Generalized linear models with the Generalized Estimating Equations for the VQI FBVAR Dataset

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Generalized linear models with the Generalized Estimating Equations for continuous outcomes

```
##
## Call:
## geeglm(formula = TOTAL_LOS ~ PRESENTATION + AGECAT + GENDER +
##     PREOP_SMOKING + PRIOR_AORSURG + PRIOR_CHF + PATHOLOGY + NUM_TREATED_BRANCHES,
##     data = FBVAR, id = X + CENTERID, corstr = "independence")
##
##  Coefficients:
##                                  Estimate  Std.err   Wald Pr(>|W|)
## (Intercept)                      14.02345  3.22857 18.866  1.4e-05 ***
## PRESENTATIONSymptomatic           4.37768  1.57643  7.712  0.00549 **
## AGECAT>79                        -5.54926  2.51499  4.869  0.02735 *
## AGECAT50-59                      -5.63310  2.54169  4.912  0.02667 *
## AGECAT60-69                      -6.27540  2.47366  6.436  0.01118 *
## AGECAT70-79                      -3.91186  2.54085  2.370  0.12366
## GENDERmale                       -3.89047  1.24993  9.688  0.00185 **
## PREOP_SMOKINGYes                  1.01738  1.12792  0.814  0.36706
## PRIOR_AORSURGEndo                 1.75589  1.75933  0.996  0.31826
## PRIOR_AORSURGNone                -1.20299  1.03455  1.352  0.24491
## PRIOR_AORSURGOpen                -0.92347  1.05578  0.765  0.38175
## PRIOR_CHFYes                      2.44576  1.25817  3.779  0.05191 .
## PATHOLOGYAneurysm from dissection  0.11921  0.86445  0.019  0.89031
## PATHOLOGYDissection               3.92622  1.71962  5.213  0.02242 *
## PATHOLOGYPAU/IMH                  2.75509  3.02240  0.831  0.36200
## NUM_TREATED_BRANCHES             -0.04634  0.38649  0.014  0.90456
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation structure = independence
## Estimated Scale Parameters:
##
##             Estimate Std.err
## (Intercept)      496   130.3
## Number of clusters:   3289  Maximum cluster size: 2
```

Characteristic	**Beta**	**95% CI**	**p-value**
PRESENTATION			
Asymptomatic	—	—	
Symptomatic	4.4	1.3, 7.5	0.005
AGECAT			
<50	—	—	
>79	-5.5	-10, -0.62	0.027
50-59	-5.6	-11, -0.65	0.027
60-69	-6.3	-11, -1.4	0.011
70-79	-3.9	-8.9, 1.1	0.12
GENDER			
female	—	—	
male	-3.9	-6.3, -1.4	0.002
PREOP_SMOKING			
No	—	—	
Yes	1.0	-1.2, 3.2	0.4
PRIOR_AORSURG			
Both	—	—	
Endo	1.8	-1.7, 5.2	0.3
