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## Prophylactic Antibiotic Use in Plastic Surgery Outpatient Cases

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Abstract:	<p>The appropriate use of prophylactic antibiotics, which accounts for millions of dollars spent in the health care system<sup>1</sup>, has been identified as a quality of care measurement by the Affordable Health Care Act<sup>2</sup>. Although widely investigated in orthopedic and general surgeries, usage parameters have not been reported in the plastic surgery literature, specifically for clean and clean contaminated outpatient surgical procedures<sup>3</sup>. This study utilizes data from a retrospective analysis of four hundred and seventy cases over a four year period in a major university outpatient setting to examine the time of preoperative antibiotic administration, whether or not postoperative antibiotics were prescribed, and if there was any correlation between this data and complications. The Center for Disease Control and Prevention suggests that patients receive preoperative antibiotics one hour prior to surgery. The Surgical Care Improvement Project (SCIP) recently found that prophylactic antibiotic administration within 60 minutes had a lower rate of complications, and those that received prophylactic antibiotics within 30 minutes prior to incision had the lowest risk.<sup>4</sup> Results from this study found that 100% of patients received preoperative antibiotics but only 19.87% received them one hour or more prior to the initial incision. 46.37% of patients received the antibiotics 15 to 44 minutes prior to surgery. Sixty-eight percent of patients received postoperative prophylactic antibiotics. When compared to the 32% who did not, there were no significant differences in complication rates. There were also no co-morbidities that were associated with a complication after surgery. Our data is consistent with previous recommendations suggesting that is no need to prescribe antibiotics postoperatively. This has the potential to save millions of dollars yearly on antibiotics and can potentially reduce the instances of antibiotic resistant bacteria.</p>

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## ABSTRACT

The appropriate use of prophylactic antibiotics, which accounts for millions of dollars spent in the health care system<sup>1</sup>, has been identified as a quality of care measurement by the Affordable Health Care Act<sup>2</sup>. Although widely investigated in orthopedic and general surgeries, usage parameters have not been reported in the plastic surgery literature, specifically for clean and clean contaminated outpatient surgical procedures<sup>3</sup>. This study utilizes data from a retrospective analysis of four hundred and seventy cases over a four year period in a major university outpatient setting to examine the time of preoperative antibiotic administration, whether or not postoperative antibiotics were prescribed, and if there was any correlation between this data and complications. The Center for Disease Control and Prevention suggests that patients receive preoperative antibiotics one hour prior to surgery. The Surgical Care Improvement Project (SCIP) recently found that prophylactic antibiotic administration within 60 minutes had a lower rate of complications, and those that received prophylactic antibiotics within 30 minutes prior to incision had the lowest risk.<sup>4</sup> Results from this study found that 100% of patients received preoperative antibiotics but only 19.87% received them one hour or more prior to the initial incision. 46.37% of patients received the antibiotics 15 to 44 minutes prior to surgery. Sixty-eight percent of patients received postoperative prophylactic antibiotics. When compared to the 32% who did not, there were no significant differences in complication rates. There were also no co-morbidities that were associated with a complication after surgery. Our data is consistent with previous recommendations suggesting that is no need to prescribe antibiotics postoperatively. This has the potential to save millions of dollars yearly on antibiotics and can potentially reduce the instances of antibiotic resistant bacteria.

## INTRODUCTION

The use of prophylactic antibiotics in plastic surgery has not been clearly defined in the current literature<sup>3</sup>. New changes in Medicare and Medicaid, especially within the new Affordable Care Act, will apply a greater weight to quality of care practices. Medicare's Physician Quality Reporting Initiative will become mandatory for physicians and includes prophylactic antibiotics as an area of reporting.<sup>5</sup> In 2015,

the importance of prophylactic antibiotics will increase after Medicare's Physician Quality Reporting Initiative program will apply a payment adjustment to physicians who do not report data or quality measures.<sup>6</sup>

