	0.000
Hispanic	0.74	0.63-0.88	0.000
Other	0.96	0.71-1.31	0.810
Primary Payer			
Medicare	1.00	Referent	
Medicaid	1.43	1.10-1.85	0.007
Private Insurance	0.83	0.71-0.98	0.032
Other	1.28	1.00-1.65	0.052
Patient Residency			
Urban	1.00	Referent	
Rural	0.87	0.67-1.12	0.283
Median Household Income			
Quartile 1	1.00	Referent	
Quartile2	0.89	0.77-1.02	0.085
Quartile3	0.86	0.74-1.00	0.054
Quartile 4	0.63	0.51-0.79	0.000
Individual Comorbidities			
Valvular Disease	0.66	0.45-0.96	0.030
Chronic Pulmonary Disease	0.76	0.60-0.97	0.029
Hypothyroidism	0.78	0.65-0.94	0.010
Deficiency anemias	0.74	0.56-0.97	0.032
Depression	0.75	0.60-0.96	0.019
Surgeon Mastectomy Volume			
Low	1.00	Referent	
Medium	1.96	1.65-2.32	0.000
High	0.61	0.52-0.72	0.000
Hospital Mastectomy Volume			
Low	1.00	Referent	
Medium	1.06	0.89-1.26	0.525
High	0.75	0.61-0.93	0.007

Table 4.10 Continued

	OM style		
	OR	95% CI	p-value
Hospital Total Discharge Volume			
Low	1.00	Referent	
Medium	0.38	0.30-0.49	0.000
High	0.88	0.65-1.20	0.418
Teaching Status			
Teaching	1.00	Referent	
Non-teaching	2.74	2.40-3.11	0.000
Ownership			
Not-for-profit	1.00	Referent	
For-profit	1.44	1.25-1.65	0.000
Hospital Bed Size			
Small	1.00	Referent	
Medium	1.54	1.31-1.81	0.000
Large	2.43	1.97-3.00	0.000
Hospital Location			
Urban	1.00	Referent	
Rural	0.32	0.20-0.50	0.000

Table 4.11: Adjusted Association between Patient and Provider Characteristics and Surgeons' Modality Approaches, 2013 Florida HCUP-SASD/SID

	Exclusive IM			Exclusive OM		
	OR	95% CI	p-value	OR	95% CI	p-value
Patient Age						
<40	1.00	Referent		1.00	Referent	
40-59	1.65	0.82-3.33	0.161	0.89	0.60-1.32	0.558
≥60	2.00	0.95-4.19	0.068	1.37	0.89-2.10	0.151
Patient Race						
White	1.00	Referent		1.00	Referent	
Black	1.53	1.02-2.28	0.039	0.87	0.63-1.21	0.416
Hispanic	1.07	0.71-1.61	0.753	0.87	0.66-1.15	0.326
Other	1.31	0.62-2.78	0.481	1.30	0.79-2.13	0.302
Primary Payer						
Medicare	1.00	Referent		1.00	Referent	
Medicaid	0.94	0.54-1.65	0.837	0.98	0.64-1.50	0.924
Private Insurance	1.46	0.98-2.17	0.062	1.28	0.98-1.69	0.074
Other	1.05	0.57-1.96	0.871	1.17	0.77-1.77	0.474
Patient Residency						
Urban	1.00	Referent		1.00	Referent	
Rural	1.49	0.92-2.42	0.108	0.15	0.08-0.29	0.000
Median Household Income						
Quartile 1	1.00	Referent		1.00	Referent	
Quartile2	0.67	0.49-0.91	0.012	0.86	0.69-1.08	0.205
Quartile3	0.55	0.37-0.81	0.002	0.69	0.53-0.89	0.005
Quartile 4	0.72	0.40-1.31	0.286	0.84	0.57-1.23	0.378
Individual Comorbidities						
Hypertension	1.06	0.78-1.43	0.715	0.73	0.58-0.91	0.005
Chronic Pulmonary Disease	0.73	0.38-1.40	0.342	0.68	0.41-1.12	0.132
Diabetes	1.00	0.69-1.45	0.995	1.20	0.90-1.60	0.220
Hypothyroidism	0.98	0.64-1.50	0.925	0.48	0.32-0.70	0.000
Renal failure	0.96	0.47-1.99	0.921	1.02	0.51-2.03	0.962
Deficiency anemias	1.47	0.87-2.49	0.147	0.58	0.32-1.06	0.079

