EXAMINING THE HISPANIC PARADOX IN POST-OPERATIVE COMPLICATION RATES

A Thesis
Submitted
to the Temple University Graduate Board

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MASTER OF SCIENCE

By
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ABSTRACT

Title: Examining the Hispanic Paradox in Post-Operative Complication Rates

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Degree: Master of Science

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INTRODUCTION: Racial disparities exist in both healthcare access and outcomes. Despite high poverty rates, less education, and worse access to healthcare, the Hispanic population as a whole experiences equal, if not better outcomes compared to their non-Hispanic White counterparts. We sought to determine if race was significantly associated with the development of serious post-operative complications (POC) among patients undergoing intra-abdominal general surgical procedures.

METHODS: We performed a retrospective cohort study of patients undergoing appendectomy, cholecystectomy, or colectomy at a single healthcare system over a 12 month period. Medical records were reviewed for patient demographics, co-morbidities, operative variables, and the occurrence of selected post-operative complications. Variables found to be significantly associated with the development of a POC on univariate analysis were entered into a multivariate logistic regression model to determine the effect of Hispanic race on POC. Additionally, we constructed a propensity score adjusted logistic regression model as a confirmation of our findings.

RESULTS: Among 456 patients, 48 (10.5%) developed a POC. Hispanic race, age, tobacco use, selected co-morbidities, surgical procedure and surgical approach were all associated with POC on univariate analysis. On multivariate logistic regression analysis, after adjusting for confounders, Hispanic race, age, tobacco use, and surgical approach were all significantly associated with POC. Hispanic race was the strongest independent predictor, and was found to be protective against the development of a POC (adjusted OR= 0.22, p-value=0.048). The propensity score adjusted regression model provided a similar estimate of the effect of Hispanic race on POC (adjusted OR= 0.20, p-value= 0.03).

CONCLUSIONS: We have demonstrated that Hispanic patients undergoing common intra-abdominal surgical procedures have lower rates of serious post-operative complications, even after adjusting for patient demographics, co-morbidities, and operative variables. This, and other existing data, suggests that Hispanic patients may incur some type of overall health advantage despite the socioeconomic hardships they often face.

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CHAPTER 1

INTRODUCTION

It has become increasingly clear that racial disparities exist in both healthcare access and outcomes. Minority groups are generally characterized by low socioeconomic status, poor access to healthcare, delayed diagnosis, and more advanced disease at presentation. Over the past twenty years, there has become increasing evidence of a Hispanic paradox, where despite high poverty rates, less education, and worse access to healthcare, the Hispanic population as a whole experiences equal, if not better health outcomes compared to their non-Hispanic White counterparts (Franzini, 2001; Gallo, 2009; Morales, 2002; Turra, 2007).

The U.S. Hispanic population has experienced unprecedented growth over the past several decades. In 1966, Hispanics represented only 4% of the total population, growing to nearly 15% of the population in 2006. Current projections estimate that by 2050, Hispanics will make up 30% of the population (Gallo, 2009). There is now urgent need for research focused specifically on Hispanic health.

The outcome that has received the most attention in health disparity research is mortality, both because it poses fewer measurement problems and because the Hispanic paradox is most apparent with regard to survival (Turra, 2007). We were interested in studying our unique healthcare system which has a nearly equal mix of Black, White, and Hispanic patients to determine if race or additional factors are predictors of serious post-operative complications. We hypothesized that race is significantly associated with the development of a POC.

The majority of studies published analyzing the effects of race on surgical outcomes have relied on large administrative data. Unfortunately, these administrative databases are limited in the amount of clinical information available for accurate risk-adjustment (Esnaola, 2008). Our present study benefits from the use of individual patient-level data which enables us to analyze specific complications, rather than simply analyzing mortality.

CHAPTER 2

METHODS

We performed a retrospective cohort study of patients undergoing intra-abdominal surgical procedures at two affiliated hospitals within our healthcare system during a single calendar year (2007). The surgical procedures were restricted to appendectomy, cholecystectomy, and colectomy. One hospital was an urban university hospital with greater than 500 beds, while the other hospital was a community-based university-affiliated hospital with 200 beds. The electronic medical records were queried by searching the respective current procedural terminology (CPT) codes (44950-44970 for appendectomy, 47562-47564, 47600-47620 for cholecystectomy, and 44140-44160, 44204-44212 for colectomy) and manually reviewed to obtain patient demographics, co-morbidities, operative data, and serious post-operative complications. This study was approved by our Institutional Review Board (see Appendix A).

We collected patient demographics including age, sex, race, body mass index, tobacco use, and alcohol use. Body mass index was calculated for each patient by dividing their weight in kilograms by height in meters squared. Operative variables included surgical procedure, surgical approach (open vs. laparoscopic), hospital setting (university vs. community), and history of prior surgery. Co-morbidities included coronary artery disease, diabetes mellitus, hypertension, and chronic obstructive pulmonary disease.

We considered the following as serious post-operative complications (POC): myocardial infarction, pulmonary embolism, ventilator dependent respiratory failure, intra-abdominal abscess, acute renal failure, sepsis, and hemorrhage. Additionally, all patient encounters to our health system within 90 days of the index procedure were reviewed for the occurrence of POC. We excluded all cases performed for traumatic injury as well as patients younger than 18 years.

Comma separated raw data is available in Appendix B. Descriptive and inferential statistics were computed using the Statistical Package for the Social Sciences (SPSS 16.0, SPSS Inc., Chicago, IL). The SPSS syntax for all statistical analyses performed is available in Appendix C. Univariate comparisons were performed with two-sample t-tests for continuous variables and Pearson's chi-square tests for categorical variables. All tests were performed 2-tailed and statistical significance was tested at $\alpha=0.05$. Further statistical methodology for the regression modeling used is discussed in the subsequent results section.