None	-1.2	-3.2, 0.82	0.2
Open	-0.92	-3.0, 1.1	0.4
PRIOR_CHF			
No	—	—	
Yes	2.4	-0.02, 4.9	0.052
PATHOLOGY			
Aneurysm	—	—	
Aneurysm from dissection	0.12	-1.6, 1.8	0.9
Dissection	3.9	0.56, 7.3	0.022
PAU/IMH	2.8	-3.2, 8.7	0.4
NUM_TREATED_BRANCHES	-0.05	-0.80, 0.71	>0.9

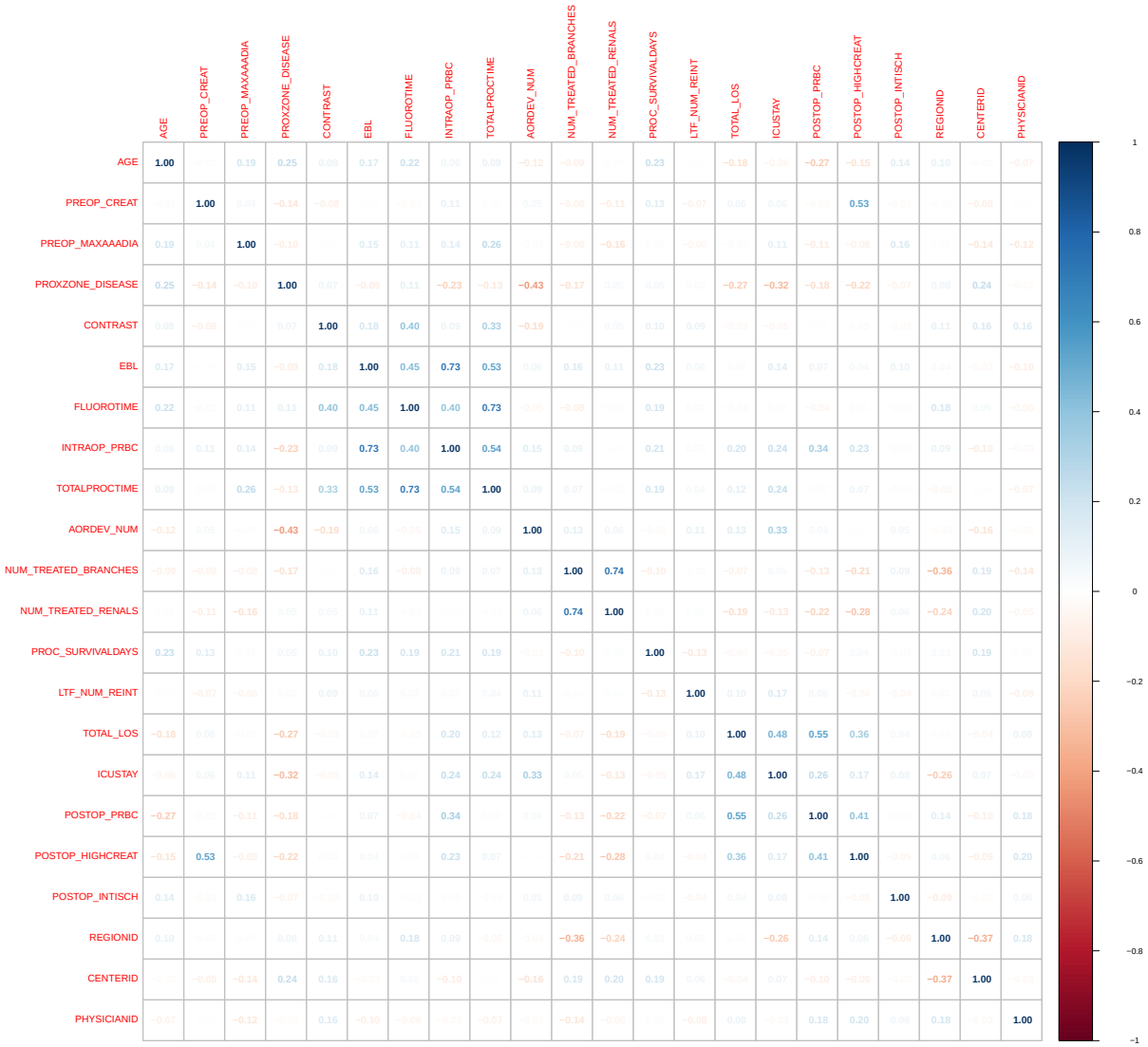
Characteristic	**Beta**	**95% CI**	**p-value**
PRESENTATION			
Asymptomatic	—	—	
Symptomatic	1.5	0.74, 2.3	<0.001
AGECAT			
<50	—	—	
>79	-4.1	-11, 3.2	0.3
50-59	-4.0	-11, 3.5	0.3
60-69	-4.2	-12, 3.3	0.3
70-79	-3.9	-11, 3.4	0.3
GENDER			
female	—	—	
male	-1.0	-1.6, -0.50	<0.001
PREOP_SMOKING			
No	—	—	
Yes	0.41	-0.30, 1.1	0.3
PRIOR_AORSURG			
Both	—	—	
Endo	-0.44	-2.1, 1.2	0.6
None	-1.9	-3.4, -0.44	0.011
Open	-0.52	-2.2, 1.1	0.5
PRIOR_CHF			
No	—	—	
Yes	0.30	-0.18, 0.79	0.2
PATHOLOGY			
Aneurysm	—	—	
Aneurysm from dissection	0.67	-0.49, 1.8	0.3
Dissection	3.9	0.25, 7.5	0.036
PAU/IMH	3.4	-2.3, 9.0	0.2
NUM_TREATED_BRANCHES	0.04	-0.17, 0.26	0.7

Characteristic	**Beta**	**95% CI**	**p-value**
PRESENTATION			
Asymptomatic	—	—	
Symptomatic	0.18	-0.44, 0.81	0.6
AGECAT			
<50	—	—	
>79	-2.7	-7.0, 1.6	0.2
50-59	-1.7	-6.1, 2.8	0.5
60-69	-2.8	-7.1, 1.5	0.2
70-79	-2.5	-6.8, 1.7	0.2
GENDER			
female	—	—	
male	-1.1	-1.4, -0.73	<0.001
PREOP_SMOKING			
No	—	—	
Yes	-0.23	-0.78, 0.32	0.4
PRIOR_AORSURG			
Both	—	—	
Endo	-0.58	-1.7, 0.50	0.3
None	-0.89	-2.0, 0.18	0.10
Open	-0.10	-1.3, 1.1	0.9
PRIOR_CHF			
No	—	—	
Yes	-0.06	-0.31, 0.19	0.6
PATHOLOGY			
Aneurysm	—	—	
Aneurysm from dissection	-0.35	-1.3, 0.61	0.5
Dissection	2.6	0.23, 4.9	0.031
PAU/IMH	0.82	-0.73, 2.4	0.3
NUM_TREATED_BRANCHES	0.07	-0.07, 0.22	0.3

Characteristic	**Beta**	**95% CI**	**p-value**
PRESENTATION			
Asymptomatic	—	—	
Symptomatic	0.38	0.14, 0.61	0.002
AGECAT			
<50	—	—	
>79	-0.16	-1.1, 0.74	0.7
50-59	0.04	-0.88, 0.96	>0.9
60-69	-0.14	-1.0, 0.74	0.7
70-79	-0.10	-1.0, 0.80	0.8
GENDER			
female	—	—	
male	0.13	0.01, 0.25	0.027
PREOP_SMOKING			
No	—	—	
Yes	0.04	-0.13, 0.21	0.6
PRIOR_AORSURG			
Both	—	—	
Endo	0.04	-0.31, 0.39	0.8
None	-0.16	-0.49, 0.18	0.4
Open	-0.10	-0.46, 0.27	0.6
PRIOR_CHF			
No	—	—	
Yes	0.29	0.12, 0.47	0.001
PATHOLOGY			
Aneurysm	—	—	
Aneurysm from dissection	-0.01	-0.38, 0.35	>0.9
Dissection	0.66	-0.30, 1.6	0.2
PAU/IMH	0.19	-0.48, 0.87	0.6
NUM_TREATED_BRANCHES	-0.10	-0.16, -0.04	<0.001

Characteristic	**Beta**	**95% CI**	**p-value**