Table 4.11 Continued

	Exclusive IM			Exclusive OM		
	OR	95% CI	p-value	OR	95% CI	p-value
Obesity	1.15	0.71-1.87	0.569	0.58	0.36-0.95	0.029
Depression	1.81	1.14-2.86	0.012	0.88	0.56-1.37	0.565
Surgical Procedures, Providers						
Surgeon Mastectomy Volume						
Low	1.00	Referent		1.00	Referent	
Medium	0.25	0.18-0.35	0.000	0.41	0.32-0.51	0.000
High	0.06	0.04-0.09	0.000	0.11	0.08-0.14	0.000
Hospital Mastectomy Volume						
Low	1.00	Referent		1.00	Referent	
Medium	0.75	0.50-1.14	0.177	0.89	0.65-1.21	0.448
High	0.67	0.37-1.20	0.173	1.50	1.03-2.17	0.033
Hospital Total Discharge Volume						
Low	1.00	Referent		1.00	Referent	
Medium	2.83	1.65-4.86	0.000	0.30	0.22-0.41	0.000
High	3.04	1.39-6.68	0.005	1.21	0.75-1.95	0.435
Teaching Status						
Teaching	1.00	Referent		1.00	Referent	
Non-teaching	1.69	1.19-2.39	0.003	1.89	1.51-2.37	0.000
Ownership						
Not-for-profit	1.00	Referent		1.00	Referent	
For-profit	2.23	1.63-3.05	0.000	2.67	2.11-3.38	0.000
Hospital Bed Size						
Small	1			1		
Medium	0.43	0.30-0.61	0.000	0.86	0.64-1.14	0.292
Large	0.97	0.54-1.74	0.915	0.78	0.54-1.13	0.194
Hospital Location						
Urban	1.00	Referent		1.00	Referent	
Rural	2.12	1.10-4.08	0.024	0.49	0.18-1.34	0.165

CHAPTER 5: DISCUSSION

5.1 Overall Findings

This retrospective, cross-sectional study investigated patient and provider non-clinical predictive factors of practice style and modality approaches selected by surgeons in mastectomy cases using 2013 Florida HCUP- state inpatient and outpatient data. Two research objectives and six hypotheses guided this research. The first objective was to explore patient-level predictors of surgeon's practice style (inpatient versus outpatient) for mastectomy procedure. Hypothesis *H1.1* under this objective was that patients with minority race and patients who have private insurance have higher odds of having their mastectomy performed by surgeons with OM style. This hypothesis, however, was not supported by the study findings. The expectation was based on the evidence found in the literature reporting higher rates of 'being uninsured' and shorter hospital stays to avoid extra costs among African-Americans compared to whites. However, in this study, African-Americans and Hispanics were less likely to be seen by OM style surgeons. These results support the findings of some other studies suggesting that nonwhites are less likely to receive OM than their white counterparts [34]. In a study by Salasky et al. [70] examining the use of OM in the U.S., all racial minorities including African-American patients and American Indian or Alaska Native patients had lower rates of OM compared with white patients [70]. Researchers speculate that racial disparities in the use of OM may be associated with the local environment of the patients' place of residence [70] as it has been documented that patients residing in racially segregated areas have

lower access and use rates of outpatient surgical procedures compared with patients in less segregated areas. [163]

Moreover, in the present study, private insurance holders were less likely to have their mastectomies performed by surgeons with OM style. However, Medicaid beneficiaries compared to Medicare patients were significantly more likely to be seen by OM style surgeons. Previous studies examining the relationship between the use of OM and patient insurance coverage have produced conflicting results. Some studies suggest that cost-conscious insurance companies limit a patient's choice to outpatient breast cancer procedures to lower hospital costs [33]. For example, in a study conducted by the AHRQ, a team of researchers examined trends and patterns for OM in the 5 states and found a significant increase in the rate of OM in the late 1990s, in part because of pressures from insurance companies during those years to make OMs mandatory [52]. Thus, the expectation was that private insurance holders would be more likely to be treated by surgeons who do more OM. However, it is important to note that more than half (about 52%) of the present study population were older adults and the majority of U.S. older adults now are under Medicare coverage [164]. Moreover, the rate of outpatient surgeries among Medicare beneficiaries has also increased by 40% over the last decade [165]. In addition, there is evidence that outpatient surgery, including OM, reduces patient exposure to the risks associated with prolonged hospitalization and has been shown to be a safe option for the treatment of breast cancer [166]. As a result, much like other insurers, Medicare has developed policies to encourage outpatient surgery in order to reduce rising health care costs. For example, the Medicare program adopted an outpatient prospective payment system authorizing payment for surgical services in a

variety of outpatient settings [70].