CHAPTER 3

RESULTS

Table 1 shows the characteristics of the 456 patients included in the study. Overall there were a total of 66 complications occurring in 48/456 (10.5%) patients. Figure 1 shows the distribution of complications among the sample. Ventilator dependent respiratory failure, intra-abdominal abscess, and sepsis were the three most common complications. For this study, we analyzed serious post-operative complication rates (frequency of patients with one or more complications, 48/456 [10.5%]) rather than total number of complications (66).

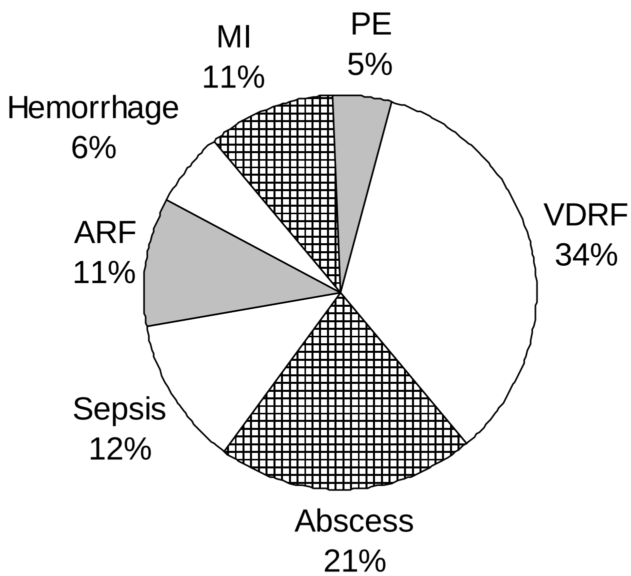
Table 2 shows the characteristics of patients with and without POC as well as the complication rate among groups. Patients who developed POC were older, were more likely to smoke tobacco, and had more co-morbidity (coronary artery disease, diabetes mellitus, hypertension, and chronic obstructive pulmonary disease) than patients without POC. Body mass index, sex, and alcohol use were not significantly associated with the development of a POC. Most striking was the association between race and POC. Only 3% of Hispanics developed a POC, compared to 8% of Asians, 12% of Whites, and 15% of Blacks ($p=0.01$). When analyzing Asians, Whites, and Blacks separately there was no statistical difference in complication rates between the three racial groups (Pearson's chi-square= 0.57, data not shown), so for this study race was dichotomized into Hispanic and non-Hispanic.

Table 1. Characteristics of Patients Included in the Study

Age	47.8 ± 18.6
Body Mass Index	29.6 ± 7.4
Sex	
Female	63% (286)
Male	37% (169)
Race	
White	36% (155)
Black	36% (158)
Hispanic	26% (111)
Asian	3% (12)
Tobacco Use	
Never	60% (269)
Former	16% (73)
Current	23% (103)
Alcohol Use	
Positive	30% (133)
Negative	70% (304)
Co-morbidities	
Coronary Artery Disease	12% (52)
Diabetes Mellitus	16% (73)
Hypertension	37% (169)
COPD	5% (23)
Surgical Procedure	
Appendectomy	20% (93)
Cholecystectomy	53% (241)
Colectomy	27% (122)
Surgical Approach	
Open Laparotomy	24% (109)
Laparoscopic	76% (347)
Prior Abdominal Surgery	
Positive	38% (170)
Negative	62% (274)
Hospital Setting	
University	71% (324)
Community	29% (132)

456 patients were included in the study. Continuous variables are expressed as means ± standard deviations. Categorical variables are expressed as percentages (number of patients).

Figure 1. Distribution of Post-Operative Complications Occurring in Study



There were a total of 66 complications occurring in 48/456 (10.5%) patients.
VDRF= ventilator dependent respiratory failure, abscess= intra-abdominal abscess, ARF= acute renal failure, MI= myocardial infarction, PE= pulmonary embolism

Table 2. Characteristics of Patients by Post-Operative Complication

Variable (patients)	No POC (408)	POC (48)	Complication Rate	p-value
Age	46.5 ± 18.2	59.3 ± 18.2		<0.01
Body Mass Index	29.7 ± 7.2	28.4 ± 8.9		0.24
Sex				0.32
Female (286)	64% (259)	56% (27)	9%	
Male (169)	36% (148)	44% (21)	12%	
Race				0.01
White (155)	35% (137)	39% (18)	12%	
Black (158)	34% (134)	52% (24)	15%	
Hispanic (111)	28% (108)	7% (3)	3%	
Asian (12)	3% (11)	2% (1)	8%	
Tobacco Use				<0.01
Never (269)	64% (254)	32% (15)	6%	
Former (73)	15% (58)	32% (15)	21%	
Current (103)	22% (86)	36% (17)	17%	
Alcohol Use				0.31
Positive (133)	30% (116)	37% (17)	13%	
Negative (304)	70% (275)	63% (29)	10%	
Coronary Artery Disease				0.03
Positive (52)	10% (42)	21% (10)	19%	
Negative (402)	90% (364)	79% (38)	10%	
Diabetes Mellitus				<0.01
Positive (73)	15% (59)	29% (14)	19%	
Negative (381)	86% (347)	71% (34)	9%	
Hypertension				0.01
Positive (169)	35% (143)	54% (26)	15%	
Negative (285)	65% (263)	46% (22)	8%	
COPD				<0.01
Positive (23)	4% (16)	15% (7)	30%	
Negative (429)	96% (389)	85% (40)	9%	
Surgical Procedure				<0.01
Appendectomy (93)	21% (85)	17% (8)	9%	
Cholecystectomy (241)	56% (227)	29% (14)	6%	
Colectomy (122)	24% (96)	54% (26)	21%	