PRESENTATION			
Asymptomatic	—	—	
Symptomatic	0.01	-0.05, 0.06	0.8
AGECAT			
<50	—	—	
>79	-0.12	-0.32, 0.09	0.3
50-59	-0.09	-0.31, 0.14	0.4
60-69	-0.13	-0.34, 0.08	0.2
70-79	-0.11	-0.32, 0.10	0.3
GENDER			
female	—	—	
male	-0.04	-0.08, 0.00	0.037
PREOP_SMOKING			
No	—	—	
Yes	-0.02	-0.06, 0.03	0.5
PRIOR_AORSURG			
Both	—	—	
Endo	0.01	-0.03, 0.06	0.5
None	0.04	0.00, 0.07	0.070
Open	0.03	-0.03, 0.08	0.3
PRIOR_CHF			
No	—	—	
Yes	0.03	-0.02, 0.08	0.3
PATHOLOGY			
Aneurysm	—	—	
Aneurysm from dissection	-0.01	-0.07, 0.06	0.8
Dissection	0.04	-0.05, 0.13	0.4
PAU/IMH	-0.03	-0.09, 0.04	0.5
NUM_TREATED_BRANCHES	0.00	-0.01, 0.02	0.6

Correlation matrix




```
## $PRESENTATION
## [1] "Asymptomatic" "Symptomatic"
##
## $AGECAT
## [1] ">79"   "60-69" "70-79" "50-59" "<50"
##
## $GENDER
## [1] "male"   "female"
##
## $ETHNICITY
## [1] "None Hispanic or Latino" "Hispanic or Latino"
## [3] NA
```

```
##
## $RACE
## [1] "White"
## [2] "Black or African American"
## [3] "Unknown/Other"
## [4] "Asian"
## [5] "More than 1 race"
## [6] "American Indian or Alaskan Native"
## [7] "Native Hawaiian or other Pacific Islander"
##
## $TRANSFER
## [1] "No"         "Hospital"   "Rehab Unit"
##
## $PRIMARYINSURER
## [1] "Medicare"         "Commercial"       "Non US Insurance" "Medicaid"
## [5] NA                 "Self Pay"         "Military/VA"
##
## $LIVINGSTATUS
## [1] "Home"         "Homeless"     "Nursing home"
##
## $PREOP_FUNCSTATUS
## [1] "Light work"    "Full"          "Assisted care" "Self care"
## [5] NA               "Bed bound"
##
## $PRIOR_CVD
## [1] "No"  "Yes"
##
## $PRIOR_CAD
## [1] "No"  "Yes"
##
## $PRIOR_CHF
## [1] "No"  "Yes"
##
## $COPD
## [1] "No"  "Yes"
##
## $DIABETES
## [1] "No"  "Yes"
##
## $PREOP_DIALYSIS
## [1] "No"  "Yes"
##
## $HTN
## [1] "Yes" "No"  NA
##
## $PREOP_SMOKING
## [1] "Yes" "No"
##
## $PRIOR_CABG
## [1] "No"  "Yes" NA
##
## $PRIOR_PCI
## [1] "No"  "Yes" NA
##
```

```
## $PRIOR_ANEURREP
## [1] "No"  "Yes"
##
## $STRESS
## [1] "No"  "Yes" NA
##
## $DC_ASA
## [1] "Yes" "No"  NA
##
## $DC_P2Y
## [1] "Yes" "No"  NA
##
## $DC_STATIN
## [1] "Yes" "No"  NA
##
## $PRIOR_AORSURG
## [1] "None" "Endo" "Open" "Both"
##
## $PATHOLOGY
## [1] "Aneurysm"                 "PAU/IMH"
## [3] "Dissection"               "Aneurysm from dissection"
##
## $URGENCY
## [1] "Elective" "Urgent"   "Emergent"