Past studies have examined the importance of both preoperative prophylactic antibiotics and postoperative antibiotics. Many of these studies have been conducted in orthopedic or general surgery settings, with very few focusing on plastic surgery cases or outpatient surgeries. The goal of prophylactic antibiotics is to prevent surgical site infections (SSI). The Center for Disease Control and Prevention (CDC) defines an SSI as an infection occurring up to thirty days after surgery (one year for patients receiving implants) affecting either the incision or deep tissue at the operational site.<sup>7</sup> Despite the increased use of prophylactic antibiotics and greater understanding of infections, postoperative wound infection rates have remained nearly the same for the past four decades.<sup>8</sup>

This retrospective review examines the time of administration of preoperative antibiotics and compares complication rates in patients receiving postoperative antibiotics to those who did not in an outpatient cohort of plastic surgery patients. The use of preoperative antibiotics is to "reduce intraoperative contamination to levels where it does not overwhelm the patient's defenses".<sup>7</sup> Due to this, there has been some controversy over the best time to administer the prophylaxis. The CDC recommends administering antibiotics between 120 (for vancomycin) and 60 minutes (all others) prior to the incision.<sup>9</sup> The Surgical Care Improvement Project recently found that administering prophylactics within 30 minutes prior to incision resulted in the fewest amounts of infection.<sup>4</sup> However, other authors have put forward that there are lower rates of infection when the prophylactic is administered closer to the initial incision.<sup>9</sup> Some even question whether or not the administration of prophylactic is need in plastic surgery cases since most are deemed clean or clean-contaminated cases. Some authors found there was no difference in infection rates between those who received prophylactics and those whom did not.<sup>3,10</sup> Current literature provides different recommendations on what approach plastic surgeons should consider. This study hopes to add information to guide plastic surgeons when administering prophylactic antibiotics.

## METHODS

A retrospective chart review was undertaken subsequent to approval by the institutional review board at **INSTITUTION REDACTED**. The study population consisted of a subset of 1801 unique plastic surgery encounters encompassing a series of complex reconstructive and body-contouring procedures as determined by CPT codes. Members of the **INSTITUTION REDACTED** Plastic Surgery Department saw patients from January 2008 to January 2012 (Table 1). The cohort involved nineteen faculty surgeons who performed operations at facilities associated with **MULTIPLE INSTITUTIONS REDACTED**. The patients who had surgery at the Outpatient Surgery Center, a part of **INSTITUTION REDACTED**, were identified and used in this study to review use of preoperative prophylactic antibiotics, the type of antibiotic, the time administered, the duration of use, any postoperative prophylactic antibiotics given, the type of antibiotic, the duration, and if any complications were noted during a thirty day follow up period. Topical antibiotics and antibiotic irrigation solutions used were not recorded for this particular study. A wound complication was defined as a wound problem, an infection, additional antibiotics prescribed by the physician, necrosis, hematoma, seroma, dehiscence, erythema, pathogen identified, and delayed wound healing. If a patient was positive for any of these, the patient was defined as having a complication. Patients who did not have sufficient follow up data (<30 days) were omitted. There were a total of 468 patients identified using this criteria for this study.

Preoperative information collection included body mass index, sex, ethnicity, age, co-morbidities, the number of past procedures, the procedures performed for the recorded surgery, an American Society of Anesthesiologists (ASA) score, Caprini score, blood pressure, body temperature, and any preoperative antibiotics or medications the patient was currently on. Intra-operative reports included information on barbed sutures, blood pressure, body temperature, the type of implant used, surgical and anesthesia durations. Postoperative notes included the duration of the hospital stay, blood pressure, body temperature, drains, the duration

of the drains, and postoperative prophylactic antibiotics given. The clinical follow up notes included any complications that may have arisen, specifically a flap complication or a wound complication.

The patients were grouped by the administration of preoperative prophylactic antibiotics. This was broken down by the time of administration and the time of the first incision. The co-morbidities discussed are defined as: diabetes, smoker-former, smoker-current, hypertension, coronary artery disease (CAD), other cardiovascular problems, chronic obstructive pulmonary disease (COPD), other pulmonary problems, renal diseases, cancer, and a history of deep vein thrombosis/pulmonary embolisms (DVT/PE). The patients were also grouped by whether or not they received post-operative prophylactic antibiotics. The group that did not receive these antibiotics were further investigated to see if there was a significant increase in complication rates.