Another study hypothesis related to patient characteristics and surgeons' choice of modality approaches *(H1.2)* was that older, rural, and racial minority patients, and patient who have private insurance have higher odds of having their mastectomy performed by surgeons who choose an exclusive approach, IM or OM, in their mastectomies than by bimodal surgeons. This hypothesis was partially supported by the study findings. In this study, African-American women were more likely to have their mastectomies performed by exclusive IM surgeons compared to bimodal surgeons. These findings are consistent with previous studies suggesting the existence of racial disparities in accessing high quality of care and new treatment methods [167, 168]. Considering bimodal surgeons as a more trained and specialized group of surgeons [169] who have the ability to perform both methods based on patient need and operation circumstances, it appears that African-Americans may not receive such treatment compared to whites. Consequently, the racial differences in accessibility to high quality treatment found in the present study is consistent with previous studies of racial disparities in quality of care. No significant associations were found for patient age and type of insurance and surgeon's selection of exclusive versus bimodality approaches. However, rural patients were less likely to have their mastectomies performed by exclusive OM surgeons than by bimodal surgeons. One explanation for this result is that mastectomy, although it is being performed as an outpatient, is a complex procedure which requires facilitated operating rooms and expert personnel [170]. Rural areas tend to have less equipped hospitals with the appropriate resources to support outpatient procedures [171]. As a result, rural residents who seek to have their mastectomies in local rural hospitals may not have OM procedures as an

option or it is possible that surgeons working in rural hospitals are less likely to operate mastectomy as an outpatient.

Two hypothesized expectations involving surgeon volume were supported by the present study. *H2.1* stated that high volume surgeons are less likely to use OM style compared to low volume surgeons. Furthermore, *H2.2* under objective 2 was that high volume surgeons have lower odds of being among 'exclusive outpatient' or 'exclusive inpatient' surgeons than among bimodal surgeons. The study findings suggest that high volume surgeons compared to lowest volume surgeons were less likely to choose OM style and also less likely to be among surgeons with exclusive approaches. These findings are supported by most previous studies suggesting that surgeon volume is a proxy for quality of care. According to these studies, high volume physicians provide complex supportive services such as clinical follow-up care and they are less likely to discharge their patients early after complex surgeries [61]. Besides, high volume surgeons tend to be experienced and well-trained surgeons who have the ability to perform different surgical approaches based on individual patients' preferences and clinical status [172]. It is also possible that high volume surgeons tend to see more complex cases and patients with advanced stages or a greater number of comorbidities who are not really good candidates for outpatient breast surgeries [75].

The first part of hypothesis *H3.1* stating that non-teaching and for-profit hospitals have higher odds of having mastectomies performed by OM style surgeons than by surgeons who use inpatient method in their mastectomies (*H3.1*) was supported. Non-teaching hospitals had significantly higher odds of their mastectomy cases being performed by surgeons who prefer OM style. These results support the findings of other

studies which suggest that non-teaching hospitals are more likely to perform same day surgeries. In a study conducted by the AHRQ [173] research team, the authors studied the distribution of outpatient surgery compared with inpatient surgical procedures by body system, as well as the most common surgical procedures performed in an outpatient setting in 28 states that provide data for both types of settings. The researchers found that compared with inpatient surgeries, outpatient procedures were more likely to be done in smaller hospitals, non-metropolitan areas, and in non-teaching settings [174]. Moreover, Case and colleagues found that women were less likely to undergo an OM in teaching compared with non-teaching hospitals [52]. In addition, the majority of outpatient medical centers and Ambulatory Surgical Centers (ASCs) are physician owned and considered as profitable settings. The existing research demonstrates that physicians who own facilities refer patients for outpatient services at much higher rates than other physicians [175]. This evidence may explain the higher rates of surgeries being performed by OM style surgeons at for-profit settings.

However, the second part of the hypothesis H3.1 involving hospital volume was not supported by the present study. This part of the hypothesis stated that high volume hospitals (both in terms of mastectomy volume and total discharge volume) are more likely to have mastectomy procedures done by OM style surgeons. The expectation was that high volume hospitals would increase the chance of surgeons performing OM because of their more specialized staff, availability of advanced technology, and limited number of available beds [176]. However, it is important to note that high volume hospitals are also more likely to admit more complex cases and those with more advanced cancer stages [177] for whom OM is not an appropriate method of treatment

[75].

Hypothesis H3.2 was that non-teaching and for-profit hospitals have higher odds of having mastectomies performed by 'exclusive outpatient' or 'exclusive inpatient' surgeons than by surgeons with other bimodal approach. This hypothesis was also supported by the study findings. These results are consistent with previous studies suggesting that teaching and non-profit hospitals compared to non-teaching and profitable settings, tend to attract and hire more experienced, specialized, and well-trained surgeons who have the ability to perform new and multimodal treatments [178].