##
## $PATHOLOGY_ANEURYSM_TYPE
## [1] "Degenerative, fusiform"        "Anastomotic"
## [3] NA                              "Degenerative, saccular"
## [5] "Intercostal or visceral patch" "Prior trauma"
##
## $PATHOLOGY_DISSECT_TYPE
## [1] NA                  "Chronic, >30 days" "Acute, <= 30 days"
##
## $GENHIST
## [1] "None"          "Non-specific"  "Ehlers-Danlos" "Marfans"
##
## $DISTZONE_DISEASE
##  [1] "9"   "8"   "10B" "10R" "6"   "11R" "10L" "11B" "7"   "11L" "5"
##
## $extent
## [1] "Juxtarenal AAA" "Type 3 TAAA"    "Type 4 TAAA"    "Type 2 TAAA"
## [5] NA               "Type 5 TAAA"    "Type 1 TAAA"
##
## $ANESTHESIA
## [1] "General"  "Regional" "Local"
##
## $IVUSTEE
## [1] "No"   "IVUS" "TEE"  "Both" NA
##
## $ACCESS
## [1] "Open"         "Percutaneous" NA
##
## $ARMNECK_ACCESS
## [1] "No"  "Yes"
```

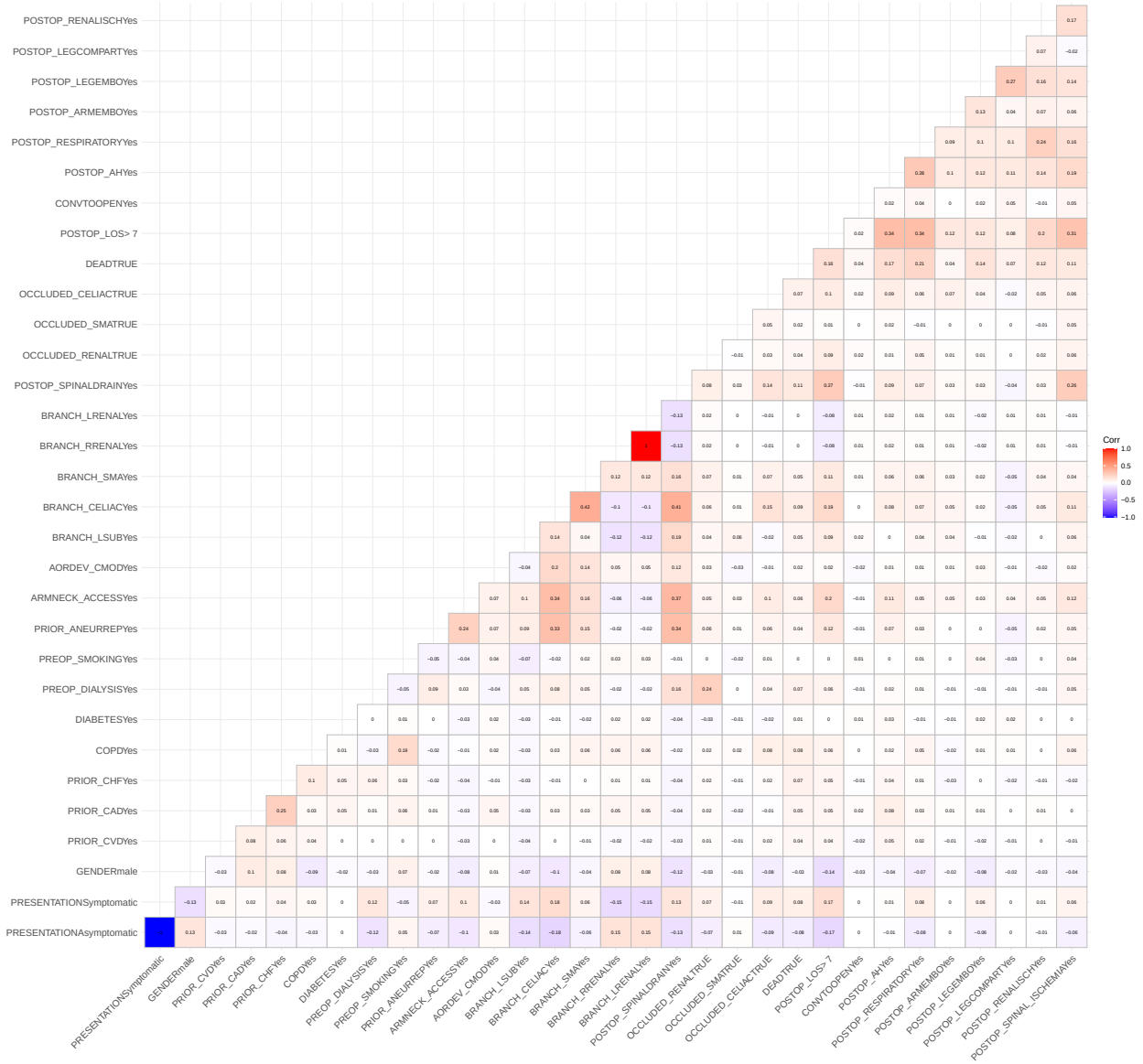
```
##
## $AORDEV_CMOD
## [1] "Yes" "No"
##
## $DEV_GTYPE
## [1] "Custom"             "Physician modified" "Standard"
##
## $ILIACDEV_END_R
## [1] "Common"               NA                     "External, Unintended"
## [4] "None"                 "External,Intended"
##
## $ILIACDEV_END_L
## [1] "External,Intended"    "Common"               NA
## [4] "None"                 "External, Unintended"
##
## $BRANCH_STAGED
## [1] "No"  "Yes" NA
##
## $BRANCH_LSUB
## [1] "No"  "Yes"
##
## $BRANCH_CELIAC
## [1] "Yes" "No"
##
## $BRANCH_SMA
## [1] "Yes" "No"
##
## $BRANCH_RRENAL
## [1] "Yes" "No"
##
## $BRANCH_LRENAL
## [1] "Yes" "No"
##
## $ANESTHESIA_GEN_TIMEEXT
## [1] "In OR"     NA          "<12 hrs"   "12-24 hrs" ">24 hrs"
##
## $POSTOP_SPINALDRAIN
## [1] "No"  "Yes"
##
## $lrenal
## [1] "Scallop/Fen/Branch/Chimney" "None"
## [3] "Occluded/Covered"           NA
##
## $rrenal
## [1] "Scallop/Fen/Branch/Chimney" "None"
## [3] NA                           "Occluded/Covered"
##
## $sma
## [1] "Scallop/Fen/Branch/Chimney" "None"
## [3] NA                           "Occluded/Covered"
##
## $celiac
## [1] "Scallop/Fen/Branch/Chimney" NA
## [3] "None"                       "Occluded/Covered"
```

```