Table 2. Continued

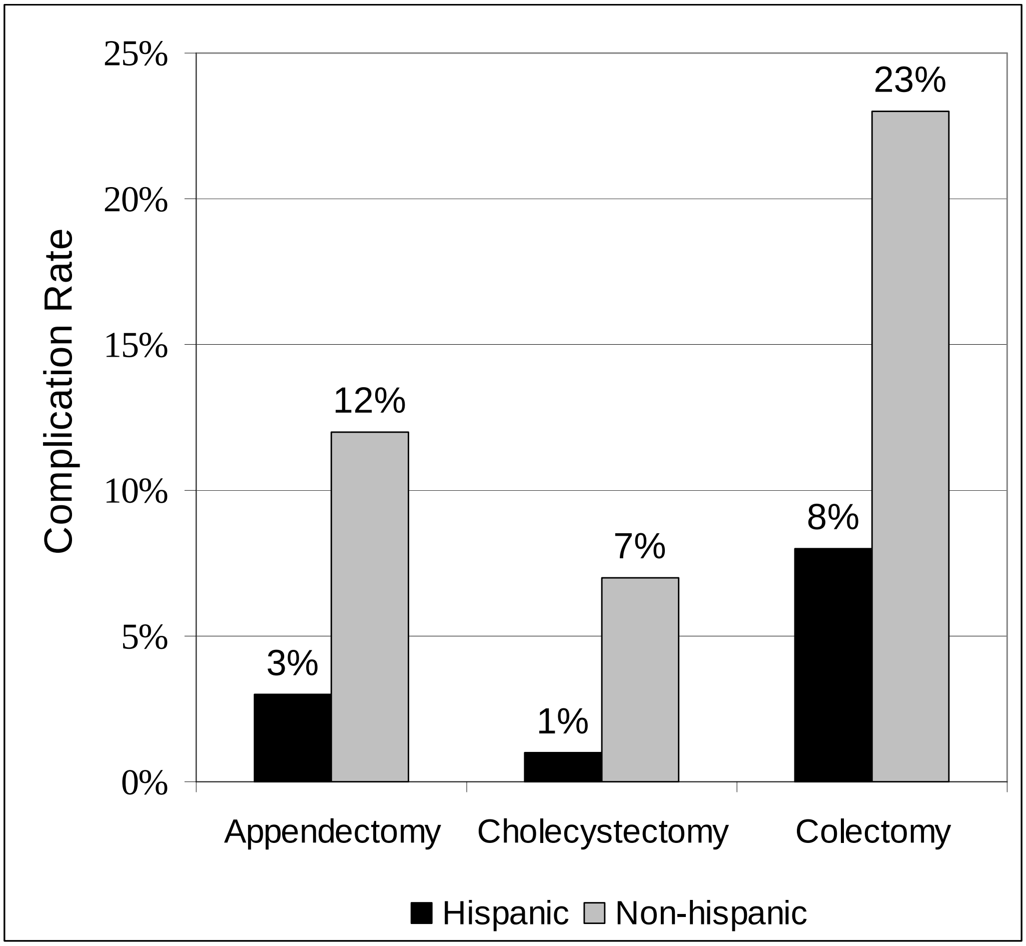
Variable (patients)	No POC (408)	POC (48)	Complication Rate	p-value
Surgical Approach				<0.01
Open Laparotomy (109)	20% (80)	60% (29)	27%	
Laparoscopic (347)	80% (328)	40% (19)	6%	
Prior Abdominal Surgery				0.67
Positive (170)	39% (153)	35% (117)	10%	
Negative (274)	61% (243)	65% (17)	11%	
Hospital Setting				0.52
University (324)	71% (288)	75% (36)	11%	
Community (132)	29% (120)	25% (12)	9%	

Continuous variables are expressed as means ± standard deviations and analyzed with t-tests. Categorical variables are expressed as percentages (number of patients) and analyzed with Pearson's chi-square tests.

Additionally, surgical procedure was associated with the development of a POC, as the complication rate for those undergoing colectomy was 21%, compared to 9% for appendectomy and 6% for cholecystectomy (p=<0.01). Surgical approach was also significantly associated with the development of POC, as the complication rate was over four-fold higher in the open laparotomy group. Neither hospital setting, nor the presence of prior abdominal surgery was significantly associated with the development of a POC.

Due to the strong associations between both race and POC as well as surgical procedure and POC, we performed an analysis of complication rates for Hispanics and Non-Hispanics stratified by surgical procedure (Figure 2). For each strata of surgical procedure (appendectomy, cholecystectomy, and colectomy), Hispanics had lower rates of post-operative complications. The common odds ratio for Hispanics developing a POC was 0.25 (Mantel-Haenszel p-value= 0.02).

