

Data Preprocessing for the VQI TEVAR Dataset

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Datasets Merging

Compare the data from July 2021 and September 2021. Keep the most updated ones.

There are 6 rows from LTF July data missing in September dataset. And also 6 missing from the PROC dataset.

Variables that exists in both LTF and PROC datasets are: PATIENTID, PRIMPROCID, DEAD, PROC_SURVIVALDAYS. Merge by these variables.

In the long term followup dataset, the variables used in this project are: PATIENTID, DEAD, PROC_SURVIVALDAYS, LTF_NUM_REINT

Initially, there are in total 25211 objectives in the dataset.

Exclusion criteria:

- PRESENTATION: exclude rupture patients
- PATHOLOGY: exclude groups with pathology: 4 = trauma, 8 = Aortic Thrombus, 9 = Other, 10 = Aorto-esophageal Fistula, 11 = Aorto-bronchial Fistula
- URGENCY: exclude rupture. (elective is the same as asymptomatic)
- PROXZONE_DISEASE: exclude 0 and 1
- DISTZONE_DISEASE: exclude 0
- PROXZONE_DISEASE < DISTZONE_DISEASE: disease starting point should be earlier than ending point. 35 wrong data points with distal zone < proximal zone are excluded.

After exclsion, there are in total 15424 objectives in the final TEVAR dataset. 1995 participants have more than one records in this dataset.

Data Cleaning

Patient demographic and co-morbidities

- Comorbidity history variables: changed to Yes/No scale.
- PREOP_CREAT: merge PREOP_CREAT with retired R_CR_PRESENT (mg/dL)

Operative variables

- PATHOLOGY: merge levels PAU and IMH
- extent: type of TAAA based on certain criteria calculated by PROXZONE_DISEASE and DISTZONE_DISEASE.
- ILIACDEV_END: from merging ILIACDEV_END_R, ILIACDEV_END_L
- ACCESS: from merging ACCESS_R, ACCESS_L: Percutaneous if both are Percutaneous, Open o.w.

- DEV_GTYPE: merge DEV1_GTYPE, DEV2_GTYPE, DEV3_GTYPE: If one device is ‘Custom’ or ‘Physician modified’, classified to this instead of ‘Standard’

Filter FBVAR patients based on having at least one branch, re-leveled as following.

- lrenal: re-leveled BRANCH_LRENAL_TRT, retired version R_LT_RENAL ignored.
- rrenal: re-leveled BRANCH_RRENAL_TRT, retired version R_RT_RENAL ignored.
- sma: re-leveled BRANCH_SMA_TRT, retired version R_SMA ignored.
- celiac: re-leveled BRANCH_CELIAC_TRT, retired version R_CELIAC ignored.
- lsub: re-leveled BRANCH_LSUB_TRT, retired version R_L_SUBCLAV ignored.

Current levels: 0 = None, 1 = Purposely covered, 2 = Unintentionally covered, 3 = Occluded - coil, 4 = Occluded - plug, 5 = Occluded - open, 6 = Stent, 7 = Stent-graft, 8 = Chimney, 9 = Scallop, 10 = Stented Scallop, 11 = Fenestration, 12 = Stented-fen, 13 = Fen branch, 14 = Side-arm branch, 15 = Surgical bypass, 16 = Thromboembolectomy, 17 = Iliac Device

ignore some retired variables without current version

- R_DISTATTZONE: Distal Attachment Zone
- R_GDPROXIMAL: Graft Diameter Proximal
- R_GRFTCONFIG: Graft Configuration
- R_PRATTZONE: Prox. Attachment Zone

Among the whole dataset, we filtered out 3510 FBVAR patients for our study.

