

HEALTH INSURANCE DESIGN AS A DETERMINANT OF BARIATRIC  
SURGERY UTILIZATION

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by  
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## ABSTRACT

**Background:** Bariatric surgery is the most effective treatment for severe obesity, resulting in much larger and longer-lasting weight loss compared with those seen with other treatment options. It also results in significant improvements in several weight-related comorbidities. Despite these favorable outcomes, bariatric surgery remains underused in the United States.

**Objective:** The goal of this dissertation was to investigate the impact of insurance-related factors on the access and utilization of bariatric procedures. The goal was achieved via three studies. The first study examined temporal changes in patient characteristics and insurer type mix among adult bariatric surgery patients in Southeastern Pennsylvania, as well as the associations between payer type, insurance plan type, cost-sharing arrangements (among traditional Medicare beneficiaries), and bariatric surgery utilization. The second study investigated whether there is an association between precertification criteria, such as 3-6 months preoperative supervised medical weight management (MWM), and documented 2-year weight history and the likelihood of undergoing bariatric surgery. The third study examined whether there is an association between insurance-mandated MWM requirement, as well as cardiology and pulmonology evaluations and short-term inpatient healthcare utilization.

**Data Source:** Pennsylvania Health Care Cost Containment Council's (PHC4) databases in Southeastern Pennsylvania during 2014-2018.

**Study Population:** In Study 1, all adult patients in the PHC4 dataset who underwent the most common types of bariatric surgery during 2014-2018 (N = 14,348) and a 1:1 matched sample of surgery patients and those who were eligible for surgery but did not undergo surgery were identified. In Study 2, privately insured patients within the PHC4 dataset who underwent bariatric surgery in 2016 and individuals who met the eligibility criteria but did not undergo surgery were identified and 1:1 matched (N = 1,054). The population of Study 3 consisted of all adult patients within the PHC4 dataset with a diagnosis of severe obesity who underwent the most common bariatric surgical procedures in 2016 and for whom the insurance-mandated precertification requirements were known (N = 2,717).

**Results:** Over the five years, there was an increase in the proportion of Black individuals (37.1% in 2014 vs 43.0% in 2018), Hispanics (5.4% vs 8.0%), and Medicaid beneficiaries (18.5% in 2014 vs 26.9% in 2018) who underwent surgery. The odds of undergoing bariatric surgery based on payer type were statistically different (22% smaller odds) only between Medicare beneficiaries compared to privately insured individuals. There were significantly different odds of undergoing surgery based on insurance plan type within Medicare and private insurance payer categories. Individuals with traditional Medicare plans with no supplementary insurance and those with dual eligibility had smaller odds of undergoing surgery (42% and 32%, respectively) compared to those with private secondary insurance.

The insurance requirement for 3-6 months MWM was associated with smaller odds of undergoing surgery (odds ratio [OR] = 0.459, 95% confidence interval [CI] 0.253 to 0.832, P = 0.010), after controlling for insurance plan type and the requirement for

documented weight history. The documented weight history requirement was not a significant predictor of the odds of undergoing surgery ( $P = 0.132$ ).

The requirement for MWM, as well as pulmonology and cardiology examinations, were not associated with the patient length of stay, the number of all-cause rehospitalizations, and the number of all-cause rehospitalization days, after adjusting for patient age, sex, race, ethnicity, the Elixhauser Comorbidity Score, type of the surgery, facility where the surgery was performed, primary payer type, and the estimated median household income. The absence of the precertification requirement for pulmonology and cardiology evaluations was associated with smaller odds of rehospitalizations with common cardiac and pulmonary conditions during the study period, (OR = 0.43, 95% CI 0.23 to 0.80,  $P = 0.008$ ), after controlling for patient age, sex, race, ethnicity, estimated median household income, and the Elixhauser Comorbidity Score.

**Conclusions and Significance:** Medicaid expansion in Pennsylvania appears to have improved access to bariatric surgery among Black and Hispanic individuals. Nevertheless, insurance plan type, cost-sharing arrangements, and precertification requirements, such as insurance-mandated 3-6 months of MWM requirement, remain key determinants for the access and utilization of bariatric surgery. Additionally, the MWM requirement, as well as the preoperative cardiology and pulmonology evaluations, were not associated with a reduction in inpatient healthcare utilization during the first postoperative year. Careful examination of the bariatric surgery benefit design and application of value-based insurance design to bariatric surgery may improve the access to this potentially life-saving surgery for many Americans.

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### **Disclosure**

The Pennsylvania Health Care Cost Containment Council (PHC4) is an independent state agency responsible for addressing the problem of escalating health costs, ensuring the quality of health care, and increasing access to health care for all citizens regardless of ability to pay. PHC4 has provided data to this entity in an effort to further PHC4's mission of educating the public and containing health care costs in Pennsylvania.

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This analysis was done by the authors at Temple University. PHC4, its agents and staff, bear no responsibility or liability for the results of the analysis, which are solely the opinion of the authors.

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## ABBREVIATIONS

<b>Acronym</b>	<b>Description</b>
BMI	Body Mass Index
HCPCS CPT-4	Healthcare Common Procedure Coding System Level I Current Procedural Terminology
HMO	Health Maintenance Organization
ICD	International Classification of Disease
MWM	Medical Weight Management
PHC4	Pennsylvania Health Care Cost Containment Council
POS	Point of Service
PPO	Preferred Provider Organization
RYGB	Roux-en-Y Gastric Bypass
SG	Sleeve Gastrectomy
T2D	Type II Diabetes Mellitus
USD	United States Dollar
VBID	Value-Based Insurance Design

# CHAPTER 1

## INTRODUCTION

Four in ten American adults have obesity, defined by a body mass index (BMI)  $\geq 30$  kg/m<sup>2</sup>.<sup>1</sup> Moreover, 9.2% of adults have severe obesity (BMI  $\geq 40$  kg/m<sup>2</sup>).<sup>1</sup> Obesity represents a serious public health issue and the economic burden of the disease has potential to negatively impact the American economy in the years ahead.<sup>2</sup> A variety of treatment options exist for severe obesity, including lifestyle modification, pharmacotherapy, and bariatric surgery.

Bariatric surgery is currently recommended for adults with severe obesity or those with a BMI  $\geq 35$  kg/m<sup>2</sup> in the presence of one or more significant comorbidities.<sup>3</sup> The surgery is the most effective treatment for severe obesity, resulting in much larger and longer-lasting weight loss compared with those seen with other treatment options.<sup>3,4</sup> It also results in significant improvements in several weight-related comorbidities.<sup>5-7</sup> For certain patient subgroups, bariatric surgery may be cost neutral compared with conventional treatment options.<sup>8</sup> Furthermore, longer-term outcomes of bariatric surgery suggest decreased or stable costs in the long run.<sup>9</sup> Despite these favorable outcomes, bariatric surgery remains underused in the United States. Only 1% of individuals who meet the weight criteria undergo bariatric surgery annually.<sup>10</sup> The contributing factors for this are not well understood.

Major barriers to bariatric surgery utilization likely include patient and physician knowledge and preconceptions about bariatric surgery, patient-physician communication, as well as insurance design-related factors.<sup>8</sup> The latest nationwide data show that approximately two-thirds of bariatric surgery patients are white.<sup>10</sup> Eight of 10 patients are women and have an average age of 44 years.<sup>10</sup> Six of 10 patients who undergo bariatric surgery have private insurance.<sup>10</sup>

Prior reports have linked private insurance with higher likelihood of pursuing surgery, based on the higher rate of private insurance coverage among bariatric surgery patients compared to those who meet the weight criteria but did not undergo surgery.<sup>11,12</sup> Previous work by Gasoyan and colleagues found that in a sample of patients who underwent bariatric surgery and who were well-matched to those eligible for, but did not undergo surgery, the type of insurance plan (e.g. health maintenance organization [HMO], preferred provider organization [PPO], point of service, fee for service), rather than more general payer type (e.g. Medicare, Medicaid, commercial), was more strongly associated with the utilization of bariatric surgery.<sup>13</sup> More generous plans, such as Blue Cross PPO and Medicare PPO, were associated with greater odds of undergoing surgery, compared to other commercial HMO and Medicare HMO plans, respectively.<sup>13</sup> This finding was novel and in contrast with previous studies; sociodemographic variables that were well-controlled for in that study may account for the difference. A subsequent study with a larger sample as well as consideration of temporal variations of this association could extend our understanding of the issue.

Access to bariatric surgery is generally restricted by insurers in numerous ways, including by precertification criteria such as documented 2-year weight history and involvement in a 3-6 month long preoperative supervised medical weight management (MWM) program.<sup>14,15</sup> Insurance plans also vary by the freedom to choose doctors and hospitals, patient out-of-pocket costs, and the spectrum of covered pre- and post-surgical services. Despite these observations, it is unclear which components of insurance plan design have the strongest influence on the access and utilization of bariatric surgery. Particularly, the impact of precertification criteria on access to bariatric surgery needs further evaluation.

The preoperative assessment process prior to bariatric surgery, which includes documented weight history, involvement in preoperative MWM program, along with nutritional, psychological, pulmonology, and cardiology evaluations, as well as program-specific laboratory tests, need to be evidenced-based; unfortunately, only a few of these are. For example, the requirement of preoperative MWM prior to surgery, theoretically implemented to produce a modest weight loss that either gives the patient an opportunity to learn and practice the dietary and behavioral requirements of surgery or enhance perioperative outcomes, has only modest support in the literature.<sup>16-18</sup> There is a need for further research to determine whether this longstanding health insurance practice has any positive impact on patient outcomes or resource utilization.

## Specific Aims

The goal of this project was to investigate the impact of insurance-related factors on the access and utilization of bariatric procedures. It was achieved via 3 studies and pursued the following aims:

**Study 1** was undertaken to investigate the temporal changes in the patient characteristics and insurer type mix among bariatric surgery patients in Southeastern Pennsylvania. The study also examined the associations between payer type, insurance plan type, cost-sharing arrangements (among traditional Medicare beneficiaries), and utilization of bariatric surgery. The study had the following *a priori* hypotheses. First, we predicted considerable variation by year in the payer mix for bariatric surgery. The largest increase in bariatric surgery utilization was expected among Medicaid and Medicare Advantage beneficiaries. Second, individuals with PPO plans in Medicare Advantage and PPO, as well as fee-for-service plans within privately insured categories, were anticipated to have greater odds of undergoing bariatric surgery compared to those with HMO plans in the corresponding insurer categories. This would confirm previously reported findings from our team on the role of insurance plan type in determining access to bariatric surgery.<sup>13</sup> Third, individuals with traditional Medicare coverage, but without supplemental insurance coverage, were expected to have smaller odds of undergoing bariatric surgery compared to those covered by traditional Medicare and with secondary private supplemental insurance or those with dual eligibility (qualifying for both Medicare and Medicaid).

**Study 2** was undertaken to examine whether there is an association between precertification criteria and utilization of bariatric surgery among individuals eligible for bariatric surgery and who have private insurance. Insurance-mandated requirements of documented 2-year weight history and involvement in a 3-6 month-long preoperative supervised MWM program were predicted to be negatively associated with the odds of undergoing bariatric surgery, after controlling for insurance plan type, patient medical history, and relevant socio-demographic variables.

**Study 3** was undertaken to investigate whether there is an association between select insurance-mandated precertification criteria (specifically MWM, cardiology, and pulmonary consultations) and short-term inpatient healthcare services utilization (operationalized by postoperative hospital length of stay and rehospitalizations in the first postoperative year) after bariatric surgery. Insurance mandated requirements of 3-6 months of MWM, as well as cardiology and pulmonology evaluations, were predicted not to be associated with less resource utilization, after controlling for relevant socio-demographic and clinical variables.

### **Significance**

These studies contribute to the body of literature on how insurance plan design influences the utilization of bariatric surgery. The findings provide a better understanding of why bariatric surgery remains largely underutilized in the US, with potential major policy implications for improving access to care, as well as patient outcomes and experience of care. For example, the findings of this dissertation could help

policymakers, health care providers, and patient advocacy groups to identify and remove insurance-mandated precertification requirements that have limited clinical and economic value and are barriers to care. Furthermore, the methodological approaches employed in this project could be further applied to studies of other high-cost essential health services, e.g. solid organ transplantation, as well as neuromodulation therapies such as spinal cord stimulation for the treatment of chronic pain syndromes, in pursuit of identifying barriers to care.

## **CHAPTER 2**

### **BACKGROUND**

#### **Obesity Prevalence and its Consequences**

Approximately 42% of American adults have obesity, defined by a body mass index (BMI)  $\geq 30$  kg/m<sup>2</sup>.<sup>1</sup> Furthermore, 11.5% of women and 6.9% of men have severe (or class III) obesity, defined by a BMI  $\geq 40$  kg/m<sup>2</sup>.<sup>1</sup> The health risks associated with obesity are well known and include type II diabetes mellitus (T2D), hypertension, coronary heart disease, stroke, osteoarthritis, obstructive sleep apnea, and asthma, among other major health conditions.<sup>19,20</sup>

The impact of obesity on medical spending has been well-documented. Almost all the costs attributable to obesity are due to obesity-related comorbidities.<sup>2</sup> The annual incremental costs of obesity per person was \$1,901 in 2014 USD and \$149.4 billion at the national level.<sup>2</sup> These cost estimates vary significantly when age and comorbidities are considered. For example, while there is no significant difference in costs attributable to obesity in children and adolescents, the incremental costs of obesity are significantly higher among adults (aged 18 – 65); those costs are even higher among older adults, most likely due to the increased burden of obesity-related comorbidities seen with aging.<sup>2</sup>

#### **Treatment Options for Severe Obesity**

There is a wide range of treatments for severe obesity, including lifestyle modification (which includes caloric restriction, increased physical activity, and

instruction in behavioral modification strategies), pharmacotherapy, and bariatric surgery. Bariatric surgery is currently recommended for adults with severe obesity (BMI  $\geq$  40 kg/m<sup>2</sup>), or those with a BMI  $\geq$  35 kg/m<sup>2</sup> in the presence of at least one significant comorbidity associated with obesity.<sup>21</sup> Bariatric surgery is the most effective treatment for severe obesity, resulting in much larger and longer-lasting weight loss compared with those seen with conventional treatment.<sup>3,4</sup>

The most common surgical procedures are laparoscopic and include the Roux-en-Y gastric bypass (RYGB) and the sleeve gastrectomy (SG).<sup>22</sup> Within the past several years, SG has surpassed the RYGB in popularity.<sup>23</sup> With both procedures, patients typically reach their maximum weight loss of 20-35% of initial body weight 6-24 months after surgery.<sup>22,24,25</sup> These weight losses are durable for the majority of patients throughout the first postoperative decade.<sup>25-27</sup> Bariatric surgery also results in significant improvements in the metabolic profile among patients with insulin-treated T2D and long-lasting remission for some individuals.<sup>5</sup> Patients with diabetes who underwent RYGB or SG were reported to be 43 times and 17 times more likely to achieve remission, respectively, than those who did not undergo surgery.<sup>6</sup> The postoperative weight loss is also associated with significant improvements in other obesity-related comorbidities, as well as decreased risk of mortality.<sup>7,28</sup>

The route to surgery typically involves several steps, including attending an information session, as well as completing nutritional, psychological, pulmonology, and cardiology evaluations. Based on insurer precertification requirements, some patients are required to obtain a letter of support from their primary care provider and which also

documents their weight history. In addition, over a period of 3-6 months, patients are encouraged to learn and practice the dietary and behavioral requirements of surgery through monthly visits with a physician or dietitian with the bariatric surgery program (commonly referred as preoperative supervised Medical Weight Management [MWM] program).<sup>16</sup>

### **Cost-Effectiveness of Bariatric Surgery**

There is substantial evidence of the cost-effectiveness of bariatric surgery for adults with severe obesity who also have diabetes compared with usual medical care or intensive lifestyle interventions.<sup>3,29-32</sup> While bariatric surgery is cost-effective compared to non-surgical treatments over a period of a few years, it may not result in cost-savings among the general population of individuals eligible for surgery.<sup>8</sup> However, among certain patient subgroups, bariatric surgery may be cost neutral compared with more conservative treatment options, which may not lead to clinically significant improvements in comorbidities that would significantly reduce health care costs over time.<sup>9,29,33</sup>

Large-scale prospective studies support prioritization of patients with obesity and T2D for bariatric surgery, based on the analysis of the long-term health-care costs.<sup>8</sup> Keating and colleagues, for example, assessed the health-care costs for 2,010 Swedish adults who had bariatric surgery and 2,037 individuals who were treated conventionally over 15 years.<sup>29</sup> While the total health-care expenditures were higher in the surgery group compared to the conventional treatment group in the euglycaemic and prediabetes

subgroups, there was no statistically significant difference in health-care expenditures between surgery and conventional treatment groups in patients with diabetes (\$88,572 vs \$79,967, respectively; difference of \$9,081, 95% Confidence Interval [CI] -\$1,419 to \$19,581).<sup>29</sup>

Longer-term outcomes of bariatric surgery suggest decreased or stable costs in the long run. Particularly, bariatric surgery patients use more outpatient and inpatient services during the first 6-years after surgery, compared with patients receiving conventional obesity treatment, but not thereafter.<sup>9</sup> Medication-related expenditures are generally lower for surgery patients compared to conventional obesity treatment patients from years 7 through 20.<sup>9</sup> This is particularly important since the average age of bariatric surgery patients is 44 years.<sup>10</sup> A longitudinal study by Weiner and colleagues analyzed 2002-2008 claims data from seven Blue Cross Blue Shield health insurance plans comparing 29,820 plan members who received bariatric surgery to a matched non-surgery group.<sup>33</sup> Health care services utilization by patients undergoing bariatric surgery was relatively stable in the period of six years after bariatric surgery.<sup>33</sup> While a decrease in costs for filled prescriptions and office-based visits was recorded in the postoperative period in the surgery group compared with the preoperative baseline, these savings were offset by considerable increases in inpatient services costs associated with the bariatric surgery.<sup>33</sup>

## Potential Barriers to the Utilization of Bariatric Surgery

Complication and mortality rates of bariatric surgery have steadily decreased over the past decade; in 2016 the rates were 1.4% and 0.04%, respectively.<sup>10</sup> Despite the safety of bariatric surgery<sup>34</sup> and the postoperative success, both in terms of weight loss and improvement in obesity-related comorbidities, the procedures remain underutilized.<sup>3</sup> At present, only 1% of the clinically eligible population undergoes surgical treatment for severe obesity,<sup>10</sup> with roughly 256,000 bariatric procedures performed in the United States in 2019.<sup>23</sup> However, compared to the 2011 data (158,000 procedures/year), this represents a 62.0% increase in the overall number of procedures performed annually.<sup>23</sup>

The reasons for underutilization of bariatric surgery are not well understood, but likely include several factors. Some of the key limiting factors have been reported to be patient-physician communication, patient and physician views and attitudes, stigma related to the surgery, as well as cost and insurance benefits structure.<sup>8,35-38</sup>

### *Patient-physician communication*

A key barrier to bariatric surgery may be the conversations that physicians (primary care physicians, endocrinologists, obstetrician/gynecologists, and other relevant specialists) and patients have about obesity and bariatric surgery. In general, physicians are often reluctant to discuss both the cause and treatment of obesity<sup>39</sup> even though the majority have positive views about bariatric surgery.<sup>40</sup> For example, a qualitative study examining how primary care physicians make treatment decisions about clinically severe obesity revealed that obesity treatment may be underprioritized and the risks associated

with bariatric surgery may be overemphasized.<sup>39</sup> Among the reasons for not referring patients for surgery, the study highlighted physicians intention to “do no harm,” inadequate knowledge on bariatric surgery, trying to avoid pursuing surgical treatment too soon, questioning the long-term positive effects of the surgery, as well as uncertainty regarding the insurance coverage.<sup>39</sup> The objective to “do no harm” was driven by concerns about the safety of bariatric surgery, the risk of complications, as well as the potential for reoperations and poor quality of life.<sup>39</sup>

An awareness of physicians’ attitudes and behaviors with respect to obesity is important when considering patient-provider communication about treatment options for obesity. Specifically, the reluctance of primary care physicians and other providers in providing a referral for bariatric surgery may be due to their doubts about the safety and efficacy of the surgery, as well as their ability to provide comprehensive postoperative care.<sup>35,39</sup> Physicians who in the past provided a referral for bariatric surgery appear to be more confident in referring other patients for surgery and in providing quality postoperative care. However, this does not appear to be the case for the majority of physicians.