Figure 2. Post-Operative Complication Rate by Surgical Procedure and Race



Common odds ratio for Hispanics developing post-operative complication= 0.25
Mantel-Haenszel p-value= 0.02

Additionally, all variables found to be significant on univariate analysis (p-value <0.05: age, race, tobacco use, coronary artery disease, diabetes mellitus, hypertension, chronic obstructive pulmonary disease, surgical procedure, and surgical approach) were introduced as independent variables in a multivariate logistic regression model, with the development of a POC as the dependent variable (Table 3). After adjusting for potential confounders, we found that Hispanic race, age, surgical approach, and tobacco use were independent predictors of developing a POC. Hispanic race was the strongest

Table 3. Multivariate Logistic Regression Modeling the Odds of a Post-Operative Complication

	Odds Ratio	95% Confidence Interval	p-value
Hispanic	0.22	0.05-0.99	0.05
Age	1.03	1.00-1.05	0.05
Surgical Procedure			
Colectomy	1.00 (referent)		
Appendectomy	2.07	0.65-6.61	0.22
Cholecystectomy	0.65	0.27-1.55	0.65
Surgical Approach			
Laparoscopy	1.00 (referent)		
Open Laparotomy	3.12	1.33-7.30	<0.01
Tobacco Use			
Never	1.00 (referent)		
Former	2.69	1.11-6.48	0.03
Current	4.21	1.81-9.77	<0.01
Co-Morbidities			
Coronary Artery Disease	0.95	0.36-2.46	0.91
Diabetes Mellitus	1.58	0.65-3.82	0.31
Hypertension	0.98	0.42-2.28	0.96
COPD	1.78	0.57-5.62	0.32

Hosmer-Lemeshow Goodness of Fit= 0.95

independent predictor, and was found to be protective against the development of a POC (adjusted OR= 0.22, p-value=0.048). Additionally, increasing age, open laparotomy, and former or current tobacco users were found to be at increased odds of developing a POC. This multivariate logistic regression model demonstrated goodness-of-fit as assessed by the Hosmer-Lemeshow test (p=0.95).

One commonly used method of adjusting for confounders is to use a regression model and enter the confounders as independent variables into the model, as we did in our multivariate logistic regression model (Table 3) (Peduzzi, 1996). This method controls for the confounders entered into the model to give an adjusted odds ratio estimate. Another accepted method that has gained popularity in the literature is the use of propensity scoring (Fitzmaurice, 2006; Pasta, 2000; Shah, 2005; Sturmer, 2006).

In this study, we were interested in determining the effect of being Hispanic on the development of a POC. Propensity scores were calculated as the predicted probability of being Hispanic from a logistic regression, using characteristics of the patient and surgery as predictors. Table 4 shows the characteristics of Hispanics and Non-Hispanics. We can see that these two groups differ with respect to age, tobacco use, coronary artery disease, hypertension, chronic obstructive pulmonary disease, surgical procedure, surgical approach, and hospital setting. To calculate a propensity score for being Hispanic, the aforementioned variables were entered as independent variables into a logistic regression model and the predicted probability of being Hispanic was calculated for each patient. Because there is no reason to believe that the propensity score would predict the outcome linearly, the propensity scores were transformed into five quintiles (Pasta, 2000). A final logistic regression model was generated to determine the effect of being Hispanic on the development of a POC after controlling for the propensity score.

Table 4. Characteristics of Patients by Race

Variable	Hispanic (111)	Non-Hispanic (325)	p-value
Age	42.7 ± 16.3	49.6 ± 19.0	<0.01
Body Mass Index	30.5 ± 8.1	29.3 ± 7.3	0.16
Sex			0.30
Female	68% (75)	62% (201)	
Male	32% (36)	38% (123)	
Tobacco Use			0.02
Never	68% (73)	58% (183)	
Former	7% (8)	19% (61)	
Current	25% (27)	23% (73)	
Alcohol Use			0.18
Positive	26% (27)	33% (102)	
Negative	74% (78)	67% (210)	
Co-morbidities			
Coronary Artery Disease	5% (5)	14% (46)	<0.01
Diabetes Mellitus	17% (18)	16% (51)	0.84
Hypertension	29% (32)	41% (132)	0.04
COPD	1% (1)	7% (22)	0.02
Surgical Procedure			<0.01
Appendectomy	26% (29)	19% (60)	
Cholecystectomy	63% (70)	49% (158)	
Colectomy	11% (12)	33% (107)	
Surgical Approach			<0.01
Open Laparotomy	10% (11)	28% (91)	
Laparoscopic	90% (100)	72% (234)	
Prior Abdominal Surgery			0.61
Positive	40% (43)	37% (117)	
Negative	60% (65)	63% (199)	
Hospital Setting			<0.01
University	87% (96)	68% (220)	
Community	14% (15)	32% (105)	
Complication Rate	3% (3)	13% (43)	<0.01

Continuous variables are expressed as means ± standard deviations and analyzed with t-tests. Categorical variables are expressed as percentages (number of patients) and analyzed with Pearson's chi-square tests.

The odds ratio for Hispanics developing a POC after adjusting for propensity score was 0.20 (p=0.03) (Table 5). This method has the effect of controlling for any group differences due to all of the variables included in the creation of the propensity score.

One benefit of using propensity scores to control for confounding is for parsimony, keeping the model as simple as possible. One can collapse a large set of confounders into a single propensity score. For the final analysis, the resulting propensity score can be used as though it is the only potential confounder that needs to be adjusted for (Fitzmaurice, 2006; Pasta, 2000). Another advantage of using propensity scores is that it is straightforward to determine if the exposed and unexposed groups overlap sufficiently to make meaningful comparisons. In contrast, the application of regression to adjust for a set of confounders will provide no indication of whether there is sufficient overlap. As a result, regression adjustment can potentially produce an adjusted estimate that is based on an extrapolation beyond the data at hand (Fitzmaurice, 2006).