Outcomes

- Create POSTOP_AH: Combine POSTOP_AH, POSTOP_MI, POSTOP_DYSRHYTHMIA for post-procedure abnormal heart disease
- Create BRANCH_POST: BRANCH_XXX_POST changed to Yes/No scale. Then combine BRANCH_LSUB_POST, BRANCH_CELIAC_POST, BRANCH_SMA_POST, BRANCH_RRENAL_POST, BRANCH_LRENAL_POST, BRANCH_RCOMILI_POST, BRANCH_LCOMILI_POST

update some variables with current version

- R_ENDOLEAK_AT_COMPLETION => LEAKATCOM_XXX variables. Only use LEAKATCOMP_NONE. Ignore others or have a brief look
- R_POSTOP_HEMATOMA => ACCESS_HEMATOMA_R, ACCESS_HEMATOMA_L; R_POSTOP_SITEOCC => ACCESS_OCCLUSION_R, ACCESS_OCCLUSION_L. Merge hematoma and occlusion, create new variable: ACCESS_COMPLICATION
- R_POSTOP_SSI => ACCESS_INFECTION_R, ACCESS_INFECTION_L Merge left and right, create new variable: ACCESS_INFECTION

ignore some retired version variables, only use the current version

- R_POSTOP_BOWELISCH <= POSTOP_INTISCH: Bowel Ischemia
- R_LE_ISCH <= POSTOP_LEGEMBO: LE Ischemia
- R_POSTOP_RENAL <= POSTOP_DIALYSIS: change of renal function

Others

Variables we cleaned but are not needed after discussion goes here.

Volume variables

Store a new dataset for further study

Select the variable related to our study. Give them labels for better-looking tables. Finally store the new dataset as a separate csv file, so that we could use the cleaned dataset in the future modeling.

Code Appendix

```
knitr::opts_chunk$set(echo = FALSE,message = FALSE,warning = FALSE)
library(tidyverse)
library(Hmisc)
library(table1)
library(ggplot2)
## ----- working directories for Lily -----
wd_lily = '/Users/hanyiwang/Desktop/Comparative-analysis-of-treatments-of-CAA'
path_lily = c(
  "../data/TEVAR_International_20210712/TEVAR_International_LTF_r12_2_14_20210701.csv",
  "../data/TEVAR_International_20210712/TEVAR_International_PROC_r12_2_14_20210701.csv",
  "../data/TEVAR_International_20210901/TEVAR_International_LTF_r12_2_14_20210901.csv",
  "../data/TEVAR_International_20210901/TEVAR_International_PROC_r12_2_14_20210901.csv",
  "../data/FBVAR.csv")

## ----- working directories for Jenn -----
wd_jenn = '/Users/jenniferici/Desktop/Comparative-analysis-of-treatments-of-CAA-main'
path_jenn = c(
  "/Users/jenniferici/Desktop/Comparative-analysis-of-treatments-of-CAA-main/TEVAR_International_20210712",
  "/Users/jenniferici/Desktop/Comparative-analysis-of-treatments-of-CAA-main/TEVAR_International_20210712",
  "/Users/jenniferici/Desktop/Comparative-analysis-of-treatments-of-CAA-main/TEVAR_International_20210901",
  "/Users/jenniferici/Desktop/Comparative-analysis-of-treatments-of-CAA-main/TEVAR_International_20210901")

## ----- read data -----
setwd(wd_lily)
TEVAR_LTF_07 = read.csv(path_lily[1])
TEVAR_PROC_07 = read.csv(path_lily[2])
TEVAR_LTF_09 = read.csv(path_lily[3])
TEVAR_PROC_09 = read.csv(path_lily[4])

#setwd(wd_jenn)
#TEVAR_LTF_07 = read.csv(path_jenn[1])
#TEVAR_PROC_07 = read.csv(path_jenn[2])
#TEVAR_LTF_09 = read.csv(path_jenn[3])
#TEVAR_PROC_09 = read.csv(path_jenn[4])
## ----- merge July and September data -----

# find data in LTF July data but not in LTF September data by `PATIENTID`
# add these data points to the September data
TEVAR_LTF <- rbind(TEVAR_LTF_07[! TEVAR_LTF_07$PATIENTID %in% TEVAR_LTF_09$PATIENTID,],
  TEVAR_LTF_09)

# filter the variables in the LTF dataset
TEVAR_LTF <- TEVAR_LTF %>% select(PATIENTID, PRIMPROCID, DEAD, PROC_SURVIVALDAYS, LTF_NUM_REINT)

# Similar for PROC data
TEVAR_PROC <-rbind(TEVAR_PROC_07[! TEVAR_PROC_07$PATIENTID %in% TEVAR_PROC_09$PATIENTID,],
  TEVAR_PROC_09)

## ----- merge LTF and PROC data-----
# same variables in LTF and PROC data
#colnames(TEVAR_PROC)[colnames(TEVAR_PROC) %in% colnames(TEVAR_LTF)]
```