#### *Patient and physician views and attitudes*

Lack of awareness about the efficacy of bariatric surgery, coupled with concerns about its safety, also may impact patients’ interest in the procedure.<sup>41</sup> For example, Kyle and colleagues, in an online survey conducted with representative samples in the United States and the United Kingdom, found that only 10.2% of respondents in the United

Kingdom and 15.9% in the United States believed that bariatric surgery is the most effective treatment for obesity.<sup>42</sup> Similarly, 8.3% of respondents in the United Kingdom and 11.3% in the United States believed that bariatric surgery was the most effective treatment for T2D among individuals with obesity.<sup>42</sup> Interestingly, between 39%-59% of surveyed individuals thought that self-directed diet and exercise was the most effective treatment for either obesity or obesity and T2D.<sup>42</sup> Furthermore, some individuals with class II (BMI 35–39.9 kg/m<sup>2</sup>) and class III obesity may not believe they weigh enough for surgery; others may erroneously believe that dramatic changes in their diet and engagement in a high level of physical activity is sufficient to produce a weight loss comparable to bariatric surgery.<sup>8</sup>

Weight stigma also appears to impact decision making with respect to medical care more generally and weight loss treatment specifically. A recent nationwide study found that 39.1% of respondents believed that individuals who had weight loss surgery chose the “easy way out;” almost one in two respondents thought that people undergo weight loss surgery for cosmetic reasons.<sup>43</sup> Quality of life, however, has been shown to be a strong component of the decision to seek bariatric surgery. In a study of patients seeking bariatric surgery, Wee et al<sup>44</sup> found that weight-based social stigma was the main reason for reduced quality of life in African American women and white men. However, in a survey of primary care patients, weight stigma was a significant contributor to reduced quality of life for white women only. When compared with the patients in primary care, these results suggest that social stigma may be an important aspect of the decision to seek bariatric surgery for African American women and white men, but not

for white women.<sup>44</sup> In a study of African American and White women’s perceptions of their physicians’ role in weight loss counseling, both groups of women desired the same style of interaction with their physician – including a personalized plan for weight loss, empathy, and a non-judgmental approach.<sup>45</sup>

### *Insurance benefits design*

The majority of studies that have investigated the link between health insurance and bariatric surgery utilization broadly categorized insurance status as “private insurance,” “government insurance,” “no insurance” or offered some detail about the insurer, but with little to no detail about the specific insurance plan type.<sup>11,12,46</sup> For example, Martin and colleagues reported that 82% of bariatric surgery patients had private insurance, while only 65% of eligible patients had private insurance, based on data from 2006 Nationwide Inpatient Sample and 2005–2006 National Health and Nutrition Examination Survey.<sup>11</sup> Among eligible patients who attended a bariatric surgery informational session in 2015, those with Medicare and private insurance other than Blue Cross Blue Shield/Blue Complete Network were more likely not to proceed to surgery.<sup>46</sup> Nevertheless, a recent study found a significant increase in the rate of patients with Medicaid and Medicare insurance undergoing bariatric surgery in the state of New York, over the past decade.<sup>47</sup> Particularly, if the share of Medicaid was only 4.4% in the payer mix for bariatric surgery in 2010, it increased more than twice (up to 10.8%) by 2016.<sup>47</sup>

Gasoyan and colleagues recently reported that in a large sample of patients who underwent bariatric surgery and who were well-matched to those eligible for, but did not undergo surgery, specific aspects of insurance plan type, rather than more general payer type, was more strongly associated with the utilization of bariatric surgery.<sup>13</sup> The study, however, did not identify statistically different odds of undergoing bariatric surgery based on payer type. This was in contrast with previous work in this area.<sup>11,12</sup> It may be that sociodemographic variables, such as age, gender, race, and geographic area, that were well-controlled for in that study, account for such difference.

Nevertheless, the later study found statistically significantly different odds of undergoing bariatric surgery associated with insurance plan within each major payer category. For example, more generous plans, such as Blue Cross preferred provider organization (PPO) and Medicare PPO were associated with greater odds of undergoing surgery, compared to other commercial health maintenance organization (HMO) and Medicare HMO plans, respectively.<sup>13</sup> The latter may be explained by the insurance plan design, particularly the list of covered procedures and services, preoperative MWM requirements, patient out-of-pocket costs, among other factors.

A recent study by Chhabra and colleagues reaffirmed the association between insurance plan type and utilization of bariatric surgery.<sup>48</sup> The utilization of surgery was higher in the more generous insurance plans, operationalized by lower out-of-payment costs, and lowest in high-deductible health plans.<sup>48</sup> As obesity, and severe obesity in particular, is found in higher rates among underserved populations, this result is not surprising and may suggest that the out-of-pocket expenses associated with multiple

preoperative assessments and the surgical procedure may be serving as a barrier to surgery.

The coverage for bariatric surgery, out-of-pocket costs, and insurance-mandated requirements (e.g. preoperative MWM, cardiology and pulmonology evaluations) vary not only among payers but also based on insurer and insurance plan.<sup>46,49</sup> Individuals with PPO plans generally have the freedom to choose doctors and hospitals in-network or out-of-network, with lower cost-sharing when staying in-network. Health Maintenance Organization plans, on the other hand, require individuals to choose a primary care physician and obtain written referral for specialized care. Point of service (POS) plans are similar to HMOs but are less restrictive in terms of the out-of-network services use.<sup>50</sup> In traditional fee-for-service plans, the health plan pays the medical provider directly after filing a claim for each covered medical expense.<sup>50</sup>

Prerequisites and insurance denials,<sup>15,49,51</sup> as well as patient cost-sharing<sup>32</sup> are often limiting factors for patients seeking bariatric surgery. For example, longer preoperative MWM programs (six vs three months) have been associated with patients leaving the program and not undergoing surgery.<sup>14</sup> Furthermore and unfortunately, some commercial insurance plans completely exclude coverage for the surgical treatment of obesity.<sup>52</sup>

The requirement of preoperative MWM prior to surgery, theoretically implemented to produce a modest weight loss that either gives the patient an opportunity to learn and practice the dietary and behavioral requirements of surgery, makes the

surgical procedure easier from a technical perspective, or is associated with shorter hospital length of stay, has only modest support.<sup>16</sup> A recent study found that a <5% weight loss prior to bariatric surgery was associated with a lower risk of 30-day mortality.<sup>17</sup> In contrast, other studies have not found a relationship between preoperative MWM and weight loss<sup>53,54</sup> or reoperation rates<sup>53</sup> in the first postoperative year. Similarly, Tewksbury and colleagues recently reported that preoperative weight loss is not linked to 30-day overall readmission, reoperation, or mortality.<sup>18</sup> Furthermore, the intensity and length of the preoperative assessment period was not found to be associated with early postoperative weight loss.<sup>55</sup> Yet, the practice endures as its implementation is ultimately dictated by local payers and influenced by historical beliefs that preoperative weight loss predicted postoperative weight loss and surgical outcomes.<sup>16</sup>

### *Summary of the Supporting Literature*

Obesity represents a serious health and financial burden in the US. Bariatric surgery is a superior treatment option as compared to the more conservative options. The surgical treatment generally leads to substantial weight loss and a decrease in risk for comorbidities and overall mortality. Despite its effectiveness with respect to weight loss and improvements in obesity-related comorbidities, bariatric surgery remains underutilized in the US and around the world. The reasons for this are not well understood but are likely multifactorial. The impact of insurance-related factors on the access and utilization of bariatric procedures might be considerable and needs further investigation.

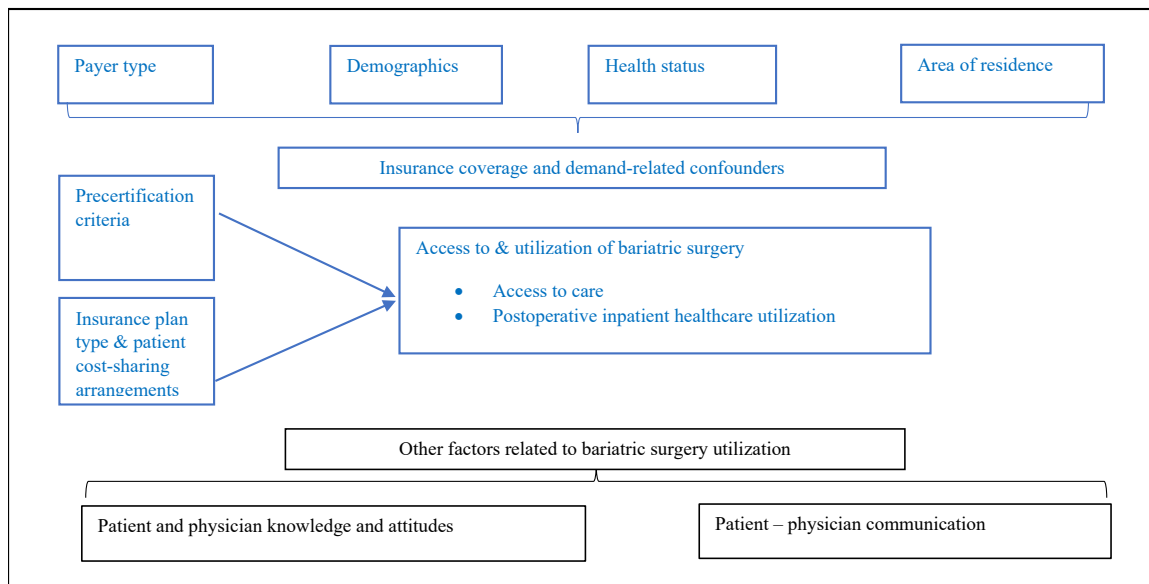
## **CHAPTER 3**

### **RESEARCH APPROACH**

The present program of research examined the temporal changes in the patient characteristics and insurer type mix among bariatric surgery patients in Southeastern Pennsylvania, as well as the associations between payer type, insurance plan type, cost-sharing arrangements (among traditional Medicare beneficiaries), and utilization of bariatric surgery. Furthermore, it investigated whether precertification criteria defined by insurers, namely requirements for documented 2-year weight history and involvement in 3-6 month-long preoperative supervised medical weight management (MWM) program are associated with utilization of bariatric surgery among individuals eligible for surgery and who have private insurance. Finally, the program studied whether there is an association between select insurance-mandated precertification criteria (specifically MWM, cardiology, and pulmonary consultations) and short-term inpatient healthcare services utilization (operationalized by postoperative hospital length of stay and rehospitalizations in the first postoperative year) after bariatric surgery. Temple University Institutional Review Board determined that review and approval of the three studies was not required as the studies used deidentified and publicly available data.

The academic products of this project are 3 empirical papers presented in the following chapters. Figure 1 outlines the conceptual diagram of the research program.

**Figure 1: Conceptual diagram of the research program**



Note. Variables highlighted in blue were studied as part of this research program. Other factors related to care utilization are presented for context and are described in the Background chapter.

## Study 1

### *Study Design, Data Source, and Study Population*

This population-based cross-sectional study used Pennsylvania Health Care Cost Containment Council’s (PHC4) inpatient discharge and ambulatory/outpatient procedure databases for the years 2014-2018.<sup>56</sup> These databases contain de-identified clinical and claims data from hospitals and outpatient and freestanding ambulatory surgery centers in the Philadelphia, Bucks, Montgomery, Chester, and Delaware counties in Southeastern Pennsylvania.

Two separate study populations were examined. To examine the temporal changes in patient demographics and payer mix, all adult patients (N=14,348), captured in the datasets, who underwent the most common types of bariatric surgery

(open/laparoscopic gastric bypass and open/laparoscopic sleeve gastrectomy) at an inpatient setting during 2014-2018 and had a diagnosis code for severe obesity were identified.

The second population was used to examine the associations between payer type, insurance plan type, cost-sharing arrangements for traditional Medicare beneficiaries, and utilization of bariatric surgery. A 1:1 matched sample of surgery patients and those who were eligible for, but did not undergo surgery and with known public or private primary insurance type was identified and served as a comparison group. There were 5,532 patients in the surgery and 5,532 in the comparison groups.

#### *Variables and Statistical Analysis*

The variables of interest included 1) demographic characteristics and the proportion of each major insurer type among all bariatric surgery patients captured in the 2014-2018 inpatient databases and 2) whether or not the patient had surgery during 2014-2018 in the 1:1 matched sample of bariatric surgery and comparison patients.

The primary predictor variables in the multivariable logistic regression models included payer type and insurance plan type, and, for patients covered by traditional Medicare, their secondary insurance coverage status/type. Patient age, sex, race, ethnicity, an estimate of median household income based on their area of residence, as well as the year when the patient encounter was recorded were included as covariates.

Contingency tables and Pearson Chi-Square tests were used to examine the associations between patient race, insurer type, and the year of bariatric surgery record

within the cohort of all surgical patients. Logistic regression models were used to examine the association between payer type and the likelihood of undergoing bariatric surgery, as well as insurance plan type and the likelihood of undergoing the surgery, within Medicare and private payer categories. A separate logistic regression model was used to examine the association between secondary insurance arrangements and the odds of undergoing bariatric surgery among traditional Medicare beneficiaries.

## **Study 2**

### *Study Design, Data Source, and Study Population*

This cross-sectional study used PHC4's inpatient and outpatient care databases for the years 2015-2016 and records of preoperative insurance precertification requirements maintained by the Bariatric Surgery Program at Temple University in 2016. The study population consisted of privately insured adult patients with known/listed health insurance plans. Bariatric surgery patients and individuals who met the eligibility criteria but did not undergo surgery were identified and 1:1 matched by sex, race, age group, and zip code. This was done to control for the potential confounding effects of socio-demographic factors on the odds of undergoing bariatric surgery or having a certain type of insurance coverage. The study sample included 1,054 individuals with private health insurance; 527 in the surgery group and 527 in the comparison group.

### *Variables and Statistical Analysis*

The primary outcome variable was whether or not the patient had undergone surgery by the end of 2016. Primary predictor variables included insurance-mandated requirements for documented weight history (none or 2-year weight history) and an insurance-mandated requirement for involvement in a preoperative MWM (none or 3-6 months). Insurance plan type was included as a covariate and to control for the potential influence of the patient's ability within a given plan type to choose doctors/hospitals and out-of-pocket costs.

Pearson Chi-Square tests and multivariable logistic regression analysis were performed to examine the association between precertification criteria, insurance plan type, and the likelihood of undergoing bariatric surgery.

### **Study 3**

#### *Study Design, Data Source, and Study Population*

This retrospective cohort study used PHC4 databases for the years 2016–2017 and the preoperative insurance precertification requirements maintained by the Bariatric Surgery Program at Temple University in 2016. The study population consisted of all adult patients with a diagnosis of severe obesity who underwent the most common bariatric surgical procedures in 2016 and for whom the insurance-mandated precertification requirements were known. The final cohort included 2,717 patients who underwent bariatric surgery. Postoperative length of stay and rehospitalizations were

followed during the first year after bariatric surgery via pseudo patient identifier variable included in the datasets.

### *Variables and Statistical Analysis*

The primary outcome variables were the number of days the patient stayed in the inpatient facility after surgery, as well as the number of all-cause rehospitalizations, the total number of all-cause rehospitalization days, and whether there was a rehospitalization with an admitting or principal diagnosis code for common cardiac and pulmonary conditions in the same or the following three quarters following discharge.

The primary exposure variables included whether a patient was subject to insurance mandated requirements of 3-6 months long MWM, as well as cardiology and pulmonology evaluations. Covariates included patient age, sex, race, ethnicity, the Elixhauser Comorbidity Score according to the AHRQ formulation,<sup>57</sup> type of the surgery, facility where the surgery was performed, primary payer type, as well as the estimated median household income (based on the patient's zip code and information from the American Community Survey 5-year estimates).<sup>58</sup>

Multivariable Poisson and logistic regression analyses were performed to examine the associations between precertification criteria and the length of stay, the number of all-cause rehospitalizations, the total number of all-cause rehospitalization days, and whether there was a rehospitalization with an admitting or principal diagnosis code for common cardiac or pulmonary conditions.

