Quality of Coronary Artery Bypass Graft Surgery Overtime

Abstract

Since 1989, New York State has published the coronary artery bypass graft sugery (CABG) Report Card to record the number of CABG surgeries a doctor has done in addition to mortality rates to improve patient care. There is a common notion that with age comes experience and improved patient care, however when does the age of a doctor become a physical burden to patient care. I have found data that suggests that age will become a burden over the age of 53. While this data is by no means conclusive it suggests that the medical profession needs to take a deeper look into how age affects a doctor's quality.

Introduction

Background

Coronary artery bypass graft surgery or CABG is a surgery given to patients who develop coronary artery disease (CAD), when plaque builds up in the heart, which causes arteries to narrow. CABG is used to allow the blood to flow properly again through out the heart. Overall there is a three to four percent mortality rate due to CABG surgery due to heart attacks, strokes, infections, lung complications, etc (Kulick, Daniel and William Shiel Jr.).

In order to improve the mortality rate of CABG surgeries in New York, The New York State Department of Health began to collect data of CABG surgeries in 1989. The three main goals The New York State Department of Health hoped to achieve were to improve the quality of CABG surgeries, inform hospitals on how to improve quality care and how to determine when to perform CABG surgeries, and assist patients to find quality CABG surgery providers (Hannan, Edward, et al). Most studies have involved looking at the risk adjusted mortality rate (RAMR), which takes into account the initial risk due to the patient.

Over the past several years the CABG program data has been used to conduct mainly studies on the accuracy of the RAMR and the quality of hospitals. Dr. Edward Hannan et al. found that the quality of CABG surgeries and the OMR have declined since the implementation of the CABG Report Card (Hannan, Edward, et al). Dr. Laurent Glance et al., also found that the CABG Report Card is a good predictor for hospital performance, with two year old data being the best predictor for future performance (Glance, Laurent et al).

While the CABG Report Card has been viewed as a positive initiative it has been met with opponents who have made justified criticisms about the program. Doctor Zoltan Turi wrote a very powerful article on the problems associated with the CABG Report Card. The three

problems that have occurred is the lack of trust of RAMR, patient selection and risk, and migration of high-risk patients to other states (Turi 1766).

A survey in 2005 showed that 85 percent of cardiologists do not trust the RAMR value in New York State. In addition to the lack of trust with the RAMR value, doctors have shown to become very risk adverse with the RAMR value and therefore have shown to not operate on people that they may have been willing to operate before the CABG Report Card was initiated. The third problem that has been shown to occur is that if patients are considered to be high risk, they are moved to hospitals that do not have CABG Report Card s such as The Cleveland Clinic in Cleveland, Ohio. These problems could significantly alter the true data and results of the CABG Report Card (Turi 1766).

Purpose

While the CABG Report Card could be a useful source of information for patients, one of the most common ways patients choose a doctor is looking at his or her years of experience. Patients view a positive correlation between the number of years a doctor has worked and his or her quality. People will usually view a doctor with 15 years experience to be better than a doctor who has 10 years of experience. Because surgery is not just based on intelligence but also dexterous skill, I believe the years of experience could also be harmful to a doctor's quality. If a doctor has 35 years of experience, that doctor is around 65 years old. By this age, the doctor's physical skills should be deteriorating from poor vision to tremors in his or her hands. I hope to show that the quality of CABG surgeries changes with age, not only for the better but also the worse.

Methods

Data Source

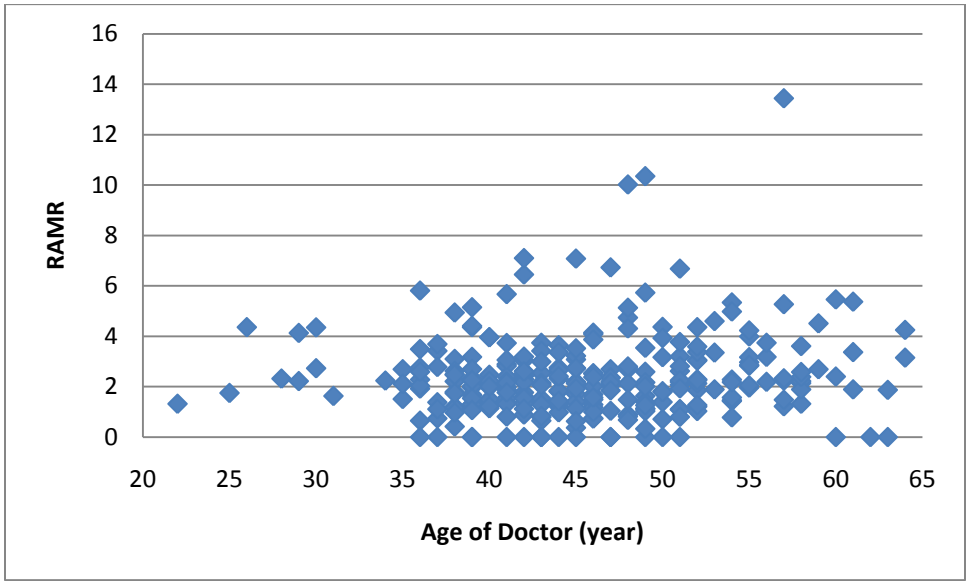
Every year New York State releases the CABG Report Card for surgeons who have performed more than --- CABG surgeries from the three previous years; for example year 2000 data includes data between 1998 and 2000. The CABG data includes the surgeon's name, number of cases, number of deaths, observed mortality rate (OMR), expected mortality rate (EMR), risk-adjusted mortality rate (RAMR), and 95 percent confidence interval for RAMR. OMR is the observed number of patient deaths divided by the total number of patients for that particular surgeon. EMR is the sum of the predicted probabilities of the number of deaths of patients divided by the total number of patients for that particular surgeon. RAMR is a statistical model that creates a mortality rate if all of the patients in the state were identical. It is found by dividing the OMR by EMR and multiplying the result by the statewide mortality rate (Adult Cardiac Surgery in New York State 1998-2000).