## RESULTS

All of the patients selected were administered prophylactic antibiotics. Most of the patients received these prophylactic antibiotics between 29 and 15 minutes prior to surgery or 14 to 0 minutes prior to surgery (Fig. 1). 46.37% of patients received prophylactic antibiotics between 44 and 15 minutes prior to surgery. The preoperative antibiotics administered included, cephazolin (384 patients), Clindamycin (4 patients), Levofloxacin (6 patients), Vancomycin (18 patients), and no name provided (56 patients).

The number of patients who had any complication were identified and grouped based on when he or she received the prophylactic antibiotics. (Figure 2) The highest rates of complications occurred in patients receiving antibiotics between 44-30 minutes prior to the first incision, with twenty-four incidences of wound problems, representing 28.92% of the total complications. Patients receiving antibiotics 29-15 minutes of administration prior to surgery had the second highest rate of complication with fifteen cases, which was 18.07% of the total cases.

An odds ratio test was performed to compare the number of complications within each time period (Fig 3). Initially there was no trend found within the p-values so each p-value was compared to the others. None had a significant value except when comparing 44-30 and 29-15 which had a p-value=.001. Upon finding this information, two groups were created. Group 1 included all of the patients from >120-30 min and group 2 had 29-0+. When these values were compared, a significant difference was found with a p-value=.003. This indicates that there is a significant decrease in infections with administration of prophylactics within 29-0 minutes of the first incision.

The number of patients having co-morbidities was assessed (Fig 4). Cancer was the highest co-morbidity found in this cohort with 110 incidences, 23.71% of total co-morbidities, followed by hypertension, which occurred in 99 patients, 21.34% of total patients with co-morbidities.

The rates of complications in the entire surgical population can be seen in Figure 5. A wound complication was the most common complication occurring within the population affecting 16%.

None of the co-morbidities outlined had a significant impact on whether or not a complication would occur (Figure 6). The odds ratio fell inside the 95% confidence interval for each co-morbidity, showing they had no significance.

The type of surgery for complications were also noted and can be seen in Figure 7.

Of the eighty-three patients who experienced a complication, fifty-one or 61.45% received post-operative prophylactic antibiotics (Fig 8). The odds ratio was found to be OR=0.73. The 95% Lower Limit Confidence Interval=0.238, while the 95% Upper Limit Confidence Interval=1.221.

Sixty-eight percent of patients received post-operative prophylactic antibiotics. The patients who did not receive antibiotics were further investigated to see if the lack of antibiotics had a significant impact on complications (Fig 9). The odds ratios indicate that not administering post-operative prophylactic antibiotics has no significant effect on complications.

## DISCUSSION

The CDC recommends administering prophylactic antibiotics one hour prior to the first incision.<sup>1</sup> However, SCIP found that patients receiving antibiotics thirty minutes prior to the first incision had the lowest overall rates of infection.<sup>4</sup>

This retrospective review examines the time of administration of preoperative antibiotics and compares complication rates in patients receiving postoperative antibiotics to those who did not in an outpatient cohort of plastic surgery patients. The use of preoperative antibiotics is to “reduce intraoperative contamination to levels where it does not overwhelm the patient’s defenses”.<sup>7</sup> Despite this transparent definition, controversy still exists in plastic surgery as to the best time to administer the prophylaxis. The CDC recommends administering antibiotics between 120 (for vancomycin) and 60 minutes (all others) prior to the incision.<sup>9</sup> Dellinger found that there was no statistical difference between administering the antibiotic between 60-30 minutes and 30-0 minutes prior to the incision, however administering the prophylaxis less than 30 minutes prior had a slightly smaller infection rate when looking at hip replacement surgeries.<sup>9</sup> Weber et al. found that prophylactic antibiotics are most effective when administered between 59-30 minutes prior to the incision, specifically when administered between 59-45 minutes prior.<sup>11</sup> The Surgical Care Improvement Project (SCIP) recently found that patients receiving antibiotic prophylaxis within two hours before incision had a much lower surgical site infection rate than those receiving prophylactic antibiotics more than three hours after the surgical incision and those receiving antibiotics more than two hours before the incision. SCIP also noted a recent study showed that administration within 60 minutes had a lower rate of complications but those that received prophylactic antibiotics within 30 minutes prior to incision had the lowest risk.<sup>4</sup>