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TEVAR <- merge(TEVAR_LTF,TEVAR_PROC, all = TRUE,
              by=c("PATIENTID","PRIMPROCID","DEAD","PROC_SURVIVALDAYS"))

## ----- exclusion-----
TEVAR = TEVAR %>%
  filter(PRESENTATION !=2) %>%
  filter(PATHOLOGY %in% c(1,2,3,5,6,7)) %>%
  filter(URGENCY %in% c(1,2,3)) %>%
  filter(PROXZONE_DISEASE %in% c(2,3,4,5,6,7,8,9)) %>%
  filter(DISTZONE_DISEASE > PROXZONE_DISEASE)

n_occur <- data.frame(table(TEVAR$PATIENTID))
#n_occur[n_occur$Freq > 1,]%>%n_distinct

## ----- variables cleaning, patient demographic and co-morbidities-----
TEVAR = TEVAR %>%
  mutate(AGECAT = factor(AGECAT,levels = c(1,2,3,4,5,6,7),
                        labels = c('<40','40-49','50-59','60-69','70-79','80-89','>89')) %>%
  mutate(URGENCY=factor(URGENCY,levels = c(1,2,3),labels = c('Elective','Urgent','Emergent')) %>%
  mutate(GENDER=factor(GENDER,levels=c(1,2),labels=c('male','female')) %>%
  mutate(R_PREOP_AMBUL = factor(R_PREOP_AMBUL,levels = c(1,2,3,4),
                              labels=c('Amb',"Amb w/ Assistance","Wheelchair","Bedridden")) %>%
  mutate(ETHNICITY = factor(ETHNICITY,levels=c(0,1),
                              labels = c('None Hispanic or Latino','Hispanic or Latino')) %>%
  mutate(RACE=factor(RACE,levels = c(5,3,2,1,4,6,7),
                              labels = c('White','Black or African American','Asian',
                                          'American Indian or Alaskan Native',
                                          'Native Hawaiian or other Pacific Islander','More than 1 race',
                                          'Unknown/Other')) %>%
  mutate(TRANSFER=factor(TRANSFER,levels = c(0,1,2),labels = c('No','Hospital','Rehab Unit')) %>%
  mutate(PRIMARYINSURER=factor(PRIMARYINSURER,levels=c(1,2,3,4,5,6),
                              labels = c('Medicare','Medicaid','Commercial','Military/VA',
                                          'Non US Insurance','Self Pay')) %>%
  mutate(LIVINGSTATUS=factor(LIVINGSTATUS,levels=c(1,2,3),
                              labels=c('Home','Nursing home','Homeless')) %>%
  mutate(PREOP_FUNCSTATUS=factor(PREOP_FUNCSTATUS,levels = c(0,1,2,3,4),
                              labels = c('Full','Light work','Self care','Assisted care',
                                          'Bed bound')) %>%
  mutate(PRIOR_CVD = factor(PRIOR_CVD,levels =c(0,1,2,3),labels = c('No','Yes','Yes','Yes')) %>%
  mutate(PRIOR_CAD = factor(PRIOR_CAD,levels =c(0,1,2,3,4,5),
                              labels = c('No','Yes','Yes','Yes','Yes','Yes')) %>%
  mutate(PRIOR_CHF = factor(PRIOR_CHF,levels =c(0,1,2,3,4),
                              labels = c('No','Yes','Yes','Yes','Yes')) %>%
  mutate(COPD = factor(COPD,levels = c(0,1,2,3),labels = c('No','Yes','Yes','Yes')) %>%
  mutate(DIABETES=factor(DIABETES,levels = c(0,1,2,3),labels = c('No','Yes','Yes','Yes')) %>%
  mutate(PREOP_DIALYSIS=factor(PREOP_DIALYSIS,levels=c(0,1,2),labels=c('No','Yes','Yes')) %>%
  mutate(HTN=factor(HTN,levels = c(0,1,2,3),labels = c('No','Yes','Yes','Yes')) %>%
  mutate(PREOP_SMOKING=factor(PREOP_SMOKING,levels=c(0,1,2),labels=c('No','Yes','Yes')) %>%
  mutate(PRIOR_CABG = factor(PRIOR_CABG,levels = c(0,1,2),labels = c('No','Yes','Yes')) %>%
  mutate(PRIOR_PCI = factor(PRIOR_PCI,levels = c(0,1,2),labels = c('No','Yes','Yes')) %>%
  mutate(PRIOR_ANEURREP = factor(PRIOR_ANEURREP,levels =c(0,1,2,3,4,5),
                              labels = c('No','Yes','Yes','Yes','Yes','Yes')) %>%
  mutate(STRESS = factor(STRESS,levels =c(0,1,2,3,4),