## CHAPTER 4

### STUDY 1: THE ROLE OF HEALTH INSURANCE CHARACTERISTICS IN UTILIZATION OF BARIATRIC SURGERY<sup>i</sup>

#### Introduction

Bariatric surgery is the most effective treatment for clinically severe obesity, providing sizable and long-lasting weight losses as well as significant improvements in obesity-related comorbidities.<sup>4,59</sup> Nevertheless, only a small percentage of individuals meeting the eligibility criteria for bariatric surgery undergo surgery each year. For example, the estimated utilization of bariatric surgery in the eligible population was 503 per 100,000 (or 0.5%) in 2016.<sup>10</sup>

Nationwide data show that approximately two-thirds of bariatric surgery patients in 2016 were white.<sup>10</sup> Eight of 10 were women and patients were an average age of 44 years.<sup>10</sup> Six of 10 patients who underwent bariatric surgery had private insurance.<sup>10</sup> The racial and socioeconomic disparities in access to bariatric surgery are becoming increasingly recognized.<sup>11,12,60,61</sup> For example, a study based on the 2005-2006 National Health and Nutrition Examination Survey and the 2006 Nationwide Inpatient Sample found significant disparities in the receipt of bariatric surgery based on race, income, education level, and insurance type.<sup>11</sup>

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<sup>i</sup> A version of this chapter was published in *Surgery for Obesity and Related Diseases*. 2021;17(5):860-868 <https://doi.org/10.1016/j.soard.2021.01.024>

Fortunately, the gap in the utilization rates among publicly and privately insured patients has been narrowing in the past decade. Particularly, the nationwide share of Medicare and Medicaid in the payer mix for bariatric surgery was 8.3% and 5.9% in 2005; those figures increased to 14.2% and 17.2% in 2016, respectively.<sup>10</sup> It is unknown, however, whether in communities with a larger percentage of non-white citizens, such as in Southeastern Pennsylvania,<sup>62</sup> followed the nationwide trends.

Our research team reported that specific aspects of insurance plan type (e.g. preferred provider organization [PPO], fee-for-service, health maintenance organization [HMO]) have been associated with the utilization of bariatric surgery.<sup>13</sup> However, statistically different odds of undergoing bariatric surgery based on payer type were not observed.<sup>13</sup> These findings were novel and in contrast with previous investigations.<sup>11,12,63</sup> Sociodemographic variables, including age, sex, race, and area of residence (zip code) and which were controlled for in the analytic plan, may account for the difference between studies.

Other studies have reaffirmed the association between insurance plan type and utilization of bariatric surgery.<sup>38,48</sup> Utilization of surgery was reported to be higher in the more generous commercial insurance plans that generally have lower out-of-pocket payments, such as PPO plans, and lowest in high-deductible health plans.<sup>38,48</sup> This is not surprising, considering the high cost of bariatric surgery (\$8,678–\$14,082).<sup>10</sup> Similarly, individuals with Medicare Advantage PPO plans (Medicare plans administered by private insurers) had greater odds of undergoing bariatric surgery compared with Medicare Advantage HMO plan beneficiaries.<sup>13</sup>

However, it is unknown whether dual-eligible beneficiaries (eligible for both Medicare and Medicaid) who generally have no or limited cost-sharing have better access to bariatric surgery compared to those enrolled in traditional Medicare with no supplemental insurance (e.g. without Medigap plans that pay for the costs not covered by Medicare).

The current study was undertaken to investigate the temporal changes in the patient characteristics and insurer type mix among bariatric surgery patients in Southeastern Pennsylvania. The study also examined the associations between payer type, insurance plan type, cost-sharing arrangements (among traditional Medicare beneficiaries), and utilization of bariatric surgery; a better understanding of these issues could help policymakers in addressing insurance-related barriers to accessing bariatric surgery.

The study had the following *a priori* hypotheses. First, we predicted considerable variation by year in the payer mix for bariatric surgery. The largest increase in bariatric surgery utilization was expected among Medicaid and Medicare Advantage beneficiaries. Second, individuals with PPO plans in Medicare Advantage and PPO, as well as fee-for-service plans within privately insured categories, were anticipated to have greater odds of undergoing bariatric surgery compared to those with HMO plans in the corresponding insurer categories. This would confirm previously reported findings from our team on the role of insurance plan type in determining access to bariatric surgery.<sup>13</sup> Third, individuals with traditional Medicare coverage but without supplemental insurance coverage were expected to have smaller odds of undergoing bariatric surgery compared

to those covered by traditional Medicare and with secondary private supplemental insurance or those with dual eligibility (qualifying for both Medicare and Medicaid).

## **Methods**

### *Data Source and Study Population*

The study used Pennsylvania Health Care Cost Containment Council's inpatient discharge and ambulatory/outpatient procedure databases for the years 2014-2018.<sup>56</sup> These data sources contain de-identified clinical and claims data from all hospitals (excluding Veterans Administration Hospitals) and outpatient and freestanding ambulatory surgery centers in the Philadelphia, Bucks, Montgomery, Chester, and Delaware counties in Southeastern Pennsylvania. The combined population of these counties in 2018 was approximately 4.1 million; 65% of individuals were white, 22% Black, and 13% were other races.<sup>62</sup> The American Community Survey 5-year data from the U.S. Census Bureau (2018)<sup>62</sup> were used to estimate median household income based on the patient's area of residence at the ZIP code level.

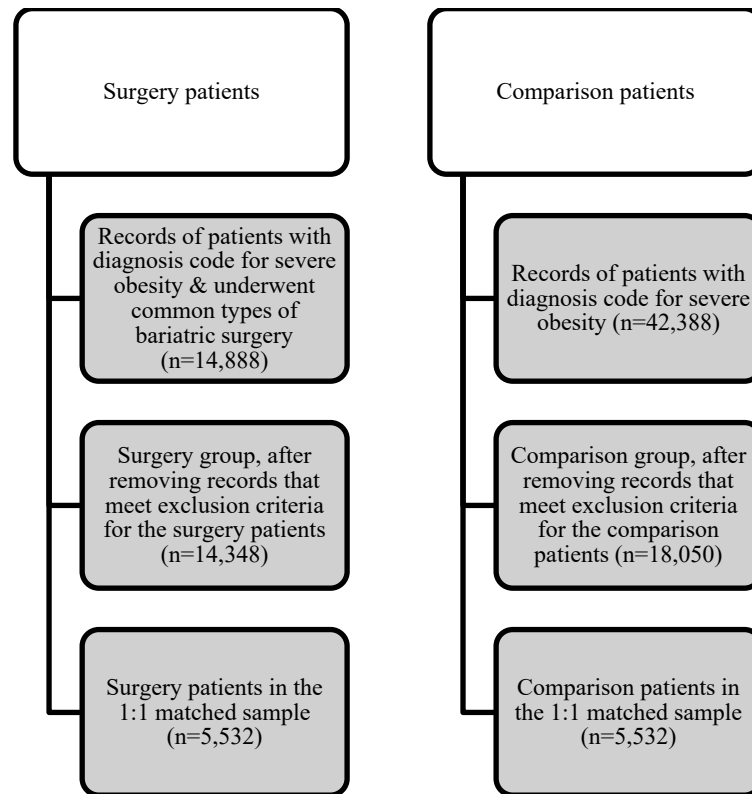
Two separate study populations were examined. First, to investigate the temporal changes in patient demographics and payer mix, all adult patients (captured in the datasets) who underwent the most common types of bariatric surgery (sleeve gastrectomy and Roux-en-Y gastric bypass) at an inpatient setting during 2014-2018 and had a diagnosis code for severe obesity were identified. Patients with a diagnosis code for noninfective enteritis and colitis and abdominal neoplasms were excluded (Appendix A).

Second, to examine the associations between payer type, insurance plan type, cost-sharing arrangements for traditional Medicare beneficiaries, and utilization of surgery, a 1:1 matched sample of bariatric surgery patients and those who were eligible for, but did not undergo surgery (based on a diagnosis of severe obesity, absence of diagnosed common relative contraindications) and with known public or private primary insurance type was identified and served as a comparison group. The sample of comparison patients included adults from the 2014-2018 ambulatory/outpatient procedure databases who met the following criteria: 1) had a diagnosis code for morbid (severe) obesity; 2) did not have a record of any bariatric procedure during 2014-2018; 3) and did not have a diagnosis code for heart failure, chronic ischemic heart disease, malignant neoplasms, portal hypertension, Crohn's disease, mental and behavioral disorders due to psychoactive substance use, or intellectual disabilities since those conditions are common relative contraindications to surgery which could decrease the likelihood of undergoing bariatric surgery.<sup>64</sup>

The international classification of disease/clinical modification procedure codes, ninth and tenth revisions (ICD-9, ICD-10), and Healthcare Common Procedure Coding System Level I Current Procedural Terminology (HCPCS CPT-4) codes used for identification of bariatric surgery and comparison patients are described in Appendix 1. ICD-9 codes were applied to discharge records from 2014-2015 and ICD-10 codes were applied to records from 2015-2018. Medicaid beneficiaries residing outside of Pennsylvania were excluded since coverage for bariatric surgery by Medicaid varies in some states.<sup>65</sup> Duplicate records in the inpatient and outpatient databases were identified

and excluded using a pseudo patient identifier variable. The number of surgery patients in the second study population is smaller compared to the one described first as the surgery and comparison patients were 1:1 matched on several sociodemographic variables. Match tolerance in the software [IBM SPSS Statistics for Windows (Version 25.0; Armonk, NY, USA)] was set to a value of zero (exact match) for matching variables. Sampling was done without replacement. Figure 2 shows how the study samples were screened and selected.

**Figure 2. Identification of study populations for the bariatric surgery and comparison groups**



Note. Diagnosis codes for morbid (severe) obesity were defined as 278.01 in the 9th and E66.01 in the 10th editions of international classification of disease. Obesity surgery types include sleeve gastrectomy and Roux-en-Y gastric bypass.

### *Study design and variables*

To examine the associations between socio-demographic factors, health insurance arrangements, and utilization of bariatric surgery, records of surgery patients were 1:1 matched by age group (18-34, 35-44, 45-54, 55-64, 65-76), sex, race, ethnicity, and zip code, and the year of medical bill's claim with those of eligible patients who did not undergo surgery. This was done to control for the potential confounding effects of those socio-demographic factors on the odds of undergoing the surgery or having a certain type of insurance coverage.

The variables of interest were 1) demographic characteristics and the proportion of each major insurer type among all bariatric surgery patients captured in the 2014-2018 inpatient databases and 2) whether or not the patient had surgery during 2014-2018 in the 1:1 matched sample of bariatric surgery and comparison patients. Major payer types were defined as patients covered by Medicare, Medicaid, other government insurance, and private insurance; studied insurance plan types included PPO, fee-for-service, HMO, and point-of-service (POS) plans.

The primary predictor variables in the multivariable logistic regression models included payer type and insurance plan type, and, for patients covered by traditional Medicare, their secondary insurance coverage status/type. Patient age, sex, race, ethnicity, an estimate of median household income based on their area of residence, as well as the year when the patient encounter was recorded were included as covariates.

### *Statistical analysis*

Contingency tables and Pearson Chi-Square tests were used to examine the associations between patient race, insurer type, and the year of bariatric surgery record within the cohort of all surgical patients. An independent *t*-test was used to compare the mean age in the matched surgery and comparison groups. Logistic regression analyses were performed to examine the association between payer type and the likelihood of undergoing bariatric surgery, as well as insurance plan type and the likelihood of undergoing the surgery, within Medicare and private payer categories. Medicaid beneficiaries were not considered for the latter model, since Medicaid fee-for-service beneficiaries transition into HMO (managed care) plans in a few months, after their initial enrollment in the Pennsylvania Medical Assistance program.<sup>66</sup> An additional logistic regression model was used to examine the association between secondary insurance arrangements and the odds of undergoing surgery among patients covered by traditional Medicare. Significance level was determined using an alpha of 0.05. The analyses were performed with IBM SPSS Statistics for Windows (Version 25.0; Armonk, NY, USA).

## **Results**

### *Demographic characteristics of bariatric surgery patients*

The study identified 14,348 patients who underwent bariatric surgery in an inpatient setting between 2014 and 2018. Almost half of the patients (45.3%) resided in Philadelphia county, followed by 13.9% in Montgomery county, 13.6% in Delaware county, 11.2% in Bucks county, and 6.5% in Chester county. Less than 10% (9.1%) of

patients resided outside of Pennsylvania. The vast majority of bariatric surgery patients were women (80.5%) with a mean age of  $43.3 \pm 11.8$  years. White (49.7%) and Black (40.8%) individuals comprised the largest racial groups with most (93.0%) not being of Hispanic/Latino origin or descent. Notably, there was a steady decrease in the proportion of white patients undergoing bariatric surgery from 55.1% in 2014 to 46.2% in 2018 and an increase in the proportion of Black patients, from 37.1% in 2014 to 43.0% in 2018. Similarly, the proportion of Hispanic/Latino origin or descent patients increased from 5.4% in 2014 to 8.0% in 2018. The demographic characteristics of these patients, stratified by year, are presented in Table 1.

#### *Payer mix for bariatric surgery*

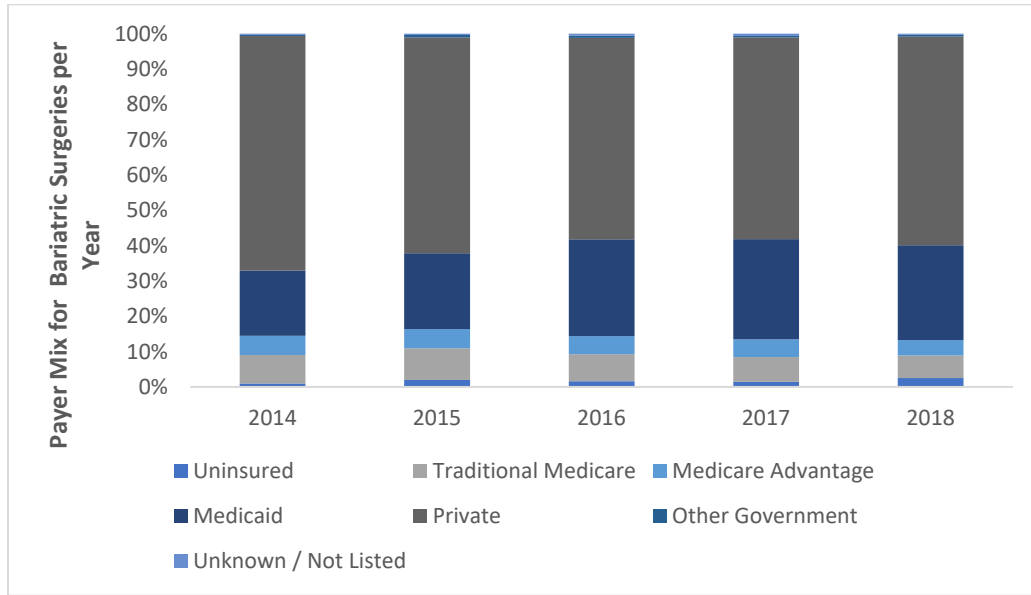
The largest insurer category for bariatric surgical procedures was private insurance (59.9%), followed by Medicaid (24.8%), traditional Medicare (7.6%), and Medicare Advantage (5.1%). As predicted, there was a steady increase of Medicaid's share within the payer mix from 18.5% in 2014 to a high of 28.4% in 2017, followed by a slight decrease in 2018 to 26.9%. However, contrary to our *a priori* hypothesis, the share of Medicare Advantage plans within the payer mix decreased slightly from 5.5% in 2014 to 4.3% in 2018 (Figure 3).

**Table 1. Number of inpatient bariatric surgeries and patient characteristics in Southeastern Pennsylvania: overall 2014 to 2018 and by year (N=14,348)**

Variables	2014-2018	2014	2015	2016	2017	2018	Pearson Chi-Square, degree of freedom, p (2-sided)
<b>No. surgeries</b>	14,348	2,616	2,683	2,877	3,179	2,993	
<b>Age</b>							
Mean	43.3	44.1	43.8	43.2	42.9	42.8	
(SD)	(11.8)	(11.6)	(11.9)	(11.6)	(11.9)	(11.9)	
<b>Sex</b>							
Female N (%)	11,549 (80.5)	2,055 (78.6)	2,131 (79.4)	2,357 (81.9)	2,569 (80.8)	2,437 (81.4)	
Male N (%)	2,799 (19.5)	561 (21.4)	552 (20.6)	520 (18.1)	610 (19.2%)	556 (18.6)	
<b>Race</b>							X <sup>2</sup> =104.5, df=28, p<0.001
White alone (%)	7,126 (49.7)	1,441 (55.1)	1,431 (53.3)	1,395 (48.5)	1,477 (46.5)	1,382 (46.2)	
Black alone (%)	5,856 (40.8)	971 (37.1)	1,016 (37.9)	1,206 (41.9)	1,376 (43.3)	1,287 (43.0)	
Asian alone (%)	42 (0.3)	5 (0.2)	8 (0.3)	8 (0.3)	12 (0.4)	9 (0.3)	
American Indian and Alaskan Native alone (%)	6 (0.0)	1 (0.0)	0 (0.0)	2 (0.1)	1 (0.0)	2 (0.1)	
Native Hawaiian or Pacific Islander (%)	3 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.0)	2 (0.1)	
Two or More Race Groups (%)	7 (0.0)	1 (0.0)	1 (0.0)	0 (0.0)	0 (0.0)	5 (0.2)	
Other (%)	981 (6.8)	146 (5.6)	176 (6.6)	201 (7.0)	217 (6.8)	241 (8.1)	
Unknown (%)	327 (2.3)	51 (1.9)	51 (1.9)	65 (2.3)	95 (3.0)	65 (2.2)	
<b>Ethnicity</b>							X <sup>2</sup> = 18.8, df=4, p= 0.001
Patient is of Hispanic/Latino origin or descent (%)	1,000 (7.0)	142 (5.4)	172 (6.4)	200 (7.0)	247 (7.8)	239 (8.0)	
Patient is not of Hispanic/Latino origin or descent (%)	13,348 (93.0)	2,474 (94.6)	2,511 (93.6)	2,677 (93.0)	2,932 (92.2)	2,754 (92.0)	

Note. Data availability: Complete data available: age, sex, and ethnicity at 100%, race at 97.7%.

**Figure 3. Proportion of insurer categories for inpatient bariatric surgeries in Southeastern Pennsylvania: 2014-2018 (N=14,348)**



Note.  $X^2= 163.4$ ,  $df=24$ ,  $p< 0.001$ .

Table 2 presents more granular information about bariatric surgery patients' insurance coverage (by insurer and insurance plan type) during 2014-2018. Table 3 provides a snapshot of the distribution of payer categories for inpatient bariatric surgeries in Southeastern Pennsylvania by county in 2014 vs 2018.

The largest increase in the proportion of bariatric surgery patients with Medicaid coverage was in Philadelphia county (31.7%,  $n = 331$  in 2014 vs 43.9%,  $n = 610$  in 2018), followed by Bucks (5.9%,  $n = 16$  vs 14.5%,  $n = 43$ ), Chester (4.9%,  $n = 9$  vs 10.2%,  $n = 15$ ), Montgomery (10.0%,  $n = 41$  vs 13.1%,  $n = 48$ ), and Delaware counties (23.6%,  $n = 85$  vs 24.5%,  $n = 87$ , respectively).