A question also remains over if prophylaxis should be used at all in plastic surgery since most cases are considered clean or clean-contaminated cases. Perrotti et al. found that antibiotic administration among aesthetic surgeons is widespread, however there is little scientific evidence to support this use.<sup>11</sup> Baran et al. found

that over the course of six years, there was no difference between patients receiving an antibiotic and those receiving a placebo in wound infection rates.<sup>3</sup> Another study found the use of antimicrobial prophylaxis had no effect on SSI's in plastic surgeries of the breast, head and neck, or hand and upper extremities cases.<sup>13</sup> Platt et al. found that perioperative antibiotics do reduce the wound infection rates significantly when compared to a placebo.<sup>14</sup> And Mirzabeigi et al. found that the lowest rates of infection occurred in breast augmentation cases where the patient only received preoperative prophylactic antibiotics.<sup>10</sup> The literature provides different takes on what approach plastic surgeons should abide by. The literature becomes even more complicated when factors such as foreign material, lengthy operations, and extensive procedures are considered.<sup>11</sup> Since the literature is lacking in aesthetic surgery cases, most defer to other specialties' clean/clean-contaminated cases and suggest a dose of prophylactic preoperative antibiotics that is discontinued within 24 hours of the first incision.<sup>15</sup>

In this study, 17.97% of patients who received antibiotics 44-15 min prior to surgery experienced complications. Yet 46.37% of total patients received prophylactic antibiotics during this time period. This time period accounts for 46.99% of all complications that were recorded. This can be compared to the 93 patients, 19.87% of the cohort, who received antibiotics within the CDC guideline of over 60 minutes prior to incision. Of which, only 16 or 19.28% had complications. This supports the Surgical Care Improvement Project (SCIP) recent findings that patients receiving antibiotic prophylaxis within two hours before incision had a much lower surgical site infection rate than those receiving prophylactic antibiotics more than three hours after the surgical incision and those receiving antibiotics more than two hours before the incision. They also noted how a recent study showed that administration within 60 minutes had a lower rate of complications but those that received prophylactic antibiotics within 30 minutes prior to incision had the lowest risk.

Since there were only significant differences between two time intervals, it is hard to determine if there was any impact on the trend between the time of administration and complication rates. However, looking at a larger time scale, there



was found to be a significant difference between those receiving antibiotics more than 30 minutes prior to surgery and those receiving them 29 minutes and less. This data seems to indicate that patients will have fewer complications if antibiotics are given closer to the initial incision. This supports some of the previous work of Dellinger and other literature. This also seems to support the SCIP's most recent findings.

For 15.38% of patients the administration time of the preoperative prophylactic antibiotics was not recorded. It was merely noted that a prophylactic was administered. This is an issue that will need to be addressed in order to comply with the upcoming Affordable Care Act guidelines.

The 32% of patients who did not receive postoperative prophylactic antibiotics had no significant increase in complications. Eighty-three patients experienced complications after the surgery. The majority of these patients, 68%, did receive postoperative prophylactic antibiotics. The Confidence Interval calculated, 0.238-1.221 includes 1 we can infer that there is no significant difference in complication rates of those who receive antibiotics versus those who do not. This is consistent with the findings of Perrotti et al. that in ten types of aesthetic surgery that were examined, postoperative antibiotics were given in over 50% of cases. The reasoning behind prescribing the postoperative prophylaxis was unclear and unsupported however.<sup>12</sup>

However, there are some trends that seem to indicate exposure to antibiotics does help lower the complication rates but not in a statistically significant manner. This data was found to reduce complication risks in the categories of wound hematoma, erythema, dehiscence, and wound problems. Our retrospective review is consistent with other data published.<sup>9,10,12</sup> There is no need to administer postoperative prophylactic antibiotics if preoperative antibiotics were given. This will not only decrease the economic burden but will help reduce the amount of antibiotic resistant bacterial strains found currently in the health care system.