In addition to the CABG Report Card, I also found the year 97 out of 250 surgeons received their Bachelor's degree. The other 153 surgeon's data is thrown out due to the time it would take to gather the rest of this data if it is even possible. I subtracted the year of college graduation by the lower year bound of year RMAR dataset. For example, if a person graduated in 1958 and I am looking at the Adult Cardiac Surgery in New York State 1998-2000, I subtracted 1998 by 1958 to get 36 years. By assuming all of the surgeons graduated at the age of 22, we can estimate the age of the surgeons by adding 22 to the years since bachelor's degree. So the doctor described above would have been considered 58 years old between 1992 and 1994.

Test Methodology

I first regressed all of the RAMR data on doctor years since bachelor's degree. The problem with this regression is because all each year uses data from three years prior, it created a large amount of overlap with the RAMR data. I fixed this overlap by only using years 1992-1994, 1995-1997, 1998-2000, 2001-2003, and 2004-2006.

I then graphed the data to see if there was anything interesting I could see with the results, as seen in the graph below.



(Figure 1: Graph of RAMR vs. Age of Doctor)

This graph gave a few insights in to how to go about this data. From looking at the data I realized that I should use a Tobit regression. This is because of a doctor cannot have a RAMR value below zero and several doctors have RAMR values that hit this lower limit. A nothing interesting insight I saw was that the data appears that it could almost be divided into three groups based on years. I created three dummy variables bottom third (bt), middle third (mt), and top third (tt) to group the data into three years. bt is 1 if the doctor's age is less than 31 years and zero if not. mt is 1 if the doctor's age is between 32 and 53 years and zero if not. tt is 1 if the doctor's age is greater than 54 years and zero if not. I also did a chow regression dividing the years into thirds

and then into halves without getting a F test value above 1.075 as seen in appendix B. I believe the lack of significance of the chow regression was due to the similar slopes of the bottom and top third RAMR values.

Results

I first did a Tobit regression of age onto RAMR with a lower limit of zero to produce the first significant results with a p value < 0.10 as seen in the figure below.

```
. tobit ramr age, ll(0)

Tobit regression                                  Number of obs     =        282
  ||                                              LR chi2(1)        =       3.16
                                                  Prob > chi2       =     0.0755
Log likelihood =   -543.855                       Pseudo R2         =     0.0029

------------------------------------------------------------------------------
        ramr |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .0252365   .0141479     1.78   0.076    -.0026128    .0530858
       _cons |   1.168195   .6533613     1.79   0.075    -.1179086    2.454299
-------------+----------------------------------------------------------------
      /sigma |    1.74976   .0774034                      1.597396    1.902124
------------------------------------------------------------------------------
  Obs. summary:         18  left-censored observations at ramr<=0
                       264     uncensored observations
                         0 right-censored observations
```

(Figure 2: Tobit regression of age on RAMR)

The first thing I noticed was that it suggests a positive correlation with the age of the doctor and RAMR, which does not appear to be completely logical. The second thing I noticed was that the coefficient on age is 0.0252365, which is very small. It suggests that while the p value is significant with 10 percent significance level, the coefficient is so small the age will make little difference with the doctor's RAMR over time.