**Table 2. Distribution of insurer categories and insurance plans by year among patients who underwent bariatric surgery at an inpatient setting: 2014-2018 (N=14,348)**

<b>Insurer type</b>	<b>Insurance plan type</b>	<b>2014-2018</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
<b>Uninsured</b>	Self-Pay or Charity/Indigent Care N (% within year)	245 (1.7)	26 (1.0)	53 (2.0)	46 (1.6)	45 (1.4)	75 (2.5)
	<b>Traditional Medicare (Parts A, B)</b>						
	Fee-for-service N (% within year)	1,087 (7.6)	210 (8.0)	241 (9.0)	221 (7.7)	223 (7.0)	192 (6.4)
<b>Medicare advantage</b>							
	PPO N (% within year)	245 (1.7)	46 (1.8)	51 (1.9)	52 (1.8)	56 (1.8)	40 (1.3)
	HMO N (% within year)	480 (3.3)	97 (3.7)	94 (3.5)	95 (3.3)	104 (3.3)	90 (3.0)
<b>Medicaid</b>							
	Fee-for-service N (% within year)	11 (0.1)	1 (0.0)	1 (0.0)	1 (0.0)	6 (0.2)	2 (0.1)
	HMO N (% within year)	3,542 (24.7)	482 (18.4)	575 (21.4)	787 (27.4)	896 (28.2)	802 (26.8)
<b>Private insurance</b>							
	PPO N (% within year)	3,394 (23.7)	619 (23.7)	657 (24.5)	680 (23.6)	746 (23.5)	692 (23.1)
	POS N (% within year)	406 (2.8)	84 (3.2)	77 (2.9)	82 (2.9)	62 (2.0)	101 (3.4)
	Fee-for-service N (% within year)	2,013 (14.0)	408 (15.6)	365 (13.6)	369 (12.8)	456 (14.3)	415 (13.9)
	HMO N (% within year)	2,429 (16.9)	566 (21.6)	477 (17.8)	436 (15.2)	475 (14.9)	475 (15.9)
	Other N (% within year)	30 (0.2)	4 (0.2)	1 (0.0)	7 (0.2)	10 (0.3)	8 (0.3)
	Unknown / Not Listed N (% within year)	328 (2.3)	56 (2.1)	63 (2.3)	67 (2.3)	66 (2.1)	76 (2.5)
<b>Other government</b>							
	PPO N (% within year)	10 (0.1)	0 (0.0)	2 (0.1)	4 (0.1)	3 (0.1)	1 (0.0)
	HMO N (% within year)	31 (0.2)	3 (0.1)	7 (0.3)	9 (0.3)	2 (0.1)	10 (0.3)
	Unknown / Not Listed N (% within year)	32 (0.2)	5 (0.2)	9 (0.3)	5 (0.2)	8 (0.3)	5 (0.2)

<b>Unknown</b>	Unknown / Not Listed N (% within year)	65 (0.5)	9 (0.3)	10 (0.4)	16 (0.6)	21 (0.7)	9 (0.3)
<b>Total (%)</b>		14,348 (100)	2,616 (100)	2,683 (100)	2,877 (100)	3,179 (100)	2,993 (100)

Note. PPO = preferred provider organization, POS = point-of-service, HMO = health maintenance organization.

### *Logistic regression analysis results*

After matching bariatric surgery and comparison patients 1:1 on age group, sex, race, ethnicity, zip code, and the year of medical bill's claim, 11,064 patient records comprised the study sample – 5,532 in the surgery and 5,532 in the comparison groups. White patients comprised 49.8% of both the surgery and comparison groups, followed by 46.4% Black patients, 3.4% other races, and 0.4% individuals for whom race was not available in the record. Similarly, in both groups, 3.5% of patients were of Hispanic/Latino origin or descent and 83.0% were female. The mean age was  $46.2 \pm 11.9$  in the surgery and  $46.6 \pm 12.4$  in the comparison group (the difference was not statistically significant,  $P = 0.07$ ). Payer type and insurance plan profile among matched bariatric surgery and comparison patients are presented in Table 4.

As found in Table 5, the odds of undergoing bariatric surgery were smaller among patients who were Medicare beneficiaries compared to those with private insurance (OR = 0.78, 95% CI 0.70 to 0.87,  $P < 0.001$ ), after adjusting for patient age, sex, race, ethnicity, estimated median household income, and year of record. The odds of undergoing bariatric surgery were not statistically different between those with Medicaid or other government insurance coverage vs privately insured patients.

**Table 3. Distribution of payer categories for inpatient bariatric surgeries among patients residing in the studied areas of Southeastern Pennsylvania by county in 2014 vs 2018**

<i>Year</i>	<i>2014 (n=2,267)</i>				
<b>Payer Type/County</b>	<b>Philadelphia</b>	<b>Bucks</b>	<b>Montgomery</b>	<b>Chester</b>	<b>Delaware</b>
<i>Uninsured</i>	2 (0.2%)	0 (0.0%)	1 (0.2%)	0 (0.0%)	0 (0.0%)
<i>Medicare</i>	146 (14.0%)	41 (15.2%)	50 (12.2%)	33 (17.9%)	45 (12.5%)
<i>Medicaid</i>	331 (31.7%)	16 (5.9%)	41 (10.0%)	9 (4.9%)	85 (23.6%)
<i>Private</i>	564 (54.1%)	213 (78.9%)	318 (77.6%)	142 (77.2%)	230 (63.9%)
<b>Total</b>	1,043 (100%)	270 (100%)	410 (100%)	184 (100%)	360 (100%)
<i>Year</i>	<i>2018 (n=2,555)</i>				
<b>Payer Type/County</b>	<b>Philadelphia</b>	<b>Bucks</b>	<b>Montgomery</b>	<b>Chester</b>	<b>Delaware</b>
<i>Uninsured</i>	6 (0.4%)	0 (0.0%)	1 (0.3%)	0 (0.0%)	2 (0.6%)
<i>Medicare</i>	143 (10.3%)	48 (16.2%)	49 (13.4%)	17 (11.6%)	39 (11.0%)
<i>Medicaid</i>	610 (43.9%)	43 (14.5%)	48 (13.1%)	15 (10.2%)	87 (24.5%)
<i>Private</i>	631 (45.4%)	206 (69.4%)	268 (73.2%)	115 (78.2%)	227 (63.9%)
<b>Total</b>	1,390 (100%)	297 (100%)	366 (100%)	147 (100%)	355 (100%)

**Table 4. Payer and insurance plan profile for bariatric surgery vs comparison patients 1:1 matched on age group, sex, race, ethnicity, zip code, and the year of medical bill's claim (N=11,064)**

<b>Payer type</b>	<b>Insurance plan</b>	<b>Surgery group (n=5,532)</b>	<b>Comparison group (n=5,532)</b>	<b>Total</b>
n (% within row)				
<b>Medicare</b>		1,013 (44.9)	1,241 (55.1)	2,254 (100)
	Traditional Medicare (Parts A & B) Fee-for-service	601 (41.2)	856 (58.8)	1,457 (100)
	Medicare Advantage PPO	114 (67.1)	56 (32.9)	170 (100)
	Medicare Advantage HMO	298 (47.5)	329 (52.5)	627 (100)
<b>Medicaid</b>		1,769 (51.8)	1,648 (48.2)	3,417 (100)
	Fee-for-service	7 (10.1)	62 (89.9)	69 (100)
	HMO	1,762 (52.6)	1,586 (47.4)	3,348 (100)
<b>Private insurance</b>		2,740 (51.0)	2,636 (49.0)	5,376 (100)
	PPO	1,309 (51.7)	1,222 (48.3)	2,531 (100)
	POS	128 (47.1)	144 (52.9)	272 (100)
	Fee-for-service	625 (55.5)	502 (44.5)	1,127 (100)
	HMO	678 (46.9)	768 (53.1)	1,446 (100)
<b>Other government</b>		10 (58.8)	7 (41.2)	17 (100)
	PPO	4 (66.7)	2 (33.3)	6 (100)
	HMO	6 (54.5)	5 (45.5)	11 (100)

Note. PPO = preferred provider organization; HMO = health maintenance organization; POS = point-of-service.

Among those with Medicare, the Medicare Advantage PPO plan was associated with greater odds (OR = 2.18, 95% CI 1.51 to 3.16, P < 0.001) and fee-for-service plan (traditional Medicare parts A & B) with smaller odds (OR = 0.78, 95% CI 0.64 to 0.95, P = 0.01) of undergoing bariatric surgery compared to Medicare Advantage HMO plan.

Among individuals with private insurance and known insurance plan, those with PPO (OR = 1.21, 95% CI 1.06 to 1.38, P = 0.006) and fee-for-service (OR = 1.39, 95% CI 1.19 to 1.63, P < 0.001) had greater odds of undergoing bariatric surgery, compared to beneficiaries of private HMO plans. POS plan was not a significant predictor in the model (Table 5).

**Table 5. Association of payer type and insurance plan type within payer category with odds of bariatric surgery**

<b>Payer type/Insurer</b>	<b>Insurance plan</b>	<b>Odds ratio</b>	<b>95% CI</b>	<b>P value</b>
<b><i>Model 1: Payer type (n=11,062)</i></b>				
Other government	-	1.37	0.52 - 3.61	0.52
Medicare	-	0.78	0.70 - 0.87	<b>&lt;0.001</b>
Medicaid	-	1.05	0.95 - 1.15	0.35
Private insurance	-		reference category	
<b><i>Model 2: Insurance plan type within Medicare (n=2,253)</i></b>				
Medicare	PPO	2.18	1.51 - 3.16	<b>&lt;0.001</b>
	Fee-for-service	0.78	0.64 - 0.95	<b>0.01</b>
	HMO		reference category	
<b><i>Model 3: Insurance plan type within private insurance (n=5,375)</i></b>				
Private insurance	PPO	1.21	1.06 - 1.38	<b>0.006</b>
	POS	1.02	0.78 - 1.32	0.90
	Fee-for-service	1.39	1.19 - 1.63	<b>&lt;0.001</b>
	HMO		reference category	
<b><i>Model 4: Medicare/Medicaid dual eligibility, supplemental private insurance, or no secondary insurance among patients with traditional Medicare (n= 1,506)</i></b>				
Traditional Medicare	No secondary insurance	0.58	0.43 - 0.79	<b>0.001</b>
	Medicaid (dual coverage)	0.68	0.51 - 0.91	<b>0.01</b>
	Supplemental private insurance		reference category	

Note. All models were adjusted for patient age, sex, race, ethnicity, an estimate of median household income based on their area of residence (ZIP code), and the year when the patient encounter was recorded. PPO = preferred provider organization, POS = point-of-service, HMO = health maintenance organization.

In the logistic regression model examining the association between secondary insurance coverage and odds of undergoing bariatric surgery, lack of secondary coverage (OR = 0.58, 95% CI 0.43 to 0.79, P = 0.001) and Medicare/Medicaid dual eligibility (OR = 0.68, 95% CI 0.51 to 0.91, P = 0.01) were associated with smaller odds of undergoing surgery compared with having supplemental private insurance (Table 5).

All the presented regression models were adjusted for patient age, sex, race, ethnicity, estimated median household income, and year of record. We did not report the multiple adjusted effect estimates of these covariates to avoid “Table 2 fallacies,” i.e. presenting and interpreting confounder coefficients.<sup>67</sup>

## **Discussion**

Over the five-year period from 2014 to 2018, there was a notable increase in the proportion of Black (37.1% in 2014 vs 43.0% in 2018) and Hispanic individuals (5.4% vs 8.0%, respectively) and a substantial decrease in the proportion of white individuals (55.1% vs 46.2%) who underwent bariatric surgery. While the corresponding nationwide trends in bariatric surgery utilization from 2013-2016 followed the same direction, the national changes were much smaller (e.g. 66.5% white patients in 2013 vs 63.9% in 2016).<sup>10</sup> The overall demographics of the region in relation to race and ethnicity did not change considerably from 2014 (66.7% white, 22.4% Black, and 7.9% Hispanic or Latino) to 2018 (65.4%, 22.3%, and 8.8% respectively).<sup>62</sup> Given the overall growth in the number of surgeries between 2014 and 2018 (2,616 in 2014 vs 2,993 in 2018) and that the increase in rates of obesity among white individuals (29.5% in 2015 vs 31.5% in

2018) was slightly higher in Pennsylvania between 2015-2018 compared to Black individuals (37.1% in 2015 vs 38.1% in 2018),<sup>68</sup> this is likely a sign of greater access to bariatric surgery among Black and Hispanic individuals.

Within the payer mix, there was a considerable increase of Medicaid's share (18.5% in 2014 vs 26.9% in 2018) that was balanced by a decrease in the proportions of patients with private insurance (66.4% vs 59.0%) and Medicare (13.5% vs 10.8%), from 2014 to 2018. These trends largely correspond to nationwide data on Medicaid's share of bariatric surgeries from 2013-2016 (e.g. 10.3% of Medicaid's share in 2013 vs 17.2% in 2016).<sup>10</sup>

Pennsylvania expanded its Medicaid program as of January 1, 2015. By February 2019, approximately 700,000 Pennsylvanians gained health insurance coverage as a result of the expansion.<sup>69</sup> Furthermore, if in 2014 the uninsured rates for the nonelderly were 8.8% among white, 14.8% among Black, and 19.4% among Hispanic individuals, the corresponding rates in 2018 were 6.0%, 8.1%, and 12.3% respectively, indicating a considerable narrowing of racial and ethnic disparities in access to health insurance.<sup>70</sup> This could explain the improved access to bariatric surgery among Black and Hispanic individuals and payer mix changes from 2014-2018.

This study detected statistically different odds of undergoing bariatric surgery based on payer type, but only between Medicare beneficiaries (22% smaller odds) compared to those with private insurance. After matching bariatric surgery and comparison patients from Southeastern Pennsylvania on several relevant

sociodemographic variables, we did not detect statistically different odds of undergoing bariatric surgery based on having Medicaid, other government insurance vs private insurance coverage. It is likely that reported disparities in private vs public insurance coverage among bariatric surgery patients and eligible patients who did not undergo surgery are largely influenced by demographic and socio-economic factors.<sup>11,12,61</sup>

As predicted, significantly different odds of undergoing bariatric surgery associated with insurance plan type within Medicare and private insurance payer categories, replicating the findings from earlier studies.<sup>13,38</sup> Particularly, individuals with PPO and fee-for-service insurance plans within the private insurance category had greater odds of undergoing bariatric surgery, compared with private HMO plan holders. This could be explained by the fact that PPO and fee-for-service plans are less restrictive in allowing enrollees to select a doctor or hospital and do not require referral for specialized care by primary care providers.<sup>13</sup> Similarly, among Medicare beneficiaries, those with Medicare Advantage PPO plans had greater odds of undergoing surgery compared to Medicare Advantage HMO plans.

Individuals with traditional Medicare (Parts A & B) fee-for-service plans had smaller odds of undergoing surgery as compared to beneficiaries of Medicare Advantage HMO plans. Furthermore, traditional Medicare beneficiaries with no supplementary insurance and those with dual eligibility had smaller odds of undergoing surgery (42% and 32%, respectively) as compared to those with private secondary insurance coverage; this likely has to do with patient cost-sharing arrangements within the traditional Medicare plan. Bariatric surgery patients covered by traditional insurance, but without

supplementary/secondary insurance, may be responsible for part A (inpatient hospital care) and part B (physician services) deductibles and copayments.<sup>71</sup> Just more than one-fifth (21.7%) of the comparison patients vs 16.4% bariatric surgery patients covered by traditional Medicare did not have any supplemental insurance coverage. A previous study of commercial health insurance beneficiaries found higher utilization rates among insurance plans with lower cost-sharing (e.g. PPO plans), compared to high-deductible health plans; a \$1,000 increase in cost-sharing was associated with 5 fewer bariatric surgeries per 100,000 insured individuals.<sup>37</sup> Thus, cost-sharing should not be used indiscriminately as a barrier to care; instead, patient out-of-pocket costs should be based on the clinical value of a specific bariatric procedure. The alignment of cost-sharing and clinical value by moving high-value services and medications into lower-priced tiers, adjusting cost-sharing based on patient characteristics, and incentivizing patients to seek high-performing providers are key principles of value-based insurance design.<sup>72,73</sup>

This study has novel findings but also has limitations. The Pennsylvania Health Care Cost Containment Council's databases allowed us to easily capture bariatric surgery patients from all hospitals (excluding Veterans Administration Hospitals) in Southeastern Pennsylvania. However, this was not true for the comparison group. Specifically, while bariatric surgery is currently recommended for adults with severe obesity (BMI  $\geq 40$  kg/m<sup>2</sup>), or those with a BMI  $\geq 35$  kg/m<sup>2</sup> in the presence of at least one significant comorbidity associated with obesity,<sup>21</sup> we were able to only capture records of patients with a diagnosis code for severe obesity and were not able to identify patients by BMI. As a result, we may not have captured a small group of individuals with BMIs between

35–39 kg/m<sup>2</sup> with severe a comorbidity, such as uncontrolled type II diabetes, and for whom the insurance company agreed to cover the use of surgical treatment. Also, bariatric surgery coverage by Medicaid varies by state.<sup>65</sup> Payer-mix and demographic factors may also vary across the United States, which may limit the generalizability of this study's findings to other areas.

This study did not investigate other elements of insurance plan design for bariatric surgery that could impact utilization. One example of this is the requirement by many insurers for preoperative supervised medical weight management prior to surgery. A recent study from our research group found that among privately insured patients, the insurance requirement for 3-6 months preoperative supervised medical weight management was associated with smaller odds of undergoing surgery (OR = 0.459, 95% CI 0.253 to 0.832, P = 0.010), after adjusting for insurance plan type and the requirement for documented weight history.<sup>38</sup> The COVID-19 pandemic has made presenting for in-person medical care even more challenging, particularly for individuals from underserved communities. In response, many bariatric programs pivoted to increased utilization of telemedicine appointments to complete preoperative assessments and postoperative follow-up visits. Previous barriers to telemedicine (such as lower reimbursement rates or a requirement for the origination site to be a medical facility) were temporarily removed by public and private payers and bariatric surgery programs anecdotally reported a profound decrease in cancellations and no shows for appointments.<sup>74,75</sup> Continued use of telemedicine as part of bariatric surgery care beyond the pandemic could help to

reorganize care around the patient and address some of the barriers to care due to insurance benefits design.<sup>74</sup>

## **Conclusions**

While private insurance remains the largest payer category for bariatric procedures in Southeastern Pennsylvania, there was a considerable increase in the proportion of patients with Medicaid from 2014-2018. It appears that there has also been an improvement in access to bariatric surgery among Black and Hispanic populations in the area. Given the profound and long-standing health disparity concerns in bariatric surgery, and obesity care in general, we find this small, yet meaningful change encouraging. We are optimistic that larger changes will be observed in the years and decades to come. Such changes will be critical to the ability of the American healthcare system to manage the obesity epidemic and provide equal access to patients.