Table 5 provides a summary of the odds ratios calculated for Hispanics developing a POC by three different modeling techniques: 1) the Mantel-Haenszel common odds ratio after stratifying by surgical procedure, 2) a multivariate logistic regression odds ratio calculated after adjusting for potential confounders entered as independent variables, and 3) a propensity score adjusted logistic regression odds ratio. Each of the three modeling techniques gives a similar estimate of the odds ratio, indicating that the odds of Hispanics developing a POC are approximately one-quarter the odds of non-Hispanics.

Table 5. Odds Ratio for Hispanics Developing a Post-Operative Complication

Model	Odds Ratio	95% CI	p-value
[a]Mantel-Haenszel Common Odds Ratio	0.25	0.07-0.83	0.02
[b]Multivariate Logistic Regression	0.22	0.05-0.99	0.05
[c]Propensity Score Logistic Regression	0.20	0.05-0.86	0.03

[a]Common odds ratio calculated in Figure 2 after stratifying by surgical procedure
[b]Logistic regression odds ratio calculated in Table 3 after adjusting for potential confounders entered as independent variables
[c]Propensity score adjusted logistic regression odds ratio

CHAPTER 4

CONCLUSIONS

While there is strong evidence to suggest an interplay of race and socioeconomic status with respect to healthcare access and utilization, the main effects of race on surgical outcomes remain poorly understood (Franzini, 2001; Gallo, 2009; Morales, 2002; Turra, 2007). Using data from a unique healthcare system with a nearly equal mix of Black, White, and Hispanic patients, we were able to show that Hispanic race portends a favorable outcome with respect to serious post-operative complications.

This is not the first data suggesting Hispanic patients may have an advantage over other races after surgery. Among patients undergoing thyroidectomy, Hispanics had the lowest overall complication rate (3.6%), compared to Whites (3.8%) and Blacks (4.9%) (Sosa, 2007). Similarly, Hispanic patients admitted to the hospital for complications of portal hypertension had the lowest adjusted odds ratio for death compared to Whites (OR= 0.83, 95% CI 0.75-0.92) (Nguyen, 2007). Artinyan, et al. demonstrated that after liver transplantation for hepatocellular carcinoma, Black patients had the worst overall survival (median survival 39.7 months), whereas Hispanics had the best survival (86.6 months). This finding held true even after adjusting for potential confounders in a multivariate Cox regression analysis (Hispanics adjusted hazard ratio for death= 0.71, 95% CI 0.56-0.89) (Artinyan, 2010).

Our study is unique in that we examined the effect of Hispanic race on the development of POC for the three most commonly performed intra-abdominal general surgical procedures. We showed that for each surgical procedure (appendectomy, cholecystectomy, and colectomy), Hispanic race was protective against POC. Additionally, using multivariate logistic regression modeling to adjust for confounders, we similarly showed that Hispanic race was protective against the development of a POC. Finally, using a propensity score adjusted regression model, we demonstrated a similar protective odds ratio estimate for Hispanics (Table 5).

Using the National Surgical Quality Improvement Program (NSQIP) data, Esnaola studied the effect of race on 30-day morbidity and mortality rates for general surgical procedures. This study was limited to non-Hispanic White and Black patients, and showed that Black patients had higher rates of post-operative complications than White patients, even after adjusting for confounders (Esnaola, 2008). It would be interesting to see their results if they included Hispanic patients in their study.

Studying patients undergoing coronary artery bypass grafting, Rumsfeld, et al. found that Hispanics had lower adjusted odds of 30-day mortality (OR= 0.70, 95% CI 0.49-0.98) and 6-month mortality (OR= 0.66, 95% CI 0.50-0.88) compared to Whites (Rumsfeld, 2002). The protective benefit incurred by Hispanics during the post-operative period is difficult to explain. It is plausible that Hispanic patients may have some environmental or intrinsic genetic differences that portend a health advantage, but this is yet to be determined (Parikh, 2009).

Alternatively, the reduced risk of post-operative complications among Hispanic patients may result from less quantifiable variables such as social dynamics and family support. There is evidence that familism within Hispanic families is associated with improved health behaviors and increased utilization of health care (Tamez, 1984; Suarez, 1994). Additionally, Hispanics living in neighborhoods with a high percentage of foreign-born residents have lower prevalence of asthma and other breathing disorders compared to Hispanics living in neighborhoods with fewer foreign-born residents (adjusted OR= 0.64, p-value<0.05) (Cagney, 2007).

Our analysis was limited to the variables directly available in the medical record. Race was self-reported, and there was no data available as to the immigration status of the Hispanics in our study, nor was there data regarding their country of origin (i.e. Mexico, Puerto Rico, Cuba, South or Central America). As with any retrospective analysis, there exists the possibility of unmeasured confounding variables. However, the corroboration of other known risk factors adds credence to our data. For example, several studies have demonstrated a link between tobacco use and surgical morbidity (Moller, 2002; Sadr Azodi, 2008; Lindstrom, 2008). In our study, compared to non-smokers, the adjusted odds ratio for former smokers developing a POC was 2.69, while the adjusted odds ratio for current smokers was 4.21 (Table 3).