##
## $lsub
## [1] NA                              "None"
## [3] "Scallop/Fen/Branch/Chimney" "Occluded/Covered"
##
## $OCCLUDED_RENAL
## [1] FALSE  TRUE
##
## $OCCLUDED_SMA
## [1] FALSE  TRUE
##
## $OCCLUDED_CELIAC
## [1] FALSE  TRUE
##
## $DEAD
## [1]  TRUE FALSE
##
## $POSTOP_LOS
## [1] "<= 7" "> 7"
##
## $AORDEV_TECHSUCC
## [1] "Yes" NA    "No"
##
## $CONVTOOPEN
## [1] "No"  "Yes"
##
## $LEAKATCOMP_NONE
## [1] "No"  "Yes" NA
##
## $POSTOP_VASO
## [1] "No"  "Yes" NA
##
## $POSTOP_COMPLICATIONS
## [1] "No"  "Yes" NA
##
## $ACCESS_COMPLICATION
## [1] NA    "No"  "Yes"
##
## $POSTOP_AH
## [1] "No"  "Yes"
##
## $POSTOP_CEREBROSX
## [1] "No"  "Yes" NA
##
## $POSTOP_RESPIRATORY
## [1] "No"  "Yes"
##
## $POSTOP_DIALYSIS
## [1] "No"  NA    "Yes"
##
## $POSTOP_ARMEMBO
## [1] "No"  "Yes"
##
## $POSTOP_LEGEMBO
```

```
## [1] "No"  "Yes"
##
## $POSTOP_LEGCOMPART
## [1] "No"  "Yes"
##
## $POSTOP_RENALISCH
## [1] "No"  "Yes"
##
## $POSTOP_SPINAL_ISCHEMIA
## [1] "No"  "Yes"
##
## $RETX_R_RTOR
## [1] "No"  "Yes" NA
##
## $DC_STATUS
## [1] "Home"           "Rehab Unit"     "Homeless"       "Dead"
## [5] "Other Hospital" "Nursing Home"
##
## $BRANCH_POST
## [1] "No"  "Yes" NA
```

```
##            PRESENTATION                  AGECAT                  GENDER
##                       2                       5                       2
##               ETHNICITY                    RACE                TRANSFER
##                       3                       7                       3
##          PRIMARYINSURER            LIVINGSTATUS        PREOP_FUNCSTATUS
##                       7                       3                       6
##              PRIOR_CVD               PRIOR_CAD              PRIOR_CHF
##                       2                       2                       2
##                   COPD                DIABETES          PREOP_DIALYSIS
##                       2                       2                       2
##                    HTN           PREOP_SMOKING              PRIOR_CABG
##                       3                       2                       3
##              PRIOR_PCI          PRIOR_ANEURREP                  STRESS
##                       3                       2                       3
##                 DC_ASA                  DC_P2Y               DC_STATIN
##                       3                       3                       3
##           PRIOR_AORSURG                PATHOLOGY                 URGENCY
##                       4                       4                       3
## PATHOLOGY_ANEURYSM_TYPE  PATHOLOGY_DISSECT_TYPE                 