Furthermore, the findings support the notion that insurance plan design and cost-sharing arrangements may be as important in determining the access and utilization of bariatric surgery as the general payer type when controlling for potentially confounding socio-demographic factors. Careful examination of the bariatric surgery benefit design and application of value-based insurance design to bariatric surgery<sup>8</sup> may improve the access to this potentially life-saving surgery for many Americans. Particularly, several studies documented the cost-effectiveness of bariatric surgery for adults with severe obesity and diabetes compared with usual medical care or intensive lifestyle intervention.<sup>29,30,32</sup> Some employers have already incorporated elements of value-based

insurance design to bariatric surgery coverage in their self-administered insurance benefit plans (for example, via offering coverage for bariatric surgery at a designated center of excellence and reimbursing patient out-of-pocket expenses if a planned weight reduction goal is achieved in a certain timeframe).<sup>8</sup> Further research could help evaluate the health and economic implications of applying value-based insurance design to bariatric surgery coverage.

## CHAPTER 5

### STUDY 2: DO INSURANCE-MANDATED PRECERTIFICATION CRITERIA AND INSURANCE PLAN TYPE DETERMINE THE UTILIZATION OF BARIATRIC SURGERY AMONG INDIVIDUALS WITH PRIVATE INSURANCE?<sup>ii</sup>

#### Introduction

Bariatric surgery is recognized as the most effective treatment for obesity in individuals with class III obesity (Body Mass Index [BMI]  $\geq 40$  kg/m<sup>2</sup>) and those with class II obesity (BMI 35–39.9 kg/m<sup>2</sup>) and at least one obesity-related comorbidity, such as type II diabetes, hypertension, sleep apnea, non-alcoholic fatty liver disease, and osteoarthritis.<sup>76–79</sup> The majority of patients lose 25–30% of their body weight and experience clinically significant improvements in weight-related comorbidities.<sup>22,24</sup> Nevertheless, bariatric surgery remains underutilized in the United States. Over 32 million Americans meet the basic eligibility criteria for bariatric surgery (class III obesity and class II obesity with comorbidities).<sup>10</sup> However, only 228,000 individuals (or less than 1%) underwent the surgery in 2017.<sup>23</sup>

Several factors likely contribute to the underutilization of bariatric surgery. These include limited knowledge and negative attitudes towards bariatric surgery by patients

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and referring physicians, barriers in patient-physician communication, stigma related to weight loss surgery, high cost of the surgery (\$8,678–\$14,082), as well as insurance coverage and benefits design-related issues.<sup>8,10,43</sup> For example, Kim and colleagues (2018) estimated that if patient cost-sharing for bariatric surgery was decreased from 6% (2014 average estimate) to 0%, surgery uptake among patients with class III obesity and type 2 diabetes mellitus could increase from 121.3 to 141.9 cases per 100,000 patients.<sup>32</sup> Such an increase in the utilization of surgery within this patient subgroup was projected to result in \$7.07 million in monetary returns at the US population level as a result of gained quality-adjusted life-years.<sup>32</sup> For reference, the average price for coronary artery bypass graft was \$151,271 in 2010,<sup>80</sup> while the average out-of-pocket spending for the procedure ranged from \$585 in 2009 to \$862 in 2013 (0.4% to 0.6% of the estimated hospital charges and physicians fees, respectively), among commercially insured nonelderly adults.<sup>81</sup>

While bariatric surgery is underutilized, insurance coverage for the procedures has expanded over the past decade.<sup>82,83</sup> As of 2018, Medicare, 49 state Medicaid programs, 43 state employee programs, individual and small-group insurance markets in 23 states, and most commercial insurers offered coverage for one or more bariatric procedures.<sup>82,84,85</sup> However, expansion of insurance coverage alone might not be enough to warrant greater access to bariatric surgery. For example, the inclusion of bariatric surgery as an essential health benefit within the individual and small-group insurance plans in 23 states did not result in a significantly greater increase of bariatric surgery utilization in those states compared to control states.<sup>82</sup> The complexity of insurance plan

design for bariatric surgery might account for the lack of change in utilization.

Particularly, access to bariatric surgery is generally restricted by the third-party payers in numerous ways, including by precertification criteria such as a referral from a primary care provider, documented 2-year weight history, as well as through extensive preoperative testing and consultations with medical specialists that can total to 8 in-person visits to program providers prior to surgery.<sup>14,82</sup>

Many insurance plans, for example, require preoperative supervised medical weight management prior to surgery.<sup>82</sup> Over a period of 3-6 months, patients are encouraged to learn and practice the dietary and behavioral requirements of surgery through monthly visits with a physician or dietitian within the bariatric surgery program. Ideally, these programs are designed to produce a modest (5%) weight loss and enhance perioperative outcomes. There is only modest evidence to support the benefit of this requirement.<sup>16,18,55,86</sup> In a recent study, the amount of weight lost preoperatively was not associated with 30-day readmission, reoperation, or mortality.<sup>18</sup> The intensity and length of the preoperative testing and consultation period were not found to be associated with early postoperative weight loss, further suggesting that these preoperative requirements are not enhancing postoperative outcomes for most patients.<sup>55</sup>

Previous work by Gasoyan and colleagues in 2019 demonstrated that the type of insurance plan (e.g. health maintenance organization [HMO], preferred provider organization [PPO], point of service [POS], fee-for-service), as opposed to more general payer type (e.g. Medicare, Medicaid, commercial), was more strongly associated with the utilization of bariatric surgery.<sup>13</sup> The Medicare Advantage PPO plan was associated with

greater odds of undergoing bariatric surgery compared with the Medicare Advantage HMO plan.<sup>13</sup> Similarly, patients with Blue Cross PPO, Blue Cross fee-for-service, and Blue Cross HMO plans had greater odds of undergoing surgery compared with individuals who had other commercial HMO plans.<sup>13</sup>

Currently, there is little understanding of the impact of precertification requirements on the likelihood of undergoing bariatric surgery. The current study was undertaken to investigate if there is such a link among individuals covered by private insurance. Insurance-mandated requirements of documented 2-year weight history and involvement in a 3-6 month-long preoperative supervised medical weight management program (MWM) were predicted to be negatively associated with the odds of undergoing bariatric surgery, after controlling for insurance plan type, patient medical history, and relevant socio-demographic variables.

## **Methods**

### *Data source and study population*

This study used Pennsylvania Health Care Cost Containment Council's inpatient and outpatient care databases for the years 2015-2016 and records of preoperative insurance precertification requirements maintained by the Bariatric Surgery Program at Temple University in 2016. The databases contain clinical and claims data from all hospitals (excluding Veterans Administration Hospitals) and outpatient and freestanding ambulatory surgery centers in the Philadelphia, Bucks, Montgomery, Chester, and Delaware counties in Southeastern Pennsylvania.

The study population consisted of privately insured patients (with known/listed health insurance plans) age 18-73. Under private insurance, we considered all forms of health insurance that were not funded by the government. This study did not include patients whose medical bills were expected to be paid by Workers' Compensation or automobile insurance. We also were unable to report utilization by insurer type, since our data use agreement does not encourage reporting insurer type by name.

A sample of bariatric surgery patients (referred as a surgery group) and those who were eligible for, but did not undergo surgery (referred as a comparison group), were identified from Pennsylvania Health Care Cost Containment Council's databases using international classification of disease, ninth and tenth revisions (ICD-9, ICD-10), and clinical modification procedure codes, as well as Healthcare Common procedure Coding System Level I Current Procedural Terminology (HCPCS CPT-4).

The surgery group included a sample of adult patients who underwent the most common types of bariatric surgery at an inpatient setting in 2016 and had a diagnosis code for morbid (severe) obesity. Individuals with a diagnosis for noninfective enteritis and colitis and abdominal neoplasms were excluded from the sample (Appendix B).

The comparison group included adults from the 2016 outpatient database who met the following criteria: 1) had a diagnosis code for morbid (severe) obesity; 2) did not have a record of any bariatric procedure during 2015-2016 in the inpatient or outpatient databases; 3) and did not have a diagnosis code for heart failure, chronic ischemic heart disease, malignant neoplasms, portal hypertension, Crohn's disease, mental and

behavioral disorders due to psychoactive substance use, or intellectual disabilities since those conditions could decrease the likelihood of undergoing bariatric surgery (Appendix B).<sup>64</sup> Duplicate records in the inpatient and outpatient databases were identified and removed using a pseudo patient identifier variable.

*Study design, variables, and statistical analysis*

To control for the potential confounding effects of socio-demographic factors on the odds of undergoing bariatric surgery or having a certain type of insurance coverage, records of surgery patients were 1:1 matched by age group (18-29, 30-35, 36-41, 42-47, 48-53, 54-59, 60-64, 65-76), sex, race, and zip code with those of eligible patients who did not undergo surgery.

The primary outcome variable was whether or not the patient had surgery by the end of 2016 - the period included in the database. Primary predictor variables included insurance-mandated requirements for documented weight history (none or 2-year weight history) and an insurance-mandated requirement for involvement in a preoperative supervised MWM program (none or 3-6 months). Insurance plan type (HMO, PPO, POS, fee-for-service) was included as a covariate and to control for the potential influence of the patient's ability within a given plan type to choose doctors/hospitals and out-of-pocket costs.

Pearson Chi-Square tests and multivariable logistic regression analysis were performed to examine the association between precertification criteria, insurance plan type, and the likelihood of undergoing bariatric surgery. An alpha of .05 was used to

determine statistical significance. Database management and statistical analysis were conducted using IBM SPSS Statistics for Windows (Version 25.0; Armonk, NY, USA).

## Results

The study sample included 1,054 individuals with private health insurance; 527 in the surgery group and 527 in the comparison group, 1:1 matched on sex, race, age group, and zip code. The majority were females (83.3%) and white (65.3%). The mean age was  $45.4 \pm 10.5$  years in the surgery group and  $45.6 \pm 10.5$  years in the comparison group, which did not significantly differ. Additional demographic characteristics are presented in Table 6.

**Table 6. Demographic characteristics of bariatric surgery patients and those who were eligible for but did not undergo surgery**

Variable	Surgery group (n= 527)	Comparison group (n= 527)
	n (percent within column) [standard deviation]	
<b><i>Sex</i></b>		
Female	439 (83.3%)	439 (83.3%)
Male	88 (16.7%)	88 (16.7%)
<b><i>Race</i></b>		
White alone	344 (65.3%)	344 (65.3%)
Black alone	179 (34.0%)	179 (34.0%)
Other	2 (0.4%)	2 (0.4%)
Unknown	2 (0.4%)	2 (0.4%)
<b><i>Ethnicity</i></b>		
No Hispanic/Latino origin or descent	521 (98.9%)	519 (98.5%)
Hispanic/Latino origin or descent	6 (1.1%)	8 (1.5%)
<b><i>Mean age</i></b>	45.4 [10.5]	45.6 [10.5]

Note. Individuals in surgery and comparison groups were 1:1 matched on sex, race, age group, and zip code.

The most common insurance plan type was PPO (n = 461), followed by HMO (n = 329), fee-for-service (n = 219), and POS (n = 45). The distribution of insurance plan types in the surgery and comparison groups are presented in Table 7.

**Table 7. Distribution of precertification requirements and insurance plan profile among bariatric surgery and comparison groups**

Variable	Surgery group (n= 527)	Comparison group (n= 527)	Pearson Chi-Square test
	n (percent within a row)		
<b><i>Requirement for preoperative medical weight management</i></b>			$X^2 = 9.502, df = 2, P = 0.009$
None	357 (53.3%)	313 (46.7%)	
3-6 months	165 (45.0%)	202 (55.0%)	
Unknown	5 (29.4%)	12 (70.6%)	
<b><i>Requirement for documented weight history</i></b>			$X^2 = 5.808, df = 2, P = 0.055$
None	376 (52.1%)	346 (47.9%)	
2-year weight history	146 (46.3%)	169 (53.7%)	
Unknown	5 (29.4%)	12 (70.6%)	
<b><i>Insurance plan type</i></b>			$X^2 = 6.098, df = 3, P = 0.107$
Health maintenance organization	147 (44.7%)	182 (55.3%)	
Point of service	21 (46.7%)	24 (53.3%)	
Fee for service	117 (53.4%)	102 (46.6%)	
Preferred provider organization	242 (52.5%)	219 (47.5%)	

The precertification requirement for involvement in a preoperative MWM program was associated with whether or not the patient had surgery by the end of the period included in the database,  $X^2(2) = 9.5, P = 0.009$  (Table 7). More specifically, individuals in the comparison group who did not have surgery had a higher rate of insurance products that required 3-6 months of supervised weight loss visits (n = 202, 55.0%) than in the surgery group (n = 165, 45.0%).

Similarly, the requirement for 2-year documented weight history was more commonly seen in the comparison group (n = 169, 53.7%) as compared to the surgery

group (n = 146, 46.3%). The association between those 2 variables approached, but did not reach, statistical significance,  $X^2 (2) = 5.8, P = 0.055$  (Table 7).

Table 8 presents the results of the multivariable logistic regression model. The requirement for 3-6 months preoperative supervised medical weight management was associated with smaller odds of undergoing bariatric surgery (odds ratio [OR] = 0.459, 95% confidence interval [CI] 0.253 to 0.832,  $P = 0.010$ ), after controlling for insurance plan type and the requirement for documented weight history.

Privately insured individuals with a PPO (OR = 1.422, 95% CI 1.063 to 1.902,  $P = 0.018$ ) and fee-for-service (OR = 1.447, 95% CI 1.021 to 2.050,  $P = 0.038$ ) plans had greater odds of undergoing bariatric surgery, compared with individuals who had HMO plans, after controlling for precertification requirements for MWM and documented weight history. The requirement for documented weight history was not a statistically significant predictor in the model ( $P = 0.132$ ).

**Table 8. Association of precertification criteria and insurance plan type with odds of bariatric surgery (N=1,037)**

Variable	Odds ratio	95% Confidence interval	P-value
<b><i>Requirement for preoperative medical weight management</i></b>			
None		Reference category	
3-6 months	0.459	0.253-0.832	<b>0.010</b>
<b><i>Requirement for documented weight history</i></b>			
None		Reference category	
2-year weight history	1.603	0.867-2.962	0.132
<b><i>Insurance plan type</i></b>			
Health maintenance organization		Reference category	
Preferred provider organization	1.422	1.063-1.902	<b>0.018</b>
Point of service	1.125	0.591 -2.142	0.719
Fee for service	1.447	1.021-2.050	<b>0.038</b>

Note. Unknown status for preoperative medical weight management and documented weight history were set as missing values in the model.

## Discussion

This study extends our knowledge regarding the role of insurance plan features in determining access to bariatric surgery. In this study of privately insured bariatric surgery patients and a matched comparison group of individuals who did not undergo surgery, enrollment in more restrictive insurance plans, and the requirement of participation in preoperative medical weight management program, were barriers to utilization of surgery during the study period.

Earlier studies, such as Love and colleagues (2017) reported that an increase in the preoperative diet requirement was associated with surgery dropout (OR = 0.880 per month required, 95% CI 0.839 to 0.922,  $P < 0.0001$ ) among patients undergoing bariatric surgery evaluation from 2010–2015.<sup>14</sup> In that study, surgery dropout was defined as not undergoing bariatric surgery by December 2015 among patients who underwent initial bariatric surgery evaluation between January 2010 and May 2015.<sup>14</sup> A 2019 study by Chhabra et al. found that individuals with more generous plans such as preferred provider organization have a higher rate of bariatric surgery utilization (20 per 100,000 insured lives), compared to those in high-deductible health plans (12 per 100,000 insured lives).<sup>37</sup>

For most patients, the route to surgery typically involves several steps, including attending an initial information/orientation session with the bariatric surgery program, as well as completing nutritional, psychological, pulmonary, and cardiology evaluations. These evaluations, whether coupled with a preoperative MWM requirement or not, can take patients approximately 6 months to complete.<sup>16</sup> Out-of-pocket expenses, such as

copayments, parking, public transportation, or childcare expenses, or the lack of sufficient time off from work for health care, maybe indirect barriers to surgery as well. Unfortunately, the database did not include these important, yet often overlooked patient-level variables.

Preferred provider organization and fee-for-service plans are less restrictive in allowing enrollees to select a doctor or hospital and do not require referral for specialized care by primary care providers.<sup>13,37</sup> Although, beneficiaries with PPO plans incur lower cost-sharing when using in-network providers.<sup>13,37</sup> The fee-for-service payment mechanism has been described as a contributor to the overuse of health services and the use of high-cost specialized care since it bases the payments on volume and not the value of provided services.<sup>87</sup> In contrast, HMO plans are generally more restrictive and are more likely to limit enrollees to in-network providers. They also require a referral by a primary care provider for specialty care visits.<sup>13,37</sup> The intent of the HMO plans to restrict the overutilization of health services could have been too restrictive in the case of bariatric surgery. This could explain the associations seen in this study, especially considering the number of pre-operative specialized services that bariatric surgery patients utilize to meet the precertification criteria.

This study did not find a statistically significant association between documented weight history precertification requirements and odds of undergoing surgery. Given the comorbidity profile of bariatric surgery candidates that generally requires medical care<sup>29</sup> and the considerable rise of electronic health records use in the United States over the past decade,<sup>88</sup> this requirement might pose less of a hurdle for privately-insured

candidates for bariatric surgery. Furthermore, the documented weight history requirement was less common compared to the preoperative supervised medical weight management and was found in only 30% of patients in the database.

As with all policies, there is a need to revisit the data supporting the policy to ensure that there is an evidence base to keep the policy in place. As evidence-based practice evolves and costs associated with clinical care change, the need for barriers preventing access to care may no longer be justified. A holistic approach to the issue may demonstrate that while some pre-authorization is needed to ensure an individual is prepared and committed to sustained change, the 3-6 month supervised MWM program requirement may be too restrictive.