5.2 Evidence Supporting Study Findings on Variations in Surgeons Practice Patterns

Consistent with previous studies, the results of the present study demonstrate that variation in physicians' practice styles can be influenced by both patient and provider level factors. According to previous studies, variation in physician clinical management, including cancer treatment, occurs with regards to patient demographic and clinical characteristics [179, 180], providers' individual attributes (gender, level of experience, specialty) [181], practice environments, and healthcare systems [182-184]. Moreover, previous studies have shown clear patterns of variation on several levels of aggregation including countries, regions, hospitals, and physicians [60]. Research has demonstrated that the choice of medical treatment can be influenced by non-clinical factors such as uncertainty about the most effective practice, response to regulations, payment system, availability of beds and facilities, and type of insurance coverage [40, 141, 185].

Most of the existing explanations on variations in practice patterns are based on the idea that physicians differ in their preferences concerning treatment [81]. Judgment

and preferences of physicians give rise to a unique pattern over time, which is called surgical modality signature [81]. Freidson [186] theorized that for some diagnoses there are no strong expectations, or norms, on how to treat. Professional uncertainty therefore exists and there is an opportunity for different practice styles. He described the social system in which physicians make their medical decisions and expected that within groups, physicians behave in similar ways because they are mutually dependent. According to Freidson, professional uncertainty provides the opportunity for variation in medical behavior; however, sharing a work environment is related to similarities in behavior. There is existing evidence that physicians find solutions to the problem of professional uncertainty, for example, by doing what colleagues are doing [84]. When acting like others, one does not have to explain, or legitimize, one's behavior. It becomes a norm. Thus, patterns of variation come into being [84]. Westert [187] found similarities among physicians working in the same hospital in the use of hospital care, but variation between the hospitals. De Jong et al. [188] also found similarities in attitudes and stated medical behavior for general practitioners working in the same partnership. However, the researchers reported differences between general practitioners working in different partnerships [189]. Some studies argue that preferences toward specific method of treatment are developed in the course of education and socialization. For example, Chassin [190] suggested variations in practice styles are associated with differences in the prevalence of physicians who are enthusiastic for certain procedures due to authoritative teachers in continuous medical education.

Findings related to the comorbidities in the present study deserve special attention. As expected, patients with comorbidities were less likely to have their surgery

performed by outpatient style surgeons or surgeons who exclusively perform OM. Specifically, in the adjusted analysis, patients with chronic pulmonary disease, hypothyroidism, deficiency anemias, obesity, and depression were less likely to be operated on by OM style surgeons and patients with hypertension, hypothyroidism, and obesity were less likely to be seen by exclusive OM surgeons. Moreover, patients with depression were 82% more likely to be treated by exclusive IM surgeons than by bimodal surgeons. These findings support the results of previous studies results suggesting that lower rates of outpatient procedures and longer lengths of stay for inpatient hospitalization among patients with comorbidities may be due to their need for higher levels of postoperative follow up [191]. Patients with mental disorders such as depression and psychoses have been reported to experience more severe depression following an operation as surgery imposes another level of depression; hence, these groups of patients are in need of higher levels of postoperative care and cannot be discharged the same day as surgery [192].

5.3 Strengths and Limitations

Some important study limitations should be noted. Previous cancer studies using clinical data have shown a significant effect of cancer stage on the decision-making process of treatment [193-195]. Unfortunately, due to the administrative nature of the HCUP databases used for the present study, some important clinically relevant factors such as cancer stage and severity of comorbid conditions were not examined. Moreover, it was not possible to extract detailed clinical information about the cases from the data. For example, there were different ICD-9-CM codes for malignant neoplasm or metastatic breast cancers, however, these codes do not reveal any information about the time of

diagnoses, time interval between diagnosis to surgery, and whether patients received any adjuvant therapy before the surgery. However, according to breast cancer studies, early diagnosis of breast cancer and more importantly timely surgical intervention, regardless of cancer stage, results in a higher survival rate and influences the type of procedure a patient receives [196, 197]. Furthermore, the HCUP databased do not include information on surgeon level factors (i.e., surgeon's demographics such as age and gender, and training/experience characteristics). Previous studies suggest that physician demographics and training/experience factors may also influence the type of treatment patients receive [198, 199]. Moreover, from the HCUP databases, it was not possible to study some other institutional variables which are often likely to contribute to variations in surgeons' practice styles and patterns including multidisciplinary team, staffing ratios, availability of technology and specialized equipment including specialized operating rooms, preoperative risk assessments, and recommendations by other physicians [40, 50, 68, 148]. All these unmeasured differences may result in confounding, and thus an over- or under-estimate of the true association.