There are limitations to this study. This study relied solely on physician reporting. There are some variances in how physicians classify certain wounds. There also were some problems with not reporting the correct time that antibiotics

were administered. These challenges could be overcome by a well-designed prospective study.

## CONCLUSION

This study examines the use of prophylactic antibiotics in outpatient plastic surgery procedures. Administration of prophylactic antibiotics between 29-0 minutes prior to the first incision was found to have the smallest rate of complications. Antibiotics continued in the postoperative period were not found to be beneficial in decreasing morbidity and carry with them their own adherent risk. Further prospective studies should be considered in plastic surgery patients to help clarify their use particularly in implant and drain cohorts.

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\* The third author is an investigator for Allergan, Erchonia, and Ultrashape, and is on the Advisory Board of Kythera

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## Figures

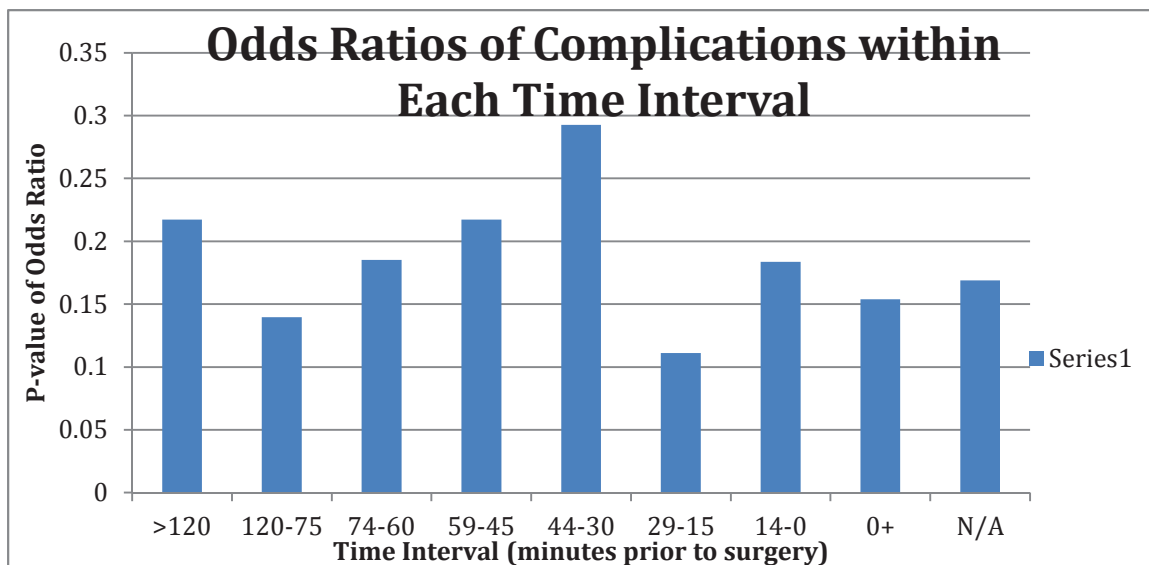
**Figure 1. Preoperative Prophylactic Antibiotic Administration Times**

While 100% of patients received preoperative prophylactics, only 19.87% fell within the CDC's guidelines of more than one hour prior to surgery. 46.37% of patients received antibiotics between 44-15 minutes prior to the first incision.