The demographic characteristics of the study population were generally comparable to the national trends in bariatric surgery utilization. Women represented 83% of patients in the database; they represent 80% of patients in the United States as of 2016. The mean age of patients in the database was 45 years as compared to 44 years nationally. Differences in race, however, were observed. The percentage of patients in the database who were white (65%) was comparable to the percentage seen nationally (64%). The sample in the database, however, was 34% Black and only 1% Hispanic. Nationally, 18% of bariatric surgery patients are Black and 14% are Hispanic. This could be explained by the racial/ethnic makeup of the 5 major counties in Southeastern Pennsylvania, where 67.2% of the population is white, 23.2% is Black, and 9.6% of individuals are other races.<sup>89</sup> Furthermore, the age-adjusted prevalence of severe obesity

is 9.3% among adult, non-Hispanic white individuals as opposed to 13.8% among non-Hispanic black individuals.<sup>1</sup>

The racial makeup of our original bariatric surgery sample (before matching) was 58.9% whites, 35.3% Blacks, 3.4% other races, 1.9% unknown, 0.3% Asians; 3.1% of the patients were of Hispanic origin. In this study, each demander (surgery patient) needed to have an exactly matching (by age group, sex, race, and zip code) supplier (comparison patient) to be included in the study sample, hence the slight difference in the racial/ethnic composition between the original and study samples of bariatric surgery patients. It should be also noted that while nationwide demographics data are drawn from all bariatric surgery patients, this study examined a specific group of individuals – those with private insurance coverage.

A strength of this study is its application of stringent inclusion and exclusion criteria used for the two groups, as well as the 1:1 matching on socio-demographic variables to control for their potential confounding effects on the likelihood of undergoing surgery or having a certain type of insurance coverage. This study also has limitations. The mix of insurance providers and plans within this study sample may not be representative of the market share of health insurance providers/plans in other areas of the United States. Therefore, the breakdown of cases where the select precertification requirements were applicable might not be generalizable. Furthermore, since some insurers had varying requirements on the length of the preoperative weight management requirement, we elected to group them as programs that had either a 3-month or 6-month duration, thus making it impossible to examine any potential dose-effect associations.

## Conclusions

The results emphasize the need for consideration of insurance benefits design as a determinant of access to bariatric surgery and possibly other high-cost, nonemergency services. Policymakers and third-party payers should pay close attention to whether insurance-mandated precertification criteria are evidence-based and designed to positively impact patient outcomes and deliver high-value care. The application of value-based insurance design to bariatric surgery could be another potential solution in that route.<sup>8</sup> A recent survey of bariatric surgery policies shows that during 2017–2018 some major health insurers removed the requirement for supervised weight loss programs and placed more emphasis on multidisciplinary education sessions and nutritional counseling prior to surgery.<sup>82</sup> This presents an opportunity for further research to determine whether the modification or discontinuation of this longstanding health insurance practice will contribute to enhanced access to needed health services among the beneficiaries of these plans.

## CHAPTER 6

### STUDY 3: ASSOCIATION BETWEEN INSURANCE-MANDATED PRECERTIFICATION CRITERIA AND INPATIENT HEALTHCARE UTILIZATION DURING ONE YEAR AFTER BARIATRIC SURGERY

#### Introduction

Modern bariatric surgical procedures have strong evidence of efficacy and safety in individuals with class III obesity [body mass index (BMI)  $\geq 40$  kg/m<sup>2</sup>] and those with class II obesity [BMI 35–39.9 kg/m<sup>2</sup>] and with at least 1 obesity-related comorbidity.<sup>3</sup> Nevertheless, only a small fraction of patients meeting these criteria undergoes bariatric surgery each year, with an estimated 256,000 bariatric procedures performed in the United States in 2019.<sup>23</sup> There are likely several contributing factors for the underutilization of bariatric surgery, including limited knowledge and unfavorable attitudes toward bariatric surgery by patients and referring physicians, stigma related to the surgery, barriers in patient-physician communication, as well as health insurance-related factors, such as insurance coverage, patient cost-sharing, and insurance-mandated precertification requirements.<sup>8,35–38</sup>

Third-party payers use variety of tools to control health services utilization and contain their costs. Prospective utilization review is one example, where the insurer evaluates the appropriateness of the treatment and may approve or deny payment for services requested by a medical provider. Many insurers employ prospective utilization review for bariatric surgery, including the common precertification criteria such as a

referral from a primary care provider as well as through extensive preoperative testing and 3-6 months preoperative supervised medical weight management (MWM).<sup>14,82</sup> The specific requirements for precertification vary based on the payer type and the insurance administrator.<sup>14,82</sup> For example, while many insurance plans require monthly in-person attendance for a preoperative MWM program, some do not require their policyholders to report any weight lost during the program, while others require patients to report their weight before and after the MWM, and might not preauthorize bariatric surgery if the patient gains any weight during the MWM program.<sup>53</sup>

Previous studies have found that patients subject to insurance-mandated precertification requirements of 3-6 months MWM and evaluation by subspecialist such as cardiology experienced significant delay in their time to surgery and, ultimately, were less likely to undergo bariatric surgery.<sup>14,38,46</sup> For example, a study of privately insured bariatric surgery patients and 1:1 matched individuals who met the eligibility criteria but did not undergo surgery demonstrated that the requirement for 3–6 months MWM was associated with smaller odds of undergoing bariatric surgery (odds ratio [OR] = 0.459; 95% confidence interval [CI], 0.253 to 0.832; P = 0.010).<sup>38</sup> Furthermore, it was reported that delaying time to surgery in bariatric surgery patients until the BMI is 50 or greater can lead to inferior outcomes with respect to achieving a BMI of less than 30 after bariatric surgery.<sup>90</sup>

There has been long-standing debate regarding the clinical benefits of the insurance-mandated MWM requirement for bariatric surgery.<sup>16</sup> The historical rationale for the practice was that losing weight prior to surgery demonstrated commitment to the

procedure, prepared patients for the dietary and behavioral changes needed for an optimal postoperative result, and reduced operative time, postoperative length of stay, adverse events and postoperative complications.<sup>16</sup> A recent study supported this later claim and found that a <5% weight loss prior to bariatric surgery was associated with a lower risk of 30-day mortality.<sup>17</sup> In contrast, other studies have not found a relationship between preoperative MWM and weight loss<sup>53,54</sup> or reoperation rates<sup>53</sup> in the first postoperative year. Similarly, Tewksbury and colleagues reported that preoperative weight loss is not linked to 30-day overall readmission, reoperation, or mortality.<sup>18</sup> Consistent with these findings, an updated position statement from the American Society for Metabolic and Bariatric Surgery, based on the review of the existing literature, concluded that there is a lack of sufficient evidence to support the practice of insurance-mandated preoperative MWM.<sup>91</sup>

The literature examining the value of insurance-mandated evaluation by subspecialist, such as cardiology and pulmonology, is generally represented in clinical practice guidelines and review papers.<sup>92,93</sup> For example, the American Society for Metabolic and Bariatric Surgery's preoperative care pathway for laparoscopic sleeve gastrectomy lists nutrition and psychological evaluation as recommended routine evaluations, while cardiology and pulmonology consultations are designated as selective evaluations.<sup>93</sup> Nevertheless, preoperative MWM, as well as cardiology and pulmonology assessments, are listed as a precertification requirement for the majority of insurance plans in the United States, thus applying to all policyholders of those plans, regardless of their designation in preoperative care pathways or clinical guidelines.

The current study was undertaken to investigate whether there is an association between select insurance-mandated precertification criteria (specifically MWM, cardiology, and pulmonary consultations) and short-term inpatient healthcare services utilization (operationalized by postoperative hospital length of stay and rehospitalizations in the first postoperative year) after bariatric surgery. Insurance mandated requirements of 3-6 months long MWM, as well as cardiology and pulmonology evaluations, were predicted to not be associated with less resource utilization, after controlling for relevant socio-demographic and clinical variables.

## **Methods**

### *Study Design, Setting, and Participants*

This retrospective cohort study used Pennsylvania Health Care Cost Containment Council's inpatient care databases for the years 2016–2017 and the preoperative insurance precertification requirements maintained by the Bariatric Surgery Program at Temple University in 2016. The databases contain de-identified clinical and claims data from all hospitals (excluding Veterans Administration and state psychiatric hospitals) in the Philadelphia, Bucks, Montgomery, Chester, and Delaware counties in Southeastern Pennsylvania. The combined population of these counties in 2018 was roughly 4.1 million.<sup>62</sup>

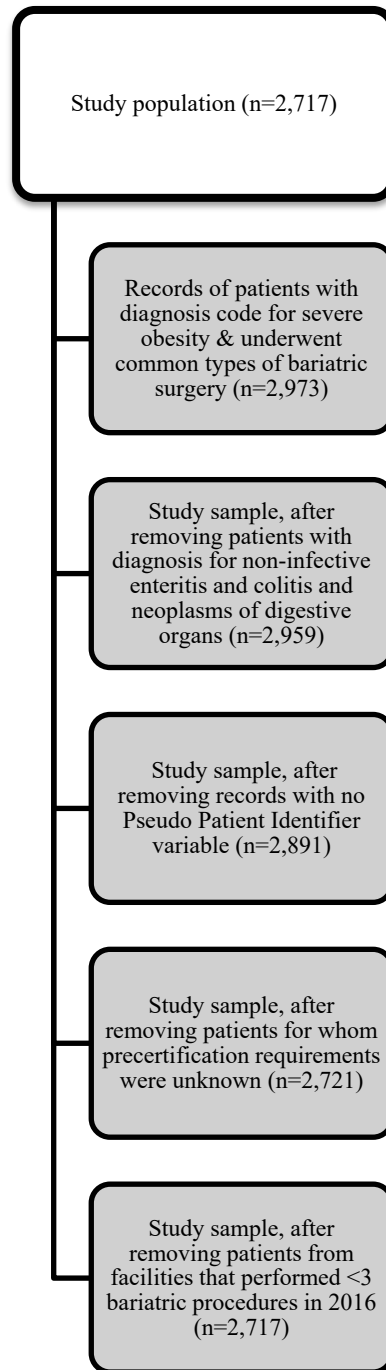
The study population consisted of all adult patients (captured in the datasets) with a diagnosis of severe obesity who underwent the most common bariatric surgical procedures (open/laparoscopic gastric bypass and open/laparoscopic sleeve gastrectomy)

in 2016 and for whom the insurance-mandated precertification requirements were known. Patients with diagnostic codes for non-infective enteritis and colitis and neoplasms of digestive organs at the time of the surgery were excluded (see Appendix C for international classification of disease, tenth revision, clinical modification diagnosis codes). Sixty-eight records of surgical patients with no Pseudo Patient Identifier variable and 4 records of patients from facilities that performed <3 bariatric procedures in 2016 were excluded. The final cohort included 2,717 patients who underwent bariatric surgery. Figure 4 presents a flow diagram on how the study population was identified. Postoperative length of stay and rehospitalizations were followed during the first year after bariatric surgery via the Pseudo Patient Identifier variable included in the datasets. The latter facilitates tracking patient transfers and rehospitalizations across time and facility.

### *Variables*

The primary outcome variables were the number of days the patient stayed in the inpatient facility after surgery (referred as the length of stay), as well as the number of all-cause rehospitalizations, the number of all-cause rehospitalization days, and whether there was a rehospitalization with an admitting or principal diagnosis code for common cardiac and pulmonary conditions (listed in Appendix C) in the same or the following three quarters following the date of discharge. For Pennsylvania facilities that perform inpatient services, a data record for each inpatient discharge is reported on a quarterly basis.

**Figure 4. Identification of the study population**



Note. Diagnosis codes for severe obesity were defined as E66.01 in the 10th editions of international classification of disease. Bariatric surgery types include open/laparoscopic sleeve gastrectomy and open/laparoscopic Roux-en-Y gastric bypass.

The primary exposure variables included whether a patient was subject to insurance mandated requirements of 3-6 months long MWM, as well as cardiology and pulmonology evaluations, based on the type of their primary health insurance plan at the time of the surgery (as submitted by the facility to Pennsylvania Health Care Cost Containment Council) and the records of preoperative insurance precertification requirements maintained by the Bariatric Surgery Program at Temple University in 2016.

Covariates included patient age, sex (captured as male, female, or unknown), race (white alone, Black alone, two or more race groups, other, unknown), ethnicity (patient of Hispanic/Latino origin or descent vs not), the Elixhauser Comorbidity Score according to the AHRQ formulation,<sup>57</sup> type of surgery (open/laparoscopic gastric bypass and open/laparoscopic sleeve gastrectomy), facility where the surgery was performed, primary payer type (private, Medicare, Medicaid, uninsured/self-pay), as well as the estimated median household income (based on the patient's zip code and information from the American Community Survey 5-year estimates).<sup>58</sup>

### *Statistical Analysis*

Multivariable Poisson and logistic regression analyses were performed to examine the associations between precertification criteria and the length of stay (Model 1), the number of all-cause rehospitalizations (Model 2), the total number of all-cause rehospitalization days (Model 3), and whether there was a rehospitalization with an admitting or principal diagnosis code for common cardiac or pulmonary conditions (Model 4). Models 1-3 were adjusted for patient age, sex, race, ethnicity, the Elixhauser

Comorbidity Score, type of the surgery, facility where the surgery was performed, primary payer type, as well as the estimated median household income. Model 4 was adjusted for the above-mentioned covariates except for surgery type, facility, and primary payer type to avoid quasi-complete separation in the data. Differences in (unadjusted) mean patient length of stay, as well as the number of all-cause rehospitalizations and the total number of all-cause rehospitalization days, were tested using independent t-tests.

Complete data was available for patient age, sex, ethnicity, facility where the surgery was performed, and primary payer type; there were 0.26% (n=7) missing data on estimated median household income, 0.07% (n=2) on Elixhauser Comorbidity Score, and 2.1% (n=58) on patient race. Given the small amount of missing data, such cases were subject to listwise deletion in the multivariable regression models.

An  $\alpha$  of 0.05 was used to determine statistical significance. Database management and statistical analysis were conducted using R (version 4.0.5; R Project for Statistical Computing, Vienna Austria) and IBM SPSS Statistics for Windows (version 27.0; IBM Corp., Armonk, NY). Calculation of the Elixhauser Comorbidity Score was done using Comorbidity: An R package for computing comorbidity scores.<sup>94</sup> Temple University Institutional Review Board reviewed the protocol and determined that approval was not required as the study used deidentified and publicly available data. STROBE guidelines were followed.

## Results

The study population included 2,717 patients who underwent bariatric surgery in 2016. The majority were women (81.9%) and not of Hispanic/Latino origin or descent (92.8%). Most patients identified as white alone (48.0%) or Black alone (42.3%). The mean age was  $43.2 \pm 11.7$  years. Almost half (49.4%) of the patients were subject to insurance-mandated 3–6 months MWM and 51.9% of the study population were required to undergo cardiology and pulmonology evaluations for precertification purposes. Insurance plans either required both cardiology and pulmonology evaluations or none.

All Medicaid beneficiaries in Pennsylvania in 2016 were required to undergo 3-6 months MWM as well as cardiology and pulmonology evaluations. In contrast, patients with Medicare coverage were exempt from the MWM precertification requirement, but most (92.8%) were required to undergo cardiology and pulmonology evaluations. Those who were not subject to the latter precertification requirement were beneficiaries of certain Medicare Advantage plans. Among privately insured bariatric surgery patients, 36.8% were subject to the 3-6 months MWM requirement and 19.5% to the cardiology and pulmonology evaluations. Additional demographic and clinical information about study participants, stratified by the exposure type, is presented in Table 9.

The mean length of stay for patients with and without 3-6 months MWM requirement were  $1.96 \pm 1.00$  and  $2.02 \pm 1.52$  days, [mean difference of 0.06, 95% CI, -0.04 to 0.16,  $P = 0.2$ ] respectively. The corresponding numbers for cardiology and pulmonology evaluations were  $2.06 \pm 1.52$  (required) and  $1.93 \pm 0.97$  (not required)

[mean difference of -0.13, 95% CI, -0.23 to -0.04, P = 0.007]. The 3-6-month MWM group had on average  $0.17 \pm 0.58$  rehospitalization, with  $0.68 \pm 3.56$  rehospitalization days during the same or the following 3 quarters following discharge. The corresponding numbers for patients with no MWM requirement were  $0.20 \pm 0.67$  rehospitalization [mean difference of 0.03, 95% CI, -0.02 to 0.08, P = 0.2], with  $1.02 \pm 6.03$  rehospitalization days [mean difference of 0.33, 95% CI, -0.04 to 0.70, P = 0.08].

**Table 9. Characteristics of the study population (N=2,717)**

<i>Variable</i>	<i>Subject to 3-6 months MWM (n=1,342)</i>	<i>Not subject to 3-6 months MWM (n= 1,375)</i>	<i>Requirement for cardiology and pulmonary evaluation applies (n= 1,410)</i>	<i>No requirement for cardiology and pulmonary evaluation (n= 1,307)</i>
Mean age (SD)	40.4 (10.7)	45.9 (12.0)	43.0 (12.4)	43.4 (10.9)
<i>Sex, n (%)</i>				
Female	1,150 (51.7%)	1,076 (48.3%)	1,197 (53.8%)	1,029 (46.2%)
Male	192 (39.1%)	299 (60.9%)	213 (43.4%)	278 (56.6%)
<i>Race, n (%)</i>				
Black alone	612 (53.3%)	536 (46.7%)	678 (59.1%)	470 (40.9%)
White alone	552 (42.3%)	753 (57.7%)	547 (41.9%)	758 (58.1%)
Other	150 (72.8%)	56 (27.2%)	158 (76.7%)	48 (23.3%)
<i>Ethnicity, n (%)</i>				
Hispanic/Latino origin or descent	147 (75.0%)	49 (25.0%)	157 (80.1%)	39 (19.9%)
Not of Hispanic/Latino origin or descent	1,195 (47.4%)	1,326 (52.6%)	1,253 (49.7%)	1,268 (50.3%)
<i>Primary payer type, n (%)</i>				
Uninsured/self-pay	0 (0%)	45 (100%)	0 (0%)	45 (100%)
Medicare	0 (0%)	360 (100%)	334 (92.8%)	26 (7.2%)
Medicaid	777 (100%)	0 (0%)	777 (100%)	0 (0%)
Commercial	565 (36.8%)	970 (63.2%)	299 (19.5%)	1,236 (80.5%)
<i>Surgery type, n (%)</i>	1,000 (48.3%)	1,069 (51.7%)	1,044 (50.5%)	1,025 (49.5%)
Laparoscopic sleeve gastrectomy				
Laparoscopic gastric bypass	310 (52.6%)	279 (47.4%)	327 (55.5%)	262 (44.5%)
Open sleeve gastrectomy	9 (47.4%)	10 (52.6%)	13 (68.4%)	6 (31.6%)
Open gastric bypass	23 (57.5%)	17 (42.5%)	26 (65.0%)	14 (35.0%)

Note. MWM - preoperative supervised medical weight management.