Some methodological challenges involved in the study should be also noted. While evidence was found regarding a validated volume categorization for surgeon volume, the same was not true for hospital volume. As previous breast cancer studies have acknowledged, no validated volume thresholds have been established for hospitals. Halm et al. [126] noted that cut-off points used to define high and low volume overlapped substantially among studies: the same number of procedures was defined as high volume in one study and low volume in another. This wide variation in the definition of low vs.

high volume at both surgeon and hospital levels creates considerable methodological challenges.

Miscoding of procedures is another possible limitation. The study analyses relies on the accuracy of the mastectomy procedure codes included in HCUP databases; while the accuracy level of HCUP is high for an administrative database [200], it is possible that some ICD-9 or CPT coded procedures may be incorrectly coded. If this type of miscoding had occurred, it likely would have biased the results towards the null.

Despite the limitations, the present study does have a number of strengths. This study is the first study that examined how patient, surgeon, and hospital characteristics are associated with surgeons' practice styles and modality approaches for mastectomy procedure. As noted by other researchers, there are multiple factors involved in the decision making process for treatment or surgical modality including patient preference, patient's comorbidities, patient lifestyle, and social support [201-203]. Some studies have also attempted to investigate racial and geographical variations in the use of outpatient mastectomy. However, physician preference and comfort with one modality can strongly affect the choice of treatment modality and had not been examined before this study [174]. Another strength of the study is the use of multilevel modeling utilized for the hierarchical data that allowed the ability to separate the impact of patient demographics and non-clinical factors, surgeon's experience, and the parameters related to the hospital system and resources. In addition, most previous studies on OM were conducted over one decade ago and focused on Medicare data. As such, these studies may not be generalizable to the larger population of patients treated in the health care environment of today. Furthermore, the present study has a large population-based design, including data

from individuals of all ages and insurance coverage plans, making the sample size larger than most other breast cancer studies. Lastly, the data used represented a diverse sample of hospitals and allowed for adjustment for multiple patient and hospital characteristics. Thus, these findings are likely generalizable to other states with similar organizational structures of health care systems.

5.4 Policy and Practice Implications

Studies have demonstrated that when patients and their families make decisions about treatments, they assume that physicians make decisions only based on medical knowledge or the patient's clinical condition. As a result, they do not give themselves the right to judge or interfere directly [186, 204] and "this gives the medical profession its special social and legal status" [60]. However, if the assumption is true, similar patients with similar conditions would receive the same treatment/procedure, regardless of the physician, hospital, or practice they attended. However, examples from literature show the existence of variations in medical practice even for patients with similar conditions (e.g., differences in diagnoses, ordering of diagnostic tests, referral rates, drug prescribing, hospital admissions, decisions on surgery, diagnostic procedures, and length of stay) [139, 140, 205]. In addition, some previous studies have revealed that even patients with the same clinical condition and same doctors treating in different care settings do not receive similar treatments [81, 190].

Understanding variations in treatment and whether patients receive the treatment that works best, whether the relation between costs and effects is acceptable, and whether all people have equal access to health care are of importance to all stakeholders in the health care system. The observation that similar patients are not treated similarly is a

concern with regard to effectiveness, efficiency and equity in delivery of health care. Policy makers, insurance companies, patient organizations, and healthcare providers generally aim at decreasing variations in medical practice. As a result, it is important to measure the extent of variation and understand its causes.

The existence of variation in the delivery of health care is often interpreted as a sign of overuse of health care resources [206]. Although overuse gets more attention, underuse of health care resources could be a problem as well [207]. It is important to identify sources of undesirable variation and examine whether the variations causes are indicators of overuse or underuse. It is helpful to place emphasis on those sources that can be eliminated to improve the quality of medical care. Variation in treatment is not a concern unless it results in overutilization of a particular treatment in one population or underutilization in another population. In other words, variation in physician approaches in treating patients is not desired if it results in disparities in receiving a particular treatment among a certain population. Part of variation in treatment can be appropriate, especially if it is based on differences in patients' clinical conditions. However, that part of variation that is not legitimate and that is associated with physicians' preferences should be reduced. Although, to date, there is no evidence of less variation associated with a higher quality of care [208], patients should receive the treatment that works best, against lower costs.