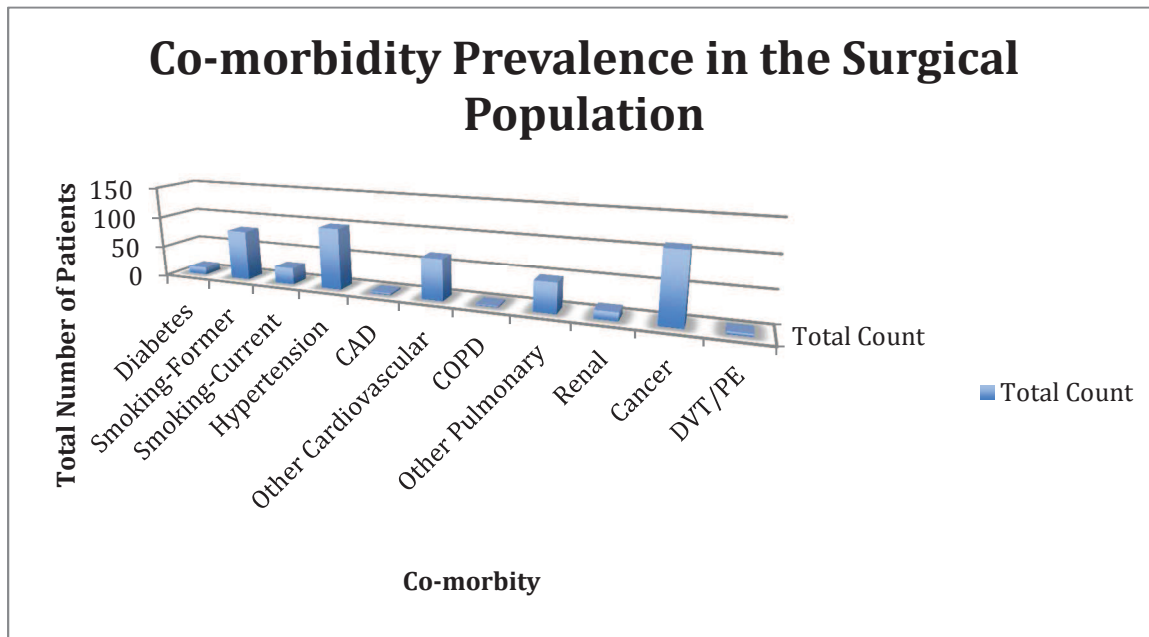
	Time	Intervals	(minutes)						
<b>Gender</b>	Less than 120	120-75	74-60	59-45	44-30	29-15	14-0	Greater than 0	Not available
Female	21	37	25	22	80	129	43	12	63
Female %	4.85	8.55	5.77	5.08	18.48	29.79	9.93	2.77	14.54
Male	2	6	2	1	2	6	6	1	9
Male %	5.71	17.14	5.71	2.86	5.71	17.41	17.41	2.86	25.71
Total %	4.91	9.19	5.77	4.91	17.52	28.85	10.47	2.78	15.38

**Figure 2. Complication Rates and Preoperative Antibiotic Administration Times (minutes).** The highest rates of complications occurred between 44-30 minutes prior to the first incision. Between 29-15 minutes had the second highest rates of complications

	<b>Less than 120</b>	<b>120-75</b>	<b>74-60</b>	<b>59-45</b>	<b>44-30</b>	<b>29-15</b>	<b>14-0</b>	<b>Greater than 0</b>	<b>N/A</b>
<b>Female</b>	4	5	5	4	24	14	7	2	11
<b>Female %</b>	5.26	6.58	6.58	5.26	31.58	18.42	9.21	2.63	14.47
<b>Male</b>	1	1	0	1	0	1	2	0	1
<b>Male %</b>	14.29	14.29	0	14.29	0	14.29	28.57	0	14.29
<b>Total</b>	5	6	5	5	24	15	9	2	12
<b>Total %</b>	6.02	7.23	6.02	6.02	28.92	18.07	10.84	2.41	14.58



**Figure 3. Odds Ratios of Complications within Each Time Interval.** Initially there was no trend found within the p-values so each p-value was compared to the others. None had a significant value except when comparing 44-30 and 29-15 which had a p-value=.001. Upon finding this information, two groups were created. Group 1 was included all of the patients from >120-30 min and group 2 had 29-0+. When these values were compared, a significant difference was found with a p-value=.003.