Because the graph above in figure 1 appears to almost dip down in the middle I did another Tobit regression of mt, the middle third dummy variable, onto RAMR. This produced the regression as seen below.

```
. tobit ramr mt, ll(0)

Tobit regression                                  Number of obs     =        282
                                                  LR chi2(1)        =       5.67
                                                  Prob > chi2       =     0.0172
Log likelihood =  -542.5975                       Pseudo R2         =     0.0052

------------------------------------------------------------------------------
        ramr |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          mt |  -.6341918   .2647824    -2.40   0.017    -1.155401   -.112983
       _cons |   2.831329   .2380196    11.90   0.000     2.362801    3.299857
-------------+----------------------------------------------------------------
       /sigma |   1.742166   .0770545                      1.590489    1.893844
------------------------------------------------------------------------------
  Obs. summary:         18  left-censored observations at ramr<=0
                       264     uncensored observations
                         0 right-censored observations
```

(Figure 3: Tobit Regression of mt on RAMR)

In the Tobit regression above, the p value of mt is 0.017 which is significant with a five percent significance level. This suggests that doctors have their lowest RAMRs between the ages of 31 and 54. I finally did a third Tobit regression with both mt and age on RAMR as seen in the figure below.

```
. tobit ramr age mt, ll(0)

Tobit regression                                  Number of obs     =        282
                                                  LR chi2(2)        =       6.31
                                                  Prob > chi2       =     0.0426
Log likelihood = -542.27807                       Pseudo R2         =     0.0058

------------------------------------------------------------------------------
        ramr |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .0126023   .0157539     0.80   0.424    -.0184088    .0436133
          mt |  -.5273908   .2961645    -1.78   0.076    -1.110383    .0556009
       _cons |   2.170686   .8594843     2.53   0.012     .4788148    3.862557
-------------+----------------------------------------------------------------
       /sigma |   1.739663   .0769506                      1.588188    1.891138
------------------------------------------------------------------------------
  Obs. summary:         18  left-censored observations at ramr<=0
                       264     uncensored observations
                         0 right-censored observations
```

(Figure 4: Tobit Regression of age and mt on RAMR)

By including the age and mt variables together, the age variable not longer is statistically significant with a p value of 0.424. Even though the mt dummy variable's p value increased from 0.17 to 0.076, it is still is statistically significant, on a 10 percent significance level.

Discussion/Conclusion

Some of these regressions are a bit shaky due to lack of information from dependent variables and the difficulty of finding the years of graduation of all of the doctors that are part of the CABG Report Card. Even though the year of graduation is a good estimate of a doctor's age, it is very common to delay graduation for several years.

While problems due occur by gathering data, the statistically significant negative correlation between the doctor's RAMR score and the middle third does suggest that doctor's perform their best between the ages of 31 and 54. Even though my project is by no means conclusive it does suggest that the age of doctor's should be looked into when finding a quality doctor. Senior citizens are required to take more drivers' license exams after a certain age, due to physical and mental deteriorations. I suggest that doctors over a certain age should take additional tests to keep their medical license after a certain age. By doing so we could significantly improve the overall quality of doctors and remove the stereotype that with age means improved quality.

Appendix A: List of Work Cited

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Cardiology. Journal of the American College of Cardiology, 2005. Web. Accessed 11 October 2010. < http://content.onlinejacc.org/cgi/content/full/45/11/1766 >.

Appendix B – Chow Test with 2 restraints

Age > 45

```
. regress ramr age if(age > 45)
```

Source	SS	df	MS		
Model	4.89015357	1	4.89015357	Number of obs	133
Residual	500.627817	131	3.82158639	F(1, 131)	1.28
				Prob > F	0.2600
				R-squared	0.0097
				Adj R-squared	0.0021
Total	505.51797	132	3.82968159	Root MSE	1.9549

ramr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	.0410919	.0363259	1.13	0.260	-.0307695	.1129533
_cons	.459743	1.892187	0.24	0.808	-3.283455	4.202941

Age <= 45

```
. regress ramr age if(age <= 45)
```

Source	SS	df	MS		
Model	1.81808884	1	1.81808884	Number of obs	149
Residual	264.065399	147	1.79636326	F(1, 147)	1.01
				Prob > F	0.3161
				R-squared	0.0068
				Adj R-squared	0.0001
Total	265.883488	148	1.79651005	Root MSE	1.3403

ramr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	-.0263733	.0262152	-1.01	0.316	-.0781806	.0254341
_cons	3.227511	1.053641	3.06	0.003	1.14527	5.309751

Unrestrained

```
. regress ramr age
```

Source	SS	df	MS		
Model	10.3439582	1	10.3439582	Number of obs	282
Residual	773.352953	280	2.76197483	F(1, 280)	3.75
				Prob > F	0.0540
				R-squared	0.0132
				Adj R-squared	0.0097
Total	783.696911	281	2.78895698	Root MSE	1.6619

ramr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	.0258563	.0133608	1.94	0.054	-.0004441	.0521567
_cons	1.191814	.6170887	1.93	0.054	-.022908	2.406536

Chow Regression

(SSRur – (SSRr1 + SSRr2))/k

(SSR_{r1} + SSR_{r2}))/(n – 3k)

$\frac{(773.35-764.32)/3}{764.32/(282-9)}$ = 1.075 = F stat not significant