The use of OM has increased rapidly since 1990 [30]. Moreover, most of the literature on OM indicates that it is a safe and effective alternative to an inpatient procedure when a patient is in good health, has early-stage breast cancer, and the physician confirms the suitability of the procedure [29]. However some surgeons have

preferences for IM and may not choose to perform OM even if OM is applicable based on a patient's clinical circumstances. The preferences of providers are at risk for being communicated to the patient. Individual patients should be treated with a strategy that is best for them. This can be facilitated through shared medical decision making. One approach is to develop and deploy decision tools that physicians can use to educate patients about the risks, benefits, and long-term outcomes of all of the surgical options (inpatient and outpatient). Decision tools can improve patients' knowledge of surgical options in an unbiased, less pressured environment and have been associated with improved decisional quality for breast cancer care [209]. Decision tools can also be used to tailor interventions to match patient values [189]. Ultimately, the true measure of quality relies not on rates of IM or OM, but the extent to which patients are adequately informed of treatment options. With effective physician-patient communication, treatment decisions reflect patients' personal values, needs, and preferences, and not physicians' comfort with a particular treatment approach.

It is important to identify sources of variations in surgeons' preferences and practice styles in order to design an effective intervention to encourage physicians to avoid adoption of an exclusive approach in their surgeries. Intervention strategies should help surgeons to get experience in using both IM and OM styles and to make decisions based on patient needs rather than their treatment style preferences. For example, if variation is very much related to the influence of a shared work environment and colleagues, consensus conferences can be a useful instrument for effective interventions. Effective strategies can be broad conferences to influence physicians from different hospitals to adopt the same evidence-based standards and guidelines which promote both

IM and OM based on patient need, or hospital-based conferences to influence all physicians in a certain group to change their "local standards" toward more global, evidence-based standards.

Another possible intervention would be physician profiling. Physician profiling is a technique that has been used in an attempt to constrain spending and change a physician's choice of hospital length of stay, by comparing his/her individual average to a benchmark figure, or a norm that is either based on practice (such as profiles of other physicians) or on standards (such as practice guidelines), adjusted for severity of illness [81]. This method of 'physician profiling' can be used to compare an individual physician's average number of inpatient and outpatient mastectomies with other physicians' practice patterns. The effectiveness of this method to change physicians' choice of length of stay has been confirmed in previous studies [81, 210]. This individual-physician-based, managerial approach avoids the informal standards within a hospital. Another powerful profiling tool can be the use of data on surgeons' clinical decision-making patterns to inform them about how they can change to become more efficient, or what to do in a particular clinical situation. Informing surgeons about characteristics of their practice styles can create behavior change through education [211].

Findings from this study also provide additional insight into understanding the need for patient education regarding mastectomy treatment options as well as specialized and focused training of breast surgeons. The findings of the study also highlight the need for policy actions at the hospital-level in order to optimize the use of both IM and OM modalities. Hospitals face a financial burden associated with unnecessary inpatient

hospitalization and long patient stays [212]. Hence, pressure to meet financial obligations is leading non-teaching and for-profit hospitals to increase outpatient procedures rates and release patients as early as possible. The wide variation in having surgery performed by OM style surgeons and surgeons with an exclusive approach between teaching and non-teaching and between for-profit and non-profit hospitals suggests that the preference of surgeons may be superseding the preference of patients. The results of this study can be used by hospitals for quality assurance measures to evaluate whether their IM or OM utilization rates are simply due to the demographics of the hospital's patient population or because of systemic issues. For situations in which both OM and IM methods are applicable, systems must be developed to ensure that women are aware of the different treatment options they have. However, it is important to note that in designing and implementing surgeon-level strategies to control factors influencing variations in surgeons practice styles, efforts will not succeed unless surgeons get involved from the beginning. Physicians, by virtue of their training and experience, have learned to trust their own judgment and they usually resist to changing their practice styles [213]. However, if programs promoting the use of both OM and IM methods based on patient needs result in improved patient outcomes and satisfaction, surgeons gradually will accept those changes especially when they see that the new policies are moving toward their principal professional goal of helping their patients.