We have demonstrated that Hispanic patients undergoing common intra-abdominal surgical procedures have a lower rate of serious post-operative complications, even after adjusting for patient demographics, co-morbidities, and operative variables. This, and other existing data, suggests that Hispanic patients may incur some type of overall health advantage despite the socioeconomic hardships they often face.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD DECLARATION

TEMPLE UNIVERSITY®

Office for Human Subjects Protections
Institutional Review Board
Medical Intervention Committees A1 & A2
Social and Behavioral Committee B

3400 North Broad Street
Philadelphia, Pennsylvania 19140
Phone:215.707.3390 Fax:215.707.8387
e-mail: richard.throm@temple.edu

MEMORANDUM

To: **FRIEDENBERG, FRANK**
MEDICINE-GASTROENTEROL (0554)

From: Richard C. Throm
Director, Office for Human Subjects Protection
Institutional Review Board Coordinator

Date: 06-Apr-2010

Re: Exempt Request Status for IRB Protocol:
13093: Factors Associated with Post-Operative Complications

It has been determined by Expedited Review that this study qualifies for exemption status as follows:

45 CFR 46 Protection of Human Subjects

Section 101 (b): Unless otherwise required by department or agency heads, research activities in which the only involvement of human subjects will be in one or more of the following categories are exempt from this policy:

Exemption 4: Collection or Study of Existing Data. Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subject.

Nothing further is required from you at this time; however, if anything in your research design should change, you must notify the Institutional Review Board immediately.

If you should have any questions, please feel free to contact me at 215-707-8757.

Thank you for keeping the IRB informed of your clinical research.

APPENDIX B

RAW DATA

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age,bmi,female,race,tobacco,etoh,surgery,open,prior,hospital,
cad,dm,htn,copd,mi,pe,vdrf,abscess,arf,sepsis,hemorrhage
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48,39.7,1,1,1,0,2,1,0,1,0,0,1,0,0,0,0,0,0,0,0
43,32.7,0,0,0,0,2,0,0,0,0,0,0,0,0,0,0,0,0,0,0
57,16.6,1,0,2,0,2,0,1,1,0,0,1,0,0,0,0,0,0,0,0
55,25.8,1,2,2,1,3,0,0,1,0,0,0,0,0,0,0,0,0,0,0
```

```
46,19.2,1,2,2,1,3,1,1,1,0,0,0,0,0,0,0,0,0,0,0
58,23.7,0,2,2,0,3,0,0,0,0,0,0,0,0,0,0,0,0,0,0
84,33.3,1,2,0,0,2,1,0,0,0,0,1,0,0,0,0,0,0,0,0
82,21.6,0,2,1,1,2,1,1,0,0,0,0,0,0,0,0,0,0,0,0
59,21.9,0,2,1,1,2,1,0,1,0,0,0,0,0,0,1,0,0,1,0
31,29.2,1,1,0,0,2,0,0,0,0,0,0,0,0,0,0,0,0,0,0
28,29.1,1,1,0,0,2,0,1,1,0,0,0,0,0,0,0,0,0,0,0
48,27.8,0,2,0,1,3,1,0,1,0,0,0,0,0,0,0,0,0,0,0
22,22.2,0,0,0,0,1,0,0,1,0,0,0,0,0,0,0,0,0,0,0
63,38.4,1,2,0,0,2,0,1,0,0,0,1,0,0,0,0,0,0,0,0
57,22.1,0,2,2,1,1,0,1,0,0,0,0,0,0,0,0,0,0,0,0
65,29.0,1,2,1,0,2,0,0,1,1,1,1,0,0,0,0,0,0,0,0
38,24.3,1,0,0,0,2,0,0,0,0,0,1,0,0,0,0,0,0,0,0
31,31.9,1,2,1,1,2,0,0,0,0,0,0,0,0,0,0,0,0,0,0
52,24.1,0,2,2,0,3,1,0,0,0,0,0,0,0,0,0,0,0,0,0
63,26.3,0,1, , ,2,0,0,1,1,0,1,0,0,0,0,0,0,0,0
67,31.3,0,0,2,1,3,1,1,1,0,1,1,0,0,0,1,0,0,0,0
52,31.9,1,0,1,0,3,0,0,0,0,0,1,0,0,0,0,0,0,0,0
46,23.3,1,0,1,0,2,0,1,1,0,0,1,0,0,0,0,0,0,0,0
64,30.1,1,0,0,0,3,1,1,1,0,0,0,0,0,0,0,0,0,0,0
76,30.3,1,1,0,0,2,0,1,0,0,0,1,0,0,0,0,0,0,0,0
50,48.5,0,2, , ,2,0,0,0,1,1,1,0,0,0,0,0,0,0,0
77,31.2,1,2,0,1,2,0,0,0,0,0,0,0,0,0,0,0,0,0,0
51,19.0,0,2,2,0,3,0,0,1,0,0,0,0,0,0,1,0,0,0,0
52,29.6,1,0,0,0,3,1,1,1,0,0,0,0,0,0,0,0,0,0,0
71,17.8,1,0, , ,3,1,1,0,0,1,1,1,0,0,1,0,0,0,0
61,26.4,0,2,2,0,3,1,1,1,0,0,1,0,0,0,0,0,0,0,0
36,25.2,0,0,2,1,2,1,1,1,0,0,0,0,0,0,0,0,0,0,0
67,42.7,1,2,0,0,2,0,1,1,0,0,1,0,0,0,0,0,0,0,0
60,27.7,0,2,0,0,3,0,0,1,0,0,0,0,0,0,0,0,0,0,0
46,39.2,1,0,1,1,3,0,0,1,0,1,1,0,0,0,0,0,0,0,0
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42,28.3,1,0,2,0,2,0,0,1,0,0,0,0,0,0,0,0,0,0,0
37,32.1,0,1,0,0,2,0,1,0,0,0,0,0,0,0,0,0,0,0,0
60,28.7,1,0,2,1,3,0,0,1,0,0,1,0,0,0,0,0,0,0,0
67,26.8,1,0,1,0,2,0,0,1,1,1,1,1,0,0,0,0,0,0,0
64,32.1,0,0,1,0,3,1,1,1,0,1,1,0,0,0,1,0,0,0,0
58,22.3,0,2,1,1,3,1,0,1,0,0,0,0,0,0,0,0,0,0,0
32,32.6,0,1,0,1,1,0,1,1,0,0,0,0,0,0,0,0,0,0,0
29,35.7,1,1,2,0,2,0,1,1,0,0,0,0,0,0,0,0,0,0,0
54,39.3,1,1,0,0,2,0,0,1,0,1,1,0,0,0,0,0,0,0,0
31,29.0,1,1,2,0,2,0,1,1,0,0,0,0,0,0,0,0,0,0,0
74,18.8,1,1,2,1,2,0,0,0,0,1,1,0,0,0,0,0,0,0,0
54,25.7,1,1,0,1,2,0,0,1,0,0,1,0,0,0,0,0,0,0,0
36,42.0,0,1,0,0,2,0,0,1,0,0,0,0,0,0,0,0,0,0,0
28,26.6,1,1,0,0,2,0,1,1,0,0,0,0,0,0,0,0,0,0,0
32,23.9,1,2,2,1,2,0,0,1,0,0,0,0,0,0,0,0,0,0,0
51,22.3,1,2,0,0,3,0,1,0,0,0,1,0,0,0,0,0,0,0,0
68,18.1,0,3,1,0,2,0,1,1,0,0,0,0,0,0,0,0,0,0,0
62,35.1,0,2,0,1,3,1,0,1,0,0,1,0,0,0,0,0,0,0,0
21,29.0,1,0,0,1,2,0,0,1,0,0,0,0,0,0,0,0,0,0,0
62,30.8,0,0,0,1,2,1,0,1,0,0,1,0,0,0,0,0,0,0,0
19,19.0,1,0,0,0,1,0,1,1,0,0,0,0,0,0,0,0,0,0,0
82,32.0,1,2,0,0,2,1,0,0,1,0,1,0,0,0,0,0,0,0,0
```