GENHIST
##                       6                       3                       4
##        DISTZONE_DISEASE                  extent              ANESTHESIA
##                      11                       7                       3
##                IVUSTEE                  ACCESS          ARMNECK_ACCESS
##                       5                       3                       2
##             AORDEV_CMOD               DEV_GTYPE          ILIACDEV_END_R
##                       2                       3                       5
##          ILIACDEV_END_L           BRANCH_STAGED             BRANCH_LSUB
##                       5                       3                       2
##           BRANCH_CELIAC              BRANCH_SMA           BRANCH_RRENAL
##                       2                       2                       2
##           BRANCH_LRENAL  ANESTHESIA_GEN_TIMEEXT      POSTOP_SPINALDRAIN
##                       2                       5                       2
##                  lrenal                  rrenal                     sma
```

```
##                     4                     4                     4
##                celiac                  lsub          OCCLUDED_RENAL
##                     4                     4                     2
##           OCCLUDED_SMA        OCCLUDED_CELIAC                  DEAD
##                     2                     2                     2
##             POSTOP_LOS        AORDEV_TECHSUCC             CONVTOOPEN
##                     2                     3                     2
##        LEAKATCOMP_NONE            POSTOP_VASO    POSTOP_COMPLICATIONS
##                     3                     3                     3
##    ACCESS_COMPLICATION             POSTOP_AH       POSTOP_CEREBROSX
##                     3                     2                     3
##     POSTOP_RESPIRATORY        POSTOP_DIALYSIS         POSTOP_ARMEMBO
##                     2                     3                     2
##         POSTOP_LEGEMBO      POSTOP_LEGCOMPART        POSTOP_RENALISCH
##                     2                     2                     2
##  POSTOP_SPINAL_ISCHEMIA            RETX_R_RTOR              DC_STATUS
##                     2                     3                     6
##            BRANCH_POST
##                     3
```