This study has raised additional questions about the factors that cause or influence differences in performing OM versus IM. The current study examined patient and provider level factors associated with surgeons' practice style preferences for mastectomy procedure, however, future studies will be needed to investigate the extent of variation in

breast cancer surgeons practice styles. Knowing the extent of variation in surgeons' practice styles is the first step towards reducing it without reducing the quality of care. Moreover, to date, it is unknown whether less variation in surgeons' practice patterns is related to better quality of care. Future studies should examine the consequences of this variation in terms of costs and patient outcomes such as patient satisfaction. Furthermore, studies evaluating different types of interventions to reduce existing practice style variations can be a valuable source of information to educate others on what does and what does not affect physician behavior. Additionally, patient socioeconomic factors require more investigation. For instance, our study demonstrated that race and income level factors explain some of the variation. It is imperative that a better understanding of such factors in the context of population-based studies on physicians' practice patterns precede any regulatory policy. In addition, future studies will be needed to evaluate the effect of surgeons' demographic, training, and specialization on variations of their practice patterns. Finally, future directions for mastectomy research should be focused on collecting richer data with more clinical information to address the concerns about important factors such as cancer stage influencing the type of procedures that a surgeon performs.

In conclusion, this study has the advantage of being comprehensive and population-based since it includes all patients undergoing mastectomy procedure in the state of Florida hospitals in 2013. Variations in receiving OM versus IM between different racial groups and patients with different socioeconomic backgrounds found in this study support existing evidence on the underutilization of OM among some patient populations. However, this study takes one more step further suggesting that physicians

preferences for OM versus IM vary by patient level factors and by the characteristics of the hospitals in which patients are treated.

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APPENDIX A: Sensitivity Analysis excluding surgeons with exact number of IM and OM

	Exclusive IM			Exclusive OM		
	OR	95%CI	p-value	OR	95%CI	p-value
Patients Characteristics						
Patient Age						
<40	1.00	Referent		1.00	Referent	
40-59	1.64	0.82-3.29	0.161	0.91	0.61-1.35	0.639
≥60	2.00	0.95-4.19	0.068	1.37	0.89-2.10	0.151
Patient Race						
White	1.00	Referent		1.00	Referent	
Black	1.53	1.02-2.28	0.039	0.83	0.60-1.15	0.273
Hispanic	1.07	0.71-1.61	0.753	0.87	0.66-1.15	0.326
Other	1.28	0.61-2.69	0.518	1.30	0.80-2.14	0.292
Primary Payer						
Medicare	1.00	Referent		1.00	Referent	
Medicaid	0.90	0.52-1.57	0.711	0.98	0.64-1.50	0.919
Private Insurance	1.46	0.98-2.17	0.061	1.25	0.95-1.65	0.106
Other	1.02	0.55-1.89	0.944	1.26	0.83-1.92	0.284
Patient Residency						
Urban	1.00	Referent		1.00	Referent	
Rural	1.43	0.89-2.30	0.143	0.16	0.08-0.30	0.000
Median Household Income						
Quartile 1	1.00	Referent		1.00	Referent	
Quartile2	0.71	0.52-0.97	0.032	0.94	0.75-1.18	0.599
Quartile3	0.55	0.37-0.81	0.002	0.74	0.58-0.96	0.025
Quartile 4	0.72	0.40-1.30	0.279	0.78	0.53-1.15	0.207
Individual Comorbidities						
Hypertension	1.06	0.78-1.43	0.708	0.75	0.60-0.93	0.010
Chronic Pulmonary Disease	0.65	0.34-1.24	0.189	0.69	0.42-1.13	0.137
Diabetes	1.07	0.74-1.55	0.706	1.17	0.88-1.56	0.290
Hypothyroidism	0.96	0.64-1.46	0.855	0.51	0.34-0.75	0.001
Renal failure	0.89	0.43-1.84	0.749	1.09	0.54-2.20	0.806
Deficiency anemias	1.47	0.87-2.49	0.147	0.57	0.31-1.04	0.068
Obesity	1.11	0.69-1.79	0.665	0.62	0.38-1.00	0.050
Depression	1.87	1.20-2.93	0.006	0.88	0.56-1.37	0.563

Surgeon Mastectomy Volume						
Low	1.00	Referent		1.00	Referent	
Medium	0.30	0.22-0.41	0.000	0.41	0.33-0.52	0.000
High	0.06	0.04-0.10	0.000	0.11	0.09-0.15	0.000
Hospital Mastectomy Volume						
Low	1.00	Referent		1.00	Referent	
Medium	0.75	0.50-1.14	0.177	0.89	0.65-1.21	0.453
High	0.67	0.37-1.20	0.174	1.49	1.03-2.16	0.034
Hospital Total Discharge Volume						
Low	1.00	Referent		1.00	Referent	
Medium	2.83	1.65-4.86	0.003	0.28	0.21-0.38	0.000
High	3.10	1.41-6.82	0.005	1.20	0.74-1.93	0.462
Teaching Status						
Teaching	1.00	Referent		1.00	Referent	
Non-teaching	1.69	1.19-2.39	0.003	1.89	1.51-2.37	0.000
Ownership						
Not-for-profit	1.00	Referent		1.00	Referent	
For-profit	2.27	1.71-3.00	0.000	2.76	2.23-3.41	0.000
Hospital Bed Size						
Small	1			1		
Medium	0.42	0.29-0.61	0.000	0.87	0.65-1.15	0.328
Large	0.96	0.53-1.72	0.883	0.79	0.54-1.15	0.212
Hospital Location						
Urban	1.00	Referent		1.00	Referent	
Rural	2.12	1.10-4.08	0.024	0.53	0.19-1.51	0.235