Patients who were required to undergo cardiology and pulmonology evaluations on average had  $0.25 \pm 0.75$  rehospitalization, with  $1.23 \pm 6.53$  rehospitalization days during the study period. The corresponding numbers for patients with no such precertification requirement were  $0.12 \pm 0.45$  rehospitalization [mean difference of  $-0.13$ , 95% CI,  $-0.17$  to  $-0.08$ ,  $P < 0.001$ ], with  $0.44 \pm 2.25$  rehospitalization days [mean difference of  $-0.79$ , 95% CI,  $-1.15$  to  $-0.43$ ,  $P < 0.001$ ]. There was a total of 57 patients who were rehospitalized with an admitting or primary diagnosis for common cardiac and pulmonary conditions during the same or the following 3 quarters after the date of discharge from surgery; 43 (75.4%) were subject to the cardiology and pulmonology evaluations requirement and 14 (24.6%) were not.

The precertification requirement for MWM was not associated with the patient length of stay. Similarly, the requirement for preoperative cardiology and pulmonology evaluations, after adjusting for patient age, sex, race, ethnicity, the Elixhauser Comorbidity Score, type of the surgery, facility where the surgery was performed, primary payer type, as well as the estimated median household income, also was not associated with length of stay (Table 10). The strongest predictor of length of stay was surgery type, with the mean length of stay lower in laparoscopic sleeve gastrectomy patients by a factor of 0.59 (lower by 40.8%), 95% CI, 0.50 to 0.70,  $P < 0.001$  compared to patients undergoing open gastric bypass surgery. Similarly, patients undergoing laparoscopic gastric bypass and open sleeve gastrectomy had lower length of stay (by factors of 0.72, 95% CI, 0.61 to 0.84,  $P < 0.001$  and 0.76, 95% CI 0.58 to 0.99,  $P = 0.04$ , respectively) compared to patients undergoing open gastric bypass surgery.

**Table 10. Association of precertification criteria and length of stay after bariatric surgery (N=2,650)**

<i>Variable</i>	<i>Exponentiated Poisson Regression Coefficient</i>	<i>95% Confidence Interval</i>	<i>P</i>
<i>Requirement for preoperative supervised medical weight management</i>			
None	1.023	0.967 - 1.083	0.4
3-6-month	Reference category		
<i>Requirement for preoperative cardiology and pulmonology evaluations</i>			
None	0.995	0.930 - 1.064	0.9
Yes	Reference category		
<i>Patient sex</i>			
Female	0.953	0.886 - 1.024	0.2
Male	Reference category		
<i>Patient race</i>			
Black alone	1.072	1.026 - 1.120	<b>0.002</b>
Other	0.999	0.862 - 1.158	0.9
White alone	Reference category		
<i>Patient ethnicity</i>			
Hispanic/Latino origin or descent	0.992	0.834 - 1.180	0.9
Not of Hispanic/Latino origin or descent	Reference category		
<i>Patient age (1 year increase)</i>			
	1.002	1.000 - 1.005	<b>0.045</b>
<i>Estimated median household income (\$1000 increase)</i>			
	0.999	0.999 - 1.000	0.2
<i>Primary payer type</i>			
Uninsured/self-pay	0.873	0.788 - 0.966	<b>0.009</b>
Medicare	1.135	1.035 - 1.246	<b>0.007</b>
Medicaid	1.072	1.010 - 1.139	<b>0.022</b>
Commercial	Reference category		
<i>Surgery type</i>			
Laparoscopic sleeve gastrectomy	0.592	0.504 - 0.695	<b>&lt;0.001</b>
Laparoscopic gastric bypass	0.716	0.608 - 0.843	<b>&lt;0.001</b>
Open sleeve gastrectomy	0.759	0.580 - 0.993	<b>0.044</b>
Open gastric bypass	Reference category		
<i>Elixhauser Comorbidity Score (1 unit increase)</i>			
	1.022	1.005 - 1.040	<b>0.011</b>

Note. The model was also adjusted for the facility where the surgery was performed. 67 records were not included in the model due to missing data.

None of the studied precertification requirements were associated with the number of rehospitalizations during the study period (Table 11). The payer type, however, was a significant predictor in the model, with the mean number of rehospitalizations being higher among Medicare patients (by a factor of 5.06, 95% CI,

2.77 to 9.23,  $P < 0.001$ ) and Medicaid patients (by a factor of 1.86, 95% CI, 1.09 to 3.20,  $P = 0.02$ ) compared to commercially insured patients, after controlling for relevant socio-demographic and clinical variables.

**Table 11. Association of precertification criteria and number of rehospitalizations during the first postoperative year (N=2,650)**

<i>Variable</i>	<i>Exponentiated Poisson Regression Coefficient</i>	<i>95% Confidence Interval</i>	<i>P</i>
<i>Requirement for preoperative supervised medical weight management</i>			
None	0.723	0.443 - 1.180	0.2
3-6-month	Reference category		
<i>Requirement for preoperative cardiology and pulmonology evaluations</i>			
None	1.426	0.847 - 2.401	0.2
Yes	Reference category		
<i>Patient sex</i>			
Female	0.971	0.718 - 1.312	0.8
Male	Reference category		
<i>Patient race</i>			
Black alone	1.119	0.799 - 1.566	0.5
Other	1.164	0.582 - 2.325	0.6
White alone	Reference category		
<i>Patient ethnicity</i>			
Hispanic/Latino origin or descent	1.463	0.693 - 3.086	0.3
Not of Hispanic/Latino origin or descent	Reference category		
<i>Patient age (1 year increase)</i>			
	1.006	0.993 - 1.018	0.4
<i>Estimated median household income (\$1000 increase)</i>			
	0.997	0.991 - 1.003	0.4
<i>Primary payer type</i>			
Uninsured/self-pay	0.748	0.241 - 2.319	0.6
Medicare	5.056	2.768 - 9.234	<b>&lt;0.001</b>
Medicaid	1.864	1.086 - 3.200	<b>0.024</b>
Commercial	Reference category		
<i>Surgery type</i>			
Laparoscopic sleeve gastrectomy	0.437	0.235 - 0.811	<b>0.009</b>
Laparoscopic gastric bypass	1.165	0.602 - 2.253	0.7
Open sleeve gastrectomy	0.506	0.109 - 2.342	0.4
Open gastric bypass	Reference category		
<i>Elixhauser Comorbidity Score (1 unit increase)</i>			
	1.037	1.009 - 1.065	<b>0.009</b>

Note. The model was also adjusted for the facility where the surgery was performed. 67 records were not included in the model due to missing data.

Furthermore, no association was observed between the precertification requirements and the number of rehospitalization days during the same or the following 3 quarters from the date of surgery discharge (Table 12).

**Table 12. Association of precertification criteria and number of rehospitalization days during the first postoperative year (N=2,650)**

<i>Variable</i>	<i>Exponentiated Poisson Regression Coefficient</i>	<i>95% Confidence Interval</i>	<i>P</i>
<i>Requirement for preoperative supervised medical weight management</i>			
None	0.626	0.288 - 1.360	0.2
3-6-month	Reference category		
<i>Requirement for preoperative cardiology and pulmonology evaluations</i>			
None	1.122	0.573 - 2.199	0.7
Yes	Reference category		
<i>Patient sex</i>			
Female	0.890	0.544 - 1.454	0.6
Male	Reference category		
<i>Patient race</i>			
Black alone	1.380	0.892 - 2.135	0.1
Other	0.789	0.334 - 1.865	0.6
White alone	Reference category		
<i>Patient ethnicity</i>			
Hispanic/Latino origin or descent	1.932	0.766 - 4.874	0.2
Not of Hispanic/Latino origin or descent	Reference category		
<i>Patient age (1 year increase)</i>	1.005	0.984 - 1.026	0.6
<i>Estimated median household income (\$1000 increase)</i>	0.996	0.987 - 1.006	0.4
<i>Primary payer type</i>			
Uninsured/self-pay	0.639	0.192 - 2.123	0.5
Medicare	6.282	2.889 - 13.662	<0.001
Medicaid	1.479	0.621 - 3.520	0.4
Commercial	Reference category		
<i>Surgery type</i>			
Laparoscopic sleeve gastrectomy	0.777	0.289 - 2.091	0.6
Laparoscopic gastric bypass	1.482	0.542 - 4.056	0.4
Open sleeve gastrectomy	0.453	0.063 - 3.280	0.4
Open gastric bypass	Reference category		
<i>Elixhauser Comorbidity Score (1 unit increase)</i>	1.092	1.061 - 1.123	<0.001

Note. The model was also adjusted for the facility where the surgery was performed. 67 records were not included in the model due to missing data.

The absence of precertification requirement for pulmonology and cardiology evaluations was associated with smaller odds of rehospitalizations with common cardiac and pulmonary conditions during the study period, OR = 0.43, 95% CI, 0.23 to 0.80, P =

0.008, after controlling for patient age, sex, race, ethnicity, estimated median household income, and the Elixhauser Comorbidity Score (Table 13).

**Table 13. Association of precertification criteria and the odds of rehospitalization with common cardiac and pulmonary conditions during the first postoperative year (N=2,650)**

<i>Variable</i>	<i>Odds Ratio</i>	<i>95% Confidence Interval</i>	<i>P</i>
<i>Requirement for preoperative cardiology and pulmonology evaluations</i>			
None	0.426	0.226 - 0.802	<b>0.008</b>
Yes	Reference category		
<i>Patient sex</i>			
Female	0.736	0.382 - 1.418	0.4
Male	Reference category		
<i>Patient race</i>			
Black alone	1.991	0.985 - 4.022	0.055
Other	0.820	0.042 - 16.081	0.9
White alone	Reference category		
<i>Patient ethnicity</i>			
Hispanic/Latino origin or descent	2.091	0.111 - 39.532	0.6
Not of Hispanic/Latino origin or descent	Reference category		
<i>Patient age (1 year increase)</i>			
	1.068	1.038 - 1.099	<b>&lt;0.001</b>
<i>Estimated median household income (\$1000 increase)</i>			
	1.000	0.989 - 1.011	0.98
<i>Elixhauser Comorbidity Score (1 unit increase)</i>			
	1.075	1.026 - 1.127	<b>0.002</b>

Note. 67 records were not included in the model due to missing data.

## Discussion

The precertification requirement for involvement in preoperative MWM, and the requirement for preoperative cardiology and pulmonology evaluations, were not associated with the postoperative patient length of stay, or the number of rehospitalizations and the total of rehospitalization days in the first postoperative year, after adjusting for relevant socio-demographic and clinical variables. This replicates previous work; Schneider and colleagues, in a study with a smaller sample size, also did not find an association between the preoperative MWM requirement and the median

postoperative hospital length of stay or postoperative rate of readmission and reoperation.<sup>53</sup>

In the present study, patients with no requirement for pulmonology and cardiology evaluations had smaller odds of rehospitalizations for common cardiac and pulmonary conditions. Adherence to clinical care pathways is an accreditation requirement by the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP).<sup>93</sup> These pathways typically outline routine (e.g. nutrition consultation and psychological evaluation), selective (e.g. cardiology and pulmonology evaluations), and not routinely recommended (e.g. mandatory preoperative weight loss) practices, procedures, studies, tests, and/or evaluations.<sup>93</sup> Bariatric surgery programs adhering to these evidence-based practices involve patients who would benefit the most from cardiology and pulmonology evaluations as part of their presurgical preparation regimen. This could explain why precertification requirements for cardiology and pulmonology evaluations - imposed on patients based on their payer type and insurance plan rather than the clinical necessity - were not associated with short-term reductions in inpatient healthcare services utilization.

There could be annual savings of \$12.8 billion to \$28.6 billion in the US health care system from measures to eliminate overtreatment or low-value care.<sup>95</sup> The latter is defined as “services that provide little or no benefit to patients, have potential to cause harm, incur unnecessary cost to patients, or waste limited healthcare resources.”<sup>96</sup> Furthermore, there have been successful examples of applying value-based insurance design (i.e. setting patient costs based on the value of a clinical service) to bariatric

surgery benefit design with a use of incentive-based cost-sharing adjustments.<sup>8,49</sup> With the absence of strong evidence for clinical benefit from mandatory preoperative MWM<sup>16,91,97</sup> and data from other studies suggesting that it can result in significant delay in the time to surgery and/or the likelihood of undergoing bariatric surgery,<sup>14,38,46</sup> MWM and other precertification requirements for bariatric surgery should be carefully examined to avoid promoting low-value care.

### *Strengths and Limitations*

To our knowledge, this is the largest study examining the association between select precertification criteria and healthcare resource utilization after bariatric surgery. Furthermore, the study includes a demographically diverse population and its design allowed for control of several socio-demographic and clinical variables. Nevertheless, this study has also several limitations. First, it is a retrospective study that is limited to bariatric surgeries performed in one state. Payer-mix and demographic factors may vary across the United States, which may limit the generalizability of this study's findings to other areas. In addition, since the data used in this study is derived from discharge and administrative claims records, it is possible that not all relevant diagnoses were captured. Also, some patients might have been rehospitalized in facilities outside of the 5 counties captured by our datasets and their rehospitalization records may have been missed by this study. Finally, in some cases, the precertification requirement for MWM is waived if the BMI is  $\geq 50$  kg/m<sup>2</sup>. Since we did not have patient BMI data, we were not able to identify patients who may have obtained MWM waiver based on their BMI.

## **Conclusions**

The findings of this study suggest that the insurance-mandated 3-6 months MWM requirement, as well as the cardiology and pulmonology evaluations were not associated with a reduction in inpatient healthcare utilization in the first postoperative year in bariatric surgery patients. Policymakers and third-party payers should carefully examine the clinical benefits of these and other precertification requirements for bariatric surgery against the unintended consequences (such as delays in accessing care or surgery dropout) when making decision about the features of bariatric surgery benefit design. Future studies should continue to examine the clinical and economic value of the discussed insurance-mandated requirements in an effort to identify elements that promote low-value care.

## CHAPTER 7

### SUMMARY AND SIGNIFICANCE

The findings of this program of research extend current knowledge regarding the role of health insurance plan features in determining access to bariatric surgery. The three studies examined the temporal changes in the patient characteristics and insurer type mix among bariatric surgery patients in Southeastern Pennsylvania, the associations between payer type, insurance plan type, cost-sharing arrangements (among traditional Medicare beneficiaries), and utilization of bariatric surgery, as well as the impact of specific insurance-mandated precertification requirements for bariatric surgery in regards to being a barrier to care vs potentially resulting in a reduction in short-term postoperative inpatient healthcare utilization.

#### *Improvements in access to bariatric surgery among Black and Hispanic individuals*

Over the five-year period from 2014 to 2018, there was a notable increase in the proportion of Black (37.1% in 2014 vs 43.0% in 2018) and Hispanic individuals (5.4% vs 8.0%, respectively) who underwent bariatric surgery in Southeastern Pennsylvania.<sup>36</sup> This was not accompanied by major changes in the demographic composition of individuals living in the region. The corresponding nationwide trends in bariatric surgery utilization from 2013-2016 were in the same direction, but were much smaller (e.g. 16.0% Black patients in 2013 vs 17.7% in 2016).<sup>10</sup> Markedly, there was an overall growth in the number of surgeries between 2014 and 2018 (2,616 in 2014 vs 2,993 in 2018) in the region, and the increase in rates of obesity among white individuals (29.5% in 2015 vs

31.5% in 2018) was slightly greater between 2015-2018 compared to Black individuals (37.1% in 2015 vs 38.1% in 2018).<sup>68</sup>

The findings of greater access to bariatric surgery among Black and Hispanic individuals is likely the result of Pennsylvania's expansion of its Medicaid program in 2015. Particularly, within the payer mix, there was a considerable increase of Medicaid's share from 18.5% in 2014 to a high of 28.4% in 2017, followed by a slight decrease in 2018 to 26.9%. Likely, the narrowing of racial and ethnic disparities in access to health insurance as a result of the full implementation of the Affordable Care Act resulted in more equitable access to bariatric surgery in our study population. Specifically, if in 2014 the uninsured rates in Pennsylvania for the nonelderly were 8.8% among white, 14.8% among Black, and 19.4% among Hispanic individuals, the corresponding rates in 2018 were 6.0%, 8.1%, and 12.3% respectively.<sup>70</sup>

*Plan type, cost-sharing, and precertification requirements as determinants of utilization*

Our findings support the notion that insurance plan design and cost-sharing arrangements may be as important in determining the access and utilization of bariatric surgery as the general payer type when controlling for potentially confounding socio-demographic factors. First, as demonstrated in Study 1, there were significantly different odds of undergoing bariatric surgery associated with insurance plan type within Medicare and private insurance payer categories. This replicated findings from an earlier study from our group.<sup>13</sup> Specifically, individuals with preferred provider organization (PPO) (Odds Ratio [OR] = 1.21, 95% Confidence Interval [CI] 1.06 to 1.38, P = 0.006) and fee-

for-service (OR = 1.39, 95% CI 1.19 to 1.63,  $P < 0.001$ ) insurance plans within the private insurance category had greater odds of undergoing bariatric surgery as compared with private health maintenance organization HMO plan holders. This could be explained by the fact that PPO and fee-for-service plans are less restrictive in allowing beneficiaries to select a doctor or facility and do not require referral for specialized care by primary care providers.<sup>13</sup> Similarly, among Medicare beneficiaries, those with Medicare Advantage PPO plans had greater odds of undergoing surgery (OR = 2.18, 95% CI 1.51 to 3.16,  $P < 0.001$ ) compared to Medicare Advantage HMO plans. Individuals with traditional Medicare (Parts A & B) fee-for-service plans had smaller odds (OR = 0.78, 95% CI 0.64 to 0.95,  $P = 0.01$ ) of undergoing surgery as compared to beneficiaries of Medicare Advantage HMO plans.<sup>36</sup>

After matching bariatric surgery and comparison patients on several relevant sociodemographic variables, the study detected statistically different odds of undergoing bariatric surgery based on payer type, but only between Medicare beneficiaries (22% smaller odds) compared to those with private insurance. The odds of undergoing surgery were not statistically different between those with Medicaid or other government insurance coverage vs privately insured patients. It is likely that reported disparities in private vs public insurance coverage among bariatric surgery patients and eligible patients who did not undergo surgery are largely influenced by demographic and socioeconomic factors.<sup>11,12,61</sup> For example, Martin and colleagues previously reported that socioeconomic factors such as race, income, and education level, along with insurance type determine access to bariatric surgery, despite medical eligibility.<sup>11</sup>

Second, cost-sharing arrangements among traditional Medicare (Parts A & B) beneficiaries were associated with the odds of undergoing bariatric surgery. Traditional Medicare beneficiaries with no supplementary insurance and those with dual eligibility (eligible for both Medicare and Medicaid) had smaller odds of undergoing surgery (42% and 32%, respectively) as compared to those with private secondary insurance coverage.<sup>36</sup> Bariatric surgery patients covered by traditional Medicare insurance, but without supplementary/secondary insurance, may be responsible for part A (inpatient hospital care) and part B (physician services) deductibles of \$1,484 and \$203, respectively, as well as a 20% coinsurance for physician services.<sup>71</sup> A previous study of commercial health insurance beneficiaries found higher utilization rates among insurance plans with lower cost-sharing (e.g. PPO plans), compared to high-deductible health plans.<sup>37</sup> In that study, a \$1,000 increase in cost-sharing was associated with 5 fewer bariatric surgeries per 100,000 insured individuals.<sup>37</sup> Also, those with dual eligibility are likely to be socioeconomically disadvantaged, as they have to meet certain income and resources criteria to qualify for Medicaid benefits.