```
## 'data.frame':    3295 obs. of  31 variables:
##  $ PRESENTATION          : chr  "Asymptomatic" "Asymptomatic" "Asymptomatic" "Asymptomatic" ...
##  $ GENDER                : chr  "male" "male" "female" "male" ...
##  $ PRIOR_CVD             : chr  "No" "No" "No" "No" ...
##  $ PRIOR_CAD             : chr  "No" "No" "No" "No" ...
##  $ PRIOR_CHF             : chr  "No" "No" "No" "No" ...
##  $ COPD                  : chr  "No" "No" "No" "Yes" ...
##  $ DIABETES              : chr  "No" "No" "No" "No" ...
##  $ PREOP_DIALYSIS        : chr  "No" "No" "No" "No" ...
##  $ PREOP_SMOKING         : chr  "Yes" "Yes" "Yes" "Yes" ...
##  $ PRIOR_ANEURREP        : chr  "No" "No" "No" "Yes" ...
##  $ ARMNECK_ACCESS        : chr  "No" "No" "No" "No" ...
##  $ AORDEV_CMOD           : chr  "Yes" "Yes" "Yes" "Yes" ...
##  $ BRANCH_LSUB           : chr  "No" "No" "No" "No" ...
```

```
##  $ BRANCH_CELIAC         : chr  "Yes" "Yes" "No" "Yes" ...
##  $ BRANCH_SMA            : chr  "Yes" "Yes" "Yes" "Yes" ...
##  $ BRANCH_RRENAL         : chr  "Yes" "Yes" "Yes" "Yes" ...
##  $ BRANCH_LRENAL         : chr  "Yes" "Yes" "Yes" "Yes" ...
##  $ POSTOP_SPINALDRAIN    : chr  "No" "No" "No" "No" ...
##  $ OCCLUDED_RENAL        : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
##  $ OCCLUDED_SMA          : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
##  $ OCCLUDED_CELIAC       : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
##  $ DEAD                  : logi  TRUE TRUE FALSE TRUE TRUE TRUE ...
##  $ POSTOP_LOS            : chr  "<= 7" "<= 7" "<= 7" "<= 7" ...
##  $ CONVTOOPEN            : chr  "No" "No" "No" "No" ...
##  $ POSTOP_AH             : chr  "No" "No" "No" "No" ...
##  $ POSTOP_RESPIRATORY    : chr  "No" "No" "No" "No" ...
##  $ POSTOP_ARMEMBO        : chr  "No" "No" "No" "No" ...
##  $ POSTOP_LEGEMBO        : chr  "No" "No" "No" "No" ...
##  $ POSTOP_LEGCOMPART     : chr  "No" "No" "No" "No" ...
##  $ POSTOP_RENALISCH      : chr  "No" "No" "No" "No" ...
##  $ POSTOP_SPINAL_ISCHEMIA: chr  "No" "No" "No" "No" ...
```

Code Appendix

```
knitr::opts_chunk$set(echo = FALSE,message = FALSE,warning = FALSE)
knitr::opts_chunk$set(fig.width=20, fig.height=20)

library(tidyverse)
library(table1)
library(survival)
library(Hmisc)
library(ggplot2)
library(ggpubr)
library(corrplot)
library(caret)
library(survminer)
library(knitr)
library(kableExtra)

## ------------- working directories for Lily ----------
#wd_lily = '/Users/hanyiwang/Desktop/Comparative-analysis-of-treatments-of-CAA'
# path_lily = c("../data/FBVAR.csv")


## ------------- working directories for Jenn ----------
wd_jenn = '/Users/jenniferci/Desktop/stlp new laptop/Capstone/Comparative-analysis-of-treatments-of-CAA
path_jenn = c("FBVAR.csv")