```
40,18.9,1,2,0,0,3,0,1,1,0,0,0,0,0,0,0,0,0,0,0
23,35.9,1,2,1,0,1,0,1,0,0,0,1,0,0,0,0,0,0,0,0
48,32.6,1,1,0,0,3,0,1,1,0,0,0,0,0,0,0,0,0,0,0
18,27.4,1,3,0,0,2,0,0,0,0,0,0,0,0,0,0,0,0,0,0
47,25.7,1,0,0,1,2,1,0,1,0,1,1,0,0,0,0,1,0,0,0
68,32.7,1,1,0,1,2,0, ,1,0,1,1,0,0,0,0,0,0,0,0
60,28.3,1,1,0,0,2,0,1,1,0,0,0,0,0,0,0,0,0,0,0
52,38.4,1, ,0,0,2,1,1,1,0,1,0,0,0,0,0,0,0,0,0
58,26.5,1,1,0,0,2,0,1,0,0,1,1,0,0,0,0,0,0,0,0
30,24.4,0,0,0,0,1,0,0,1,0,0,0,0,0,0,0,0,0,0,0
23,50.2,1,1,2,1,2,0,1,1,0,0,0,0,0,0,0,0,0,0,0
68,27.5,1,1,0,0,1,0,1,1,0,1,1,0,0,0,0,0,0,0,0
88,24.8,0, ,0,0,2,0,0,0,0,0,1,0,0,0,0,0,0,0,0
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44,29.0,0,1,2,1,1,0,0,1,0,0,1,0,0,0,0,0,0,0,0
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74,39.3,1,2,0,0,3,1,1,0,1,1,1,0,0,0,0,0,0,0,0
29,32.3,1,2,0,0,2,0,1,1,0,0,0,0,0,0,0,0,0,0,0
23,27.1,0,2,2,1,1,0,0,1,0,0,0,0,0,0,0,0,0,0,0
68,21.4,0,0,2,0,1,0,0,1,1,0,1,0,0,0,0,0,0,0,0
51,22.5,1,2,2,0,1,0,1,1,0,0,0,0,0,0,0,0,0,0,0
68,33.4,1,2,0,1,2,0,0,0,0,0,0,0,0,0,0,0,0,0,0
59,37.0,0,2,1,1,2,1,0,1,0,1,1,0,1,0,0,0,0,0,0
76,25.7,1,0,1,0,3,1,1,0,1,1,1,0,0,0,0,0,0,1,0
64,27.1,1,0,0,0,3,1,1,1,1,1,1,0,0,0,0,0,0,0,0
21,34.0,0,0,2,0,1,0,0,1,0,0,0,0,0,0,0,0,0,0,0
74,21.2,0,0,0,0,3,0,0,1,0,0,0,0,0,0,0,0,0,0,0
67,22.6,0,0,2,0,3,0,0,1,0,0,0,0,0,0,0,0,0,0,0
39,44.0,0,0,2,0,2,0,0,1,0,0,0,0,0,0,0,0,0,0,0
52,32.1,1,0,0,0,2,0,0,1,0,0,1,0,0,0,0,0,0,0,0
21,21.6,1, ,0,0,1,0,1,0,0,0,0,0,0,0,0,0,0,0,0
56,32.7,1,0,2,0,1,1,1,1,0,1,1,0,1,0,1,0,0,0,0
20,28.3,1,0,0,0,2,1,0,1,0,0,0,0,0,0,0,0,0,0,0
41,32.3,1,0,2,0,2,0,1,1,0,0,0,0,0,0,0,0,0,0,0
60,28.7,1,2,0,1,2,0,0,0,0,1,0,0,0,0,0,0,0,0,0
23,23.0,0,2,0,1,1,0,0,1,0,0,0,0,0,0,0,0,0,0,0
50,28.9,0,2,2,0,3,1,1,1,0,0,0,0,0,0,1,0,0,0,0
69,21.0,0,3,0,0,2,0, ,1,0,0,1,0,0,0,0,0,0,0,0
```

APPENDIX C

SPSS SYNTAX