Third, as found in Study 2, among privately insured bariatric surgery patients and a matched comparison group of individuals who did not undergo surgery, the requirement of participation in preoperative medical weight management (MWM) program was a barrier to utilization of surgery during the study period. Specifically, the requirement for 3-6 months preoperative supervised WMW was associated with smaller odds of undergoing surgery (OR = 0.459, 95% CI 0.253 to 0.832, P = 0.010).<sup>38</sup> Earlier studies, such as by Love and colleagues (2017), reported that an increase in the preoperative diet

requirement was associated with surgery dropout (OR = 0.880 per month required, 95% CI 0.839 to 0.922,  $P < 0.0001$ ) among patients who underwent initial bariatric surgery evaluation between January 2010 and May 2015.<sup>14</sup> In that study, surgery dropout was operationalized as patients not undergoing surgery at their program by December 2015. Nevertheless, the study was not able to account for patients who might have pursued surgery at another center.

*Precertification requirements and postoperative inpatient care utilization*

In Study 3, the precertification requirement for involvement in preoperative supervised MWM program and the requirement for preoperative cardiology and pulmonology evaluations were not associated with the postoperative length of stay, the number of rehospitalizations, or the total of rehospitalization days in the first postoperative year. An earlier study with a smaller sample size also did not find an association between the preoperative MWM requirement and the median postoperative hospital length of stay or postoperative rate of readmission and reoperation.<sup>53</sup> Thus, it appears that these requirements do not result in a short-time reduction in inpatient healthcare utilization.

As found in Study 3, patients with no requirement for pulmonology and cardiology evaluations had smaller odds of rehospitalizations for common cardiac and pulmonary conditions (OR = 0.43, 95% CI 0.23 to 0.80,  $P = 0.008$ ). This could be explained by the fact that bariatric surgery programs adhering to clinical care pathways (as part of an accreditation requirement by the Metabolic and Bariatric Surgery

Accreditation and Quality Improvement Program)<sup>93</sup> involve select subgroups of patients who would benefit the most from cardiology and pulmonology evaluations as part of their presurgical assessments. Therefore, precertification requirements for cardiology and pulmonology evaluations - imposed on patients based on their payer type and insurance plan rather than the clinical necessity – may not have additional clinical utility.

In summary, Medicaid expansion in Pennsylvania appears to have improved access to bariatric surgery among Black and Hispanic individuals. Nevertheless, insurance plan type, cost-sharing arrangements, and precertification requirements such as insurance-mandated 3-6 months MWM requirement remain key determinants for the access and utilization of bariatric surgery. Additionally, the MWM requirement, as well as the preoperative cardiology and pulmonology evaluations, were not associated with a reduction in inpatient healthcare utilization during the first postoperative year.

### **Implications for Policymakers, Providers, and Patients**

#### *Value-based insurance design for bariatric surgery*

Alternative payment models for healthcare services have received attention from payers and policymakers to contain health care spending and promote high-value services. One promising approach, value-based insurance design (VBID), reflects setting patient costs (e.g., copayments) based on the value of a clinical service.<sup>98</sup> VBID aligns cost sharing and clinical value by moving high-value services and medications into lower-priced tiers, adjusting cost-sharing based on patient characteristics, and incentivizing patients to seek high-performing providers.<sup>72,73</sup> VBID recognizes that: a)

not all medical services produce the same amount of health; and b) the clinical benefits of medical services vary based on who is receiving it, who is providing the service, and the setting where the service is provided.<sup>98,99</sup> To date, VBID has been applied mostly to low-cost preventive tests and chronic care medications.<sup>73</sup> The results have been favorable in promoting the use of targeted services and adherence to medications for chronic conditions.<sup>73,100,101</sup> The impact on cost savings is less clear. To observe major cost savings and stronger clinical impact, VBID should be extended to expensive services, such as major surgical procedures, which are of higher financial stakes than those traditionally targeted by VBID initiatives.<sup>102</sup>

Some employers have already incorporated bariatric surgery into their self-administered benefit plans via utilizing VBID. For example, MGM Resorts International, a global hospitality and entertainment company, introduced it for employees and dependents in 2010.<sup>103</sup> The plan offered coverage for bariatric surgery at a designated center of excellence, a medically supervised weight loss program prior to surgery, and reversal procedures in case of medical necessity (which is rare). As a cost-sharing adjustment, the company offered the following: At two years, if a planned weight reduction goal is achieved, reimbursement of \$5,000 out-of-pocket copayment; and at four years, \$5,000 incentive that could be used to pay for excess skin removal cosmetic procedures. Early results of the program indicated positive clinical outcomes (via reduction in comorbidities) and return on investment (via reduced direct claims costs, indirect costs, and prescription drug costs).<sup>103</sup> Interestingly, the company decided to introduce the program since they believed it was “the right thing to do.”<sup>103</sup> A business

case for providing bariatric surgery coverage for employees could be further argued, since an association has been shown between bariatric surgery and a decrease in lost workdays.<sup>104</sup> Furthermore, patients undergoing bariatric surgery have decreased or stable healthcare costs in the long run, improvements in overall quality of life, as well as substantially lower all-cause mortality rates and longer life expectancy, compared with patients receiving conventional obesity treatment.<sup>9,105,106</sup>

VBID could be applied to bariatric surgery because the postoperative clinical outcomes and costs vary among the different sub-groups of bariatric surgery eligible patients. There is substantial evidence of the cost-effectiveness of bariatric surgery for adults with severe obesity who also have diabetes compared with usual medical care or intensive lifestyle interventions.<sup>3,29-32</sup> Payers would achieve higher return on investment if the utilization of bariatric surgery increases among these sub-groups of bariatric surgery eligible patients ( $BMI \geq 40 \text{ kg/m}^2$  and T2D); such result could be achieved via optimal health insurance benefit design.<sup>32,107</sup> The findings of this program of research further suggest that cost-sharing should not be used indiscriminately as a barrier to care. Instead, patient out-of-pocket costs should be based on the clinical value of a specific bariatric procedure.

The setting where medical services are provided also needs to be considered when determining the value of bariatric surgery. This issue becomes particularly important for insurers, hospital administrators, and policymakers as they consider readmission rates as a metrics for quality bariatric surgery.<sup>108</sup> For example, the use of a Centers of Excellence model for bariatric surgery has been indicated as a strategy to address low-value care<sup>109</sup>

and has been incorporated into VBID for bariatric surgery coverage by self-insured employers.<sup>110</sup>

Before 2012, 2 agencies provided accreditation for bariatric surgery centers in the United States, the American Society for Metabolic and Bariatric Surgery and the American College of Surgeons. From 2012 to 2014, the 2 organizations combined to create 1 accrediting body, the Metabolic and Bariatric Surgery Accreditation Program.<sup>111</sup> Accreditation from this program is required by most private payers and is based on established quality standards. These standards include comprehensive preoperative assessment, continuous quality metrics reporting, adequate bariatric specific resources and equipment, required team trainings, and continuous quality improvement.

*Careful selection of insurance-mandated precertification requirements*

The findings of this research suggest that the insurance-mandated 3-6 months MWM requirement is a barrier to bariatric surgery. Furthermore, the MWM requirement, as well as the cardiology and pulmonology evaluations, were not associated with a reduction in inpatient healthcare utilization in the first postoperative year in bariatric surgery patients. An earlier study with a smaller sample size also did not find an association between the preoperative MWM requirement and the median postoperative hospital length of stay or postoperative rate of readmission and reoperation.<sup>53</sup> Similarly, Tewksbury and colleagues recently reported that preoperative weight loss is not linked to 30-day overall readmission, reoperation, or mortality.<sup>18</sup>

Policymakers and third-party payers should pay close attention to whether insurance-mandated precertification criteria are evidence-based and designed to positively impact patient outcomes and deliver high-value care. In addition, they should consider the unintended consequences (such as delays in accessing care) when making decision about the features of bariatric surgery benefit design.

### *Reorganizing care around the patient*

The COVID-19 pandemic has made presenting for in-person medical care even more challenging, particularly for individuals from underserved communities. In response, many bariatric programs pivoted to increased utilization of telemedicine appointments to complete preoperative assessments and postoperative follow-up visits. Previous barriers to telemedicine (such as lower reimbursement rates or a requirement for the origination site to be a medical facility) were temporarily removed by public and private payers and bariatric surgery programs anecdotally reported a profound decrease in cancellations and no shows for appointments.<sup>74,75</sup> Continued use of telemedicine as part of bariatric surgery care beyond the pandemic could help to reorganize care around the patient and address some of the barriers to care due to insurance benefits design.<sup>74</sup>

### **Future Research**

This program of research lays a foundation for future investigations into the reasons for underutilization of bariatric surgery in the United States and the specific role of health insurance benefit design in determining access to care more broadly. A recent survey of bariatric surgery policies found that during 2017–2018 some major health

insurers removed the requirement for supervised MWM and placed more emphasis on multidisciplinary education sessions and nutritional counseling prior to surgery.<sup>82</sup> This presents an opportunity for further research to determine whether the modification or discontinuation of this longstanding health insurance practice will contribute to enhanced access to needed health services among the beneficiaries of these plans.

While the current program of research extends our understanding on whether there is an association between specific, insurance-mandated precertification criteria for bariatric surgery and short-term inpatient healthcare services, future studies should continue to examine the clinical and economic value of the discussed insurance-mandated requirements in an effort to identify elements that promote low-value care.

In-response to the COVID-19 pandemic and prompted by the temporary removal of barriers to telemedicine by third-party payers, many bariatric programs pivoted to increased utilization of telemedicine appointments to complete preoperative assessments and postoperative follow-up visits. This presents an opportunity for further research to determine whether the transition from in-person to remote preoperative visits could improve the access to bariatric surgery (e.g. by reducing the surgery dropout among patients undergoing bariatric surgery evaluation) and patient-centered outcomes for certain patients, as well as whether there are disparities in those outcomes based on socio-economic determinants.

The three studies were not designed to investigate the role of other factors that are likely barriers to bariatric surgery utilization, such as patient-physician communication,

patient and physician views and attitudes, as well as stigma related to the surgery. Nevertheless, further understanding of the impact of those barriers and the development of mitigation strategies is imperative. Finally, the methodological approaches employed in this work could be further applied to studies of other high-cost essential health services, e.g. solid organ transplantation, as well as neuromodulation therapies such as spinal cord stimulation for the treatment of chronic pain syndromes, in pursuit of identifying barriers to care.

The findings of this program of research are expected to have major policy implications for improving access to care, as well as patient outcomes and experience of care. Particularly, they are envisaged to help advocacy groups, policy-makers, and third-party payers to identify and remove insurance-design related barriers that have no evidence of clinical benefit, providing access to thousands of Americans to potentially life-saving surgery, thereby improving health outcomes without inflating costs.

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## APPENDICES

### APPENDIX A. PROCEDURE AND DIAGNOSTIC CODES USED FOR IDENTIFICATION OF BARIATRIC SURGERY AND COMPARISON PATIENTS (STUDY 1)

Procedure or diagnosis code	ICD-9	ICD-10	HCPCS CPT-4
<b>Inclusion criteria for both surgery and comparison patients</b>			
Diagnosis code for morbid (severe) obesity	278.01	E66.01	
<b>Inclusion criteria for the surgery patients</b>			
Underwent common types of bariatric surgery (open/laparoscopic gastric bypass and open/laparoscopic sleeve gastrectomy)	44.39, 44.38, 43.89, 43.82	0D164ZA, 0D160ZA, 0DB64Z3, 0DB60Z3	
<b>Exclusion criteria for the surgery patients</b>			
Diagnosis code for non-infective enteritis and colitis	555–558	K50 - K52	
Diagnosis code for neoplasms of digestive organs	150–159	C15 - C26	
<b>Exclusion criteria for comparison patients</b>			
Underwent bariatric procedures during 2015-2016	43.82, 44.38, 44.68, 44.95, 44.96, 44.97, 44.98	0D160ZA, 0D160ZB, 0D164ZA, 0D164ZB, 0DB60Z3, 0DB60ZZ, 0DB64Z3, 0DV64CZ, 0DV63CZ, 0D164Z9, 0DB64ZZ	43644, 43645, 43770 - 43775, 43842, 43843, 43845 - 43848, 43886 - 43888
Heart failure	428	I50	
Chronic ischemic heart disease	414	I25	
Malignant neoplasms of lip, oral cavity, and pharynx; digestive organs; respiratory and intrathoracic organs; bone and articular cartilage; mesothelial and soft tissue; breast; female genital organs; male genital organs; urinary tract; eye, brain and other parts of central nervous system; thyroid and other endocrine glands; Melanoma and other malignant neoplasms of skin; Malignant neoplasms of ill-defined, other secondary and unspecified sites; Malignant neuroendocrine tumors; Secondary neuroendocrine tumors	140-165, 170-176, 179-199, 209	C00-C26, C30-C41, C43-C58, C60-C80, C7A, C7B	
Portal hypertension	572.3	K76.6	
Crohn's disease	555	K50	
Mental and behavioral disorders due to psychoactive substance use	303-305	F10-F19	
Intellectual disabilities	317-319	F70 - F79	

Note. ICD-9 International Classification of Disease, ninth revision; ICD-10 International Classification of Disease, tenth revision; HCPCS CPT-4 Healthcare Common procedure Coding System Level I Current Procedural Terminology. ICD-9 codes were applied to discharge records from 2014-2015 and ICD-10 codes were applied to records from 2015-2018.

**APPENDIX B. PROCEDURE AND DIAGNOSTIC CODES USED FOR IDENTIFICATION OF  
BARIATRIC SURGERY AND COMPARISON GROUPS (STUDY 2)**

<b>Procedure or diagnosis code</b>	<b>ICD-9*</b>	<b>ICD-10</b>	<b>HCPCS CPT-4</b>
<b><i>Inclusion criteria for both surgery and comparison groups</i></b>			
Diagnosis code for morbid (severe) obesity		E66.01	
<b><i>Inclusion criteria for the surgery group</i></b>			
Underwent common types of bariatric surgery	44.39, 44.38, 43.89, 43.82	0D164ZA, 0D160ZA, 0DB64Z3, 0DB60Z3	
<b><i>Exclusion criteria for the surgery group</i></b>			
Diagnosis code for non-infective enteritis and colitis		K50 - K52	
Diagnosis code for abdominal neoplasms		C15 - C26	
<b><i>Exclusion criteria for comparison group</i></b>			
Underwent bariatric procedures during 2015-2016	43.82, 44.38, 44.68, 44.95, 44.96, 44.97, 44.98	0D160ZA, 0D160ZB, 0D164ZA, 0D164ZB, 0DB60Z3, 0DB60ZZ, 0DB64Z3, 0DV64CZ, 0DV63CZ, 0D164Z9, 0DB64ZZ	43644, 43645, 43770 - 43775, 43842, 43843, 43845 - 43848, 43886 - 43888
Heart failure		I50	
Chronic ischemic heart disease		I25	
Malignant neoplasms of lip, oral cavity, and pharynx; digestive organs; respiratory and intrathoracic organs; bone and articular cartilage; mesothelial and soft tissue; breast; female genital organs; male genital organs; urinary tract; eye, brain and other parts of central nervous system; thyroid and other endocrine glands Melanoma and other malignant neoplasms of skin		C00-C14, C15-C26, C30-C39, C40-C41, C45-C49, C50, C51- C58, C60-C63, C64-C68, C69-C72, C73-C75	
Malignant neoplasms of ill-defined, other secondary and unspecified sites		C43-C44	
Malignant neuroendocrine tumors Secondary neuroendocrine tumors		C76-C80  C7A C7B	
Portal hypertension		K76.6	
Crohn's disease		K50	
Mental and behavioral disorders due to psychoactive substance use		F10-F19	
Intellectual disabilities		F70 - F79	

Note. \*ICD-9 codes apply only to the 2015 inpatient database and were used to identify and remove patients who received bariatric surgery from the comparison group.

**APPENDIX C. PROCEDURE AND DIAGNOSTIC CODES USED FOR IDENTIFICATION OF BARIATRIC SURGERY PATIENTS AND REHOSPITALIZATIONS FOR COMMON CARDIAC OR PULMONARY CONDITIONS (STUDY 3)**

<b>Procedure or diagnosis</b>	<b>ICD-10 code/range</b>
<b><i>Inclusion criteria for identification of bariatric surgery patients</i></b>	
Diagnosis code for morbid (severe) obesity	E66.01
Underwent common types of bariatric surgery (open/laparoscopic gastric bypass and open/laparoscopic sleeve gastrectomy)	0D164ZA, 0D160ZA, 0DB64Z3, 0DB60Z3
<b><i>Exclusion criteria for identification of bariatric surgery patients</i></b>	
Diagnosis code for non-infective enteritis and colitis	K50 - K52
Diagnosis code for neoplasms of digestive organs	C15 - C26
<b><i>Tracking rehospitalization with an admitting or principal diagnosis* for cardiac or pulmonary conditions</i></b>	
Transient cerebral ischemic attacks and related syndromes	G45
Hypertensive diseases	I10 - I16
Ischemic heart diseases	I20 - I25
Pulmonary heart disease and diseases of pulmonary circulation	I26 - I28
Other forms of heart disease	I30 - I52
Cerebrovascular diseases	I60 - I69
Diseases of arteries, arterioles and capillaries	I70 - I79
Diseases of veins, lymphatic vessels and lymph nodes, not elsewhere classified	I80 - I89
Other and unspecified disorders of the circulatory system	I95 - I99
Systemic connective tissue disorders	M30 - M36
Acute upper respiratory infections	J00 - J06
Influenza and pneumonia	J09 - J18
Other acute lower respiratory infections	J20 - J22
Other diseases of upper respiratory tract	J30 - J39
Chronic lower respiratory diseases	J40 - J47
Intraoperative and postprocedural complications and disorders of respiratory system, not elsewhere classified	J95 - J95
Other diseases of the respiratory system	J96 - J99

Note. \*Admitting Diagnosis is the international classification of disease, tenth revision, clinical modification (ICD-10.CM) diagnosis code used to indicate the reason for admission as supplied by the facility. This may differ from the principal diagnosis code that is assigned at discharge.