## ------------- working directories for Thu ----------
# wd_thu = '/Users/thuvu/Desktop/Comparative-analysis-of-treatments-of-CAA'
# path_thu = c("FBVAR.csv")

## ------------- read data ----------
#setwd(wd_lily)
#FBVAR = read.csv(path_lily)

setwd(wd_jenn)
FBVAR = read.csv(path_jenn)

# setwd(wd_thu)
# FBVAR = read.csv(path_thu)

library(geepack)
library(gtsummary)

# repeated patients, need id, geeglm needs complete data, extent is not complete
LOS<-geeglm(TOTAL_LOS ~ PRESENTATION+AGECAT+GENDER+PREOP_SMOKING+PRIOR_AORSURG+PRIOR_CHF+PATHOLOGY+NUM_
            , data=FBVAR, id = X + CENTERID, corstr = "independence")
summary(LOS)
LOS %>%tbl_regression

#adjust<-c('PRESENTATION','AGECAT', 'GENDER', 'PREOP_SMOKING','PRIOR_AORSURG', 'PRIOR_CHF','PATHOLOGY',
#FBVAR %>%
#  tbl_uvregression(
#    y = TOTAL_LOS,
```

```
#    x = PRESENTATION+AGECAT+GENDER+PREOP_SMOKING+PRIOR_AORSURG+PRIOR_CHF+PATHOLOGY+NUM_TREATED_BRANCHE
#    method = geepack::geeglm,
#    method.args = list(id = X+CENTERID, corstr = "independence"),
#    include = all_of(adjust)
#  ) %>%
#  as_kable()


ICU<-geeglm(ICUSTAY ~ PRESENTATION+AGECAT+GENDER+PREOP_SMOKING+PRIOR_AORSURG+PRIOR_CHF+PATHOLOGY+NUM_TR
            , data=FBVAR, id = CENTERID, corstr = "independence")
ICU %>%tbl_regression




POSTOP_PRBC<-geeglm(POSTOP_PRBC ~ PRESENTATION+AGECAT+GENDER+PREOP_SMOKING+PRIOR_AORSURG+PRIOR_CHF+PATH
POSTOP_PRBC %>%tbl_regression

POSTOP_HIGHCREAT<-geeglm(POSTOP_HIGHCREAT ~ PRESENTATION+AGECAT+GENDER+PREOP_SMOKING+PRIOR_AORSURG+PRIO
                         , data=FBVAR, id = CENTERID, corstr = "independence")
POSTOP_HIGHCREAT %>%tbl_regression







POSTOP_INTISCH<-geeglm(POSTOP_INTISCH ~ PRESENTATION+AGECAT+GENDER+PREOP_SMOKING+PRIOR_AORSURG+PRIOR_CH
                       , data=FBVAR, id = CENTERID, corstr = "independence")
POSTOP_INTISCH %>%tbl_regression




#model<-geeglm(outcome~predictor+confounder, family=binomial(link = "logit"),
#data=na.omit(data), corstr='ar1', id=id, std.err="san.se")
#TOTAL_LOS

#ICUSTAY
#POSTOP_PRBC
#POSTOP_HIGHCREAT

#POSTOP_INTISCH



library(corrplot)
library(tidyverse)
library(caret)
library(ggcorrplot)

matrix <- FBVAR %>%
    select_if(is.numeric) %>% subset(., select = -1)%>%
```

```
    cor(.,use = "complete")

corrplot(matrix, method="number")



#select dataset that column are not numeric
matrix <- FBVAR %>% select_if(negate(is.numeric))


# find out the variables
lapply(matrix[,], unique)
sapply(lapply(matrix, unique), length)

#select if more than one variable
y<-matrix %>%select_if(function(col) length(unique(col))==2)

# Convert all columns to factor
data3 <- as.data.frame(unclass(y),
                       stringsAsFactors = TRUE)



 model.matrix(~0 +., data=data3) %>%
  cor(use="pairwise.complete.obs") %>%
  ggcorrplot(show.diag = F, type="lower", lab=TRUE, lab_size=2)



str(y)
```