```
* Import comma delimited dataset 'C:\complication.csv'

GET DATA
  /TYPE=TXT
  /FILE='C:\complication.csv'
  /DELCASE=LINE
  /DELIMITERS=","
  /ARRANGEMENT=DELIMITED
  /FIRSTCASE=2
  /IMPORTCASE=ALL
  /VARIABLES=
  age F2.0
  bmi F4.0
  female F1.0
  race F1.0
  tobacco F1.0
  etoh F1.0
  surgery F1.0
  open F1.0
  prior F1.0
  hospital F1.0
  cad F1.0
  dm F1.0
  htn F1.0
  copd F1.0
  MI F1.0
  PE F1.0
  VDRF F1.0
  abscess F1.0
  ARF F1.0
  sepsis F1.0
  hemorrhage F1.0.
CACHE.
EXECUTE.
DATASET NAME DataSet1 WINDOW=FRONT.

* Define Variable Properties.
*race.
VALUE LABELS race
  0 'black'
  1 'hispanic'
  2 'white'
```

```
  3 'asian'.
*tobacco.
VALUE LABELS tobacco
  0 'never'
  1 'former'
  2 'current'.
*surgery.
VALUE LABELS surgery
  1 'appendectomy'
  2 'cholecystectomy'
  3 'colectomy'.
*hospital.
VALUE LABELS hospital
  0 'Jeanes'
  1 'Temple'.
EXECUTE.

* Create POC variable, code 1 if patient has MI or PE or VDRF or
abscess or ARF or sepsis or hemorrhage, code 0 if no complication

IF  (MI=1 | PE=1 | VDRF=1 | abscess=1 | ARF=1 | sepsis=1 | hemorrhage=1
) POC=1.
EXECUTE.

RECODE POC (SYSMIS=0).
EXECUTE.

* Create hispanic variable, code 1 if hispanic, code 0 if non-hispanic

RECODE race (0=0) (1=1) (2=0) (3=0) (SYSMIS=SYSMIS) INTO hispanic.
EXECUTE.

* Table 1

DESCRIPTIVES VARIABLES=age bmi
  /STATISTICS=MEAN STDDEV MIN MAX.

FREQUENCIES VARIABLES=female race tobacco etoh surgery open prior
hospital cad dm htn copd
  /ORDER=ANALYSIS.

* Figure 1

FREQUENCIES VARIABLES=MI PE VDRF abscess ARF sepsis hemorrhage POC
  /ORDER=ANALYSIS.

* Table 2

T-TEST GROUPS=POC(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=age bmi
  /CRITERIA=CI(.9500).
```

```
CROSSTABS
  /TABLES=female race hispanic tobacco etoh surgery open prior hospital
cad dm htn copd BY POC
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT COLUMN ROW
  /COUNT ROUND CELL.

* Figure 2

CROSSTABS
  /TABLES=hispanic BY POC BY surgery
  /FORMAT=AVALUE TABLES  /STATISTICS=CMH(1)
  /CELLS=COUNT ROW
  /COUNT ROUND CELL.

* Table 3

LOGISTIC REGRESSION VARIABLES POC
  /METHOD=ENTER age tobacco surgery open cad dm htn copd hispanic
  /CONTRAST (surgery)=Indicator
  /CONTRAST (tobacco)=Indicator(1)
  /PRINT=GOODFIT CI(95)
  /CRITERIA=PIN(0.05) POUT(0.10) ITERATE(20) CUT(0.5).

* Table 4

T-TEST GROUPS=hispanic(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=age bmi
  /CRITERIA=CI(.9500).

CROSSTABS
  /TABLES=female tobacco etoh surgery open prior hospital cad dm htn
copd poc BY hispanic
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT COLUMN
  /COUNT ROUND CELL.

* create propensity score for hispanic and transform into quintiles

LOGISTIC REGRESSION VARIABLES hispanic
  /METHOD=ENTER age tobacco surgery open hospital cad htn copd
  /CONTRAST (surgery)=Indicator
  /CONTRAST (tobacco)=Indicator
  /SAVE=PRED
  /CRITERIA=PIN(.05) POUT(.10) ITERATE(20) CUT(.5).

FREQUENCIES VARIABLES=PRE_1
  /FORMAT=NOTABLE
  /NTILES=5
  /ORDER=ANALYSIS.
```

```
RECODE PRE_1 (Lowest thru .0866944=1) (.0866944 thru .1765504=2)
(.1765504 thru .3338053=3)
    (.3338053 thru .4120432=4) (.4120432 thru Highest=5) INTO

propensity.
EXECUTE.

DELETE VARIABLES PRE_1.

* Table 5 Logistic regression adjusting for propensity score

LOGISTIC REGRESSION VARIABLES POC
  /METHOD=ENTER hispanic propensity
  /CONTRAST (propensity)=Indicator
  /PRINT=GOODFIT CI(95)
  /CRITERIA=PIN(0.05) POUT(0.10) ITERATE(20) CUT(0.5).
```