APPENDIX B: Sensitivity Analysis excluding surgeons with one Record of Mastectomy

	Exclusive IM			Exclusive OM		
	OR	95%CI	p-value	OR	95%CI	p-value
Patients Characteristics						
Patient Age						
<40	1.00	Referent		1.00	Referent	
40-59	1.64	0.81-3.30	0.170	0.88	0.60-1.31	0.534
≥60	1.96	0.93-4.11	0.076	1.37	0.89-2.10	0.151
Patient Race						
White	1.00	Referent		1.00	Referent	
Black	1.52	1.02-2.28	0.040	0.87	0.63-1.21	0.416
Hispanic	1.07	0.71-1.61	0.743	0.81	0.62-1.04	0.100
Other	1.31	0.61-2.78	0.487	1.32	0.84-2.07	0.234
Primary Payer						
Medicare	1.00	Referent		1.00	Referent	
Medicaid	0.99	0.61-1.61	0.965	0.98	0.64-1.50	0.919
Private Insurance	1.46	0.98-2.17	0.062	1.19	0.91-1.55	0.198
Other	1.07	0.57-1.99	0.837	1.25	0.85-1.83	0.253
Patient Residency						
Urban	1.00	Referent		1.00	Referent	
Rural	1.49	0.92-2.42	0.166	0.19	0.11-0.33	0.000
Median Household Income						
Quartile 1	1.00	Referent		1.00	Referent	
Quartile2	0.66	0.50-0.88	0.004	0.87	0.70-1.07	0.189
Quartile3	0.58	0.41-0.81	0.002	0.69	0.54-0.88	0.002
Quartile 4	0.77	0.46-1.29	0.317	0.78	0.54-1.11	0.165
Individual Comorbidities						
Hypertension	1.05	0.77-1.42	0.764	0.73	0.59-0.89	0.003
Chronic Pulmonary Disease	0.73	0.38-1.40	0.342	0.68	0.41-1.12	0.131
Diabetes	1.00	0.69-1.45	0.995	1.20	0.90-1.60	0.220
Hypothyroidism	0.98	0.64-1.50	0.925	0.48	0.33-0.69	0.000
Renal failure	0.96	0.47-1.99	0.921	1.01	0.50-2.03	0.980
Deficiency anemias	1.48	0.93-2.38	0.101	0.61	0.36-1.03	0.062
Obesity	1.19	0.78-1.82	0.420	0.57	0.36-0.90	0.016
Depression	1.79	1.17-2.72	0.007	0.85	0.56-1.29	0.435

Surgeon Mastectomy Volume						
Low	1.00	Referent		1.00	Referent	
Medium	0.17	0.12-0.23	0.000	0.41	0.32-0.51	0.000
High	0.03	0.02-0.05	0.000	0.07	0.06-0.09	0.000
Hospital Mastectomy Volume						
Low	1.00	Referent		1.00	Referent	
Medium	0.70	0.44-1.12	0.132	0.89	0.65-1.21	0.453
High	0.67	0.37-1.20	0.174	1.49	1.03-2.16	0.034
Hospital Total Discharge Volume						
Low	1.00	Referent		1.00	Referent	
Medium	2.83	1.64-4.88	0.000	0.30	0.21-0.41	0.000
High	3.10	1.41-6.82	0.005	1.20	0.74-1.93	0.462
Teaching Status						
Teaching	1.00	Referent		1.00	Referent	
Non-teaching	1.72	1.21-2.44	0.002	1.89	1.51-2.37	0.000
Ownership						
Not-for-profit	1.00	Referent		1.00	Referent	
For-profit	2.23	1.63-3.03	0.000	2.68	2.12-3.39	0.000
Hospital Bed Size						
Small	1			1		
Medium	0.42	0.29-0.60	0.000	0.87	0.65-1.15	0.328
Large	0.96	0.53-1.72	0.883	0.79	0.54-1.15	0.212
Hospital Location						
Urban	1.00	Referent		1.00	Referent	
Rural	2.13	1.11-4.11	0.024	0.49	0.18-1.36	0.173