**Figure 4. Co-morbidity Prevalence in the Surgical Population.** Cancer was the most prevalent co-morbidity in the cohort with 110 incidences. Hypertension followed with 99 incidences. Patients were counted separately for each co-morbidity.



Complications	Yes	Number of Patients	No	Number of Patients
	%		%	
VTE	0.43	2	99.67	466
Wound Problem	16	73	84	395
Wound Infection	3.8	18	96	450
Wound Dehiscence	3.2	15	97	453
Wound Erythema	6.8	32	93	436
Wound Necrosis	1.5	7	99	461
Wound Seroma	4.7	22	95	446
Wound Hematoma	1.1	5	99	463
Wound Delayed Healing	1.5	7	99	461

**Figure 5. Complication Rates Among the Surgical Patient Population.** A wound problem was the most recorded complication, affecting 16% of the cohort. Each complication was recorded separately.

Co-morbidity	Odds Ratio	95% Lower Conf Limit	95% Upper Conf Limit
Diabetes	1.0845	0.1132	5.2465
Smoking-Current	0.9644	0.3210	2.0643
Smoking-Former	1.1585	0.5149	1.8021
Hypertension	1.6413	0.8836	2.9631
CAD	11.0986	0.5660	656.3572
Other Cardiovascular	0.9609	0.4147	2.0326
COPD	5.4722	0.0688	430.5985
Other Pulmonary	0.7732	0.2581	1.9332
Renal	0.4433	0.0102	3.0876
Cancer	0.5962	0.2805	1.1782
DVT/PE	1.8148	0.0341	22.9275

**Figure 6. Co-morbidity Effect on Patient Complication Rates.** No co-morbidity had a significant impact on whether or not a complication would occur. Every odds ratio fell within the 95% confidence limit, making the co-morbidities insignificant individually.

	Delayed Breast Prosthesis	Suction Assisted Lipectomy	Excise Excessive Skin Tissue	Breast Reconstruction	Exc Skin ABD	Muscle Skin Graft, Trunk	Removal of Skin Wrinkles	Muscle Skin Graft, Arm
Number of Total Patients	94	173	75	17	84	2	24	1
Number of Patients with Complications	5	24	26	5	17	1	5	0
Percentage of Patients Experiencing a Complication	5.32%	13.87%	34.67%	29.41%	20.24%	50%	20.83%	0%

**Figure 7. Type of Surgery Performed and Complication Rates.** Of the 83 patients experiencing complications, 51 or 61.45% received postoperative prophylactic antibiotics. After eliminating skin grafting complications (n of 2) the highest group with complications was excisional body contouring with a complication rate of 34.67%.

		Complication?	
		Y	N
Post op antibiotics?	Y	51	264
	N	32	121

**Figure 8. The Rates of Complications with Regards to Administration of Postoperative Prophylactic Antibiotics.** The odds ratio was found to be  $OR=0.73$ . The 95% Lower Limit Confidence Interval= $0.238$ , while the 95% Upper Limit Confidence Interval= $1.221$ . Since the Confidence Interval includes 1 we can infer that there is no significant difference in complication rates of those who receive antibiotics versus those who do not.

Complication	Odds Ratio	95% Lower Conf Interval	95% Upper Conf Interval
VTE	0.9937	0.9849	1.0025
Wound Problem	1.1860	0.6721	2.0569
Wound Infection	0.7956	0.2180	2.4357
Wound Dehiscence	1.8655	0.5633	6.0058
Wound Erythema	1.6861	0.7515	3.7030
Wound Necrosis	5.3596	0.8618	56.6849
Wound Seroma	0.6003	0.1700	1.7403
Wound Hematoma	1.3960	0.1154	12.3115

**Figure 9. Complication Rates Among Patients Not Receiving Post-Operative Antibiotics.** Sixty-eight percent of patients received postoperative prophylactic antibiotics. The remaining thirty-two percent were investigated to see if they had higher complication rates. The odds ratios indicate there was no significant increase in complications in patients not receiving postoperative prophylactic antibiotics.