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        labels = c('No', 'Yes', 'Yes', 'Yes', 'Yes')) %>%
mutate(DC_ASA = factor(DC_ASA, levels = c(0,1,2,3), labels = c('No', 'Yes', 'No', 'No')) %>%
mutate(DC_P2Y = factor(DC_P2Y, levels = c(0,1,2,3,4,5,6,7),
        labels = c('No', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'No', 'No')) %>%
mutate(DC_STATIN = factor(DC_STATIN, levels = c(0,1,2,3), labels = c('No', 'Yes', 'No', 'No')) %>%
## merge PREOP_CREAT, R_CR_PRESENT
mutate(PREOP_CREAT = coalesce(PREOP_CREAT, R_CR_PRESENT))

## ----- variables cleaning, operative variables-----

TEVAR = TEVAR %>% mutate(
  PRESENTATION = factor(PRESENTATION, levels = c(0,1), labels = c('Asymptomatic', 'Symptomatic')),
  extent = ifelse((PROXZONE_DISEASE %in% c(2,3)) & DISTZONE_DISEASE<6, 1,
    ifelse((PROXZONE_DISEASE %in% c(2,3)) & DISTZONE_DISEASE>=8, 2,
      ifelse((PROXZONE_DISEASE %in% c(4,5)) & DISTZONE_DISEASE>=8, 3,
        ifelse((PROXZONE_DISEASE <=7) & DISTZONE_DISEASE>=8, 4,
          ifelse((PROXZONE_DISEASE %in% c(4,5)) & DISTZONE_DISEASE<9, 5,
            ifelse( PROXZONE_DISEASE<=8 & DISTZONE_DISEASE>=9, 6, NA))))),
mutate(extent = factor(extent, levels=c(1,2,3,4,5,6),
        labels = c("Type 1 TAAA", "Type 2 TAAA", "Type 3 TAAA", "Type 4 TAAA",
          "Type 5 TAAA", "Juxtarenal AAA")) %>%
mutate(PROXZONE_DISEASE=factor(PROXZONE_DISEASE)) %>%
mutate(DISTZONE_DISEASE=
  factor(DISTZONE_DISEASE, levels = c(0:15),
    labels = c(0,1,2,3,4,5,6,7,8,9, '10R', '10L', '10B', '11R', '11L', '11B'))

TEVAR = TEVAR %>%
mutate(PATHOLOGY=factor(PATHOLOGY, levels=c(1,2,3,5,6,7),
        labels = c('Aneurysm', 'Dissection', 'Aneurysm from dissection',
          'PAU/IMH', 'PAU/IMH', 'PAU/IMH')) %>%
mutate(PRIOR_AORSURG=factor(PRIOR_AORSURG, levels=c(0,1,2,3,4),
        labels=c('None', 'Open', 'Endo', 'Both', 'Other')) %>%
mutate(PATHOLOGY_ANEURYSM_TYPE=
  factor(PATHOLOGY_ANEURYSM_TYPE, levels = c(1,2,3,4,5),
    labels = c('Degenerative, fusiform', 'Degenerative, saccular', 'Anastomotic',
      'Prior trauma', 'Intercostal or visceral patch')) %>%
mutate(PATHOLOGY_DISSECT_TYPE=
  factor(PATHOLOGY_DISSECT_TYPE, levels = c(1,2),
    labels = c('Acute, <= 30 days', 'Chronic, >30 days')) %>%
mutate(GENHIST = factor(GENHIST, levels = c(0,1,2,3,4,5),
        labels = c('None', 'Marfans', 'Ehlers-Danlos', 'Loeys-Dietz',
          'Non-specific', 'Other')) %>%
mutate(ANESTHESIA=factor(ANESTHESIA, levels = c(1,2,3), labels = c('Local', 'Regional', 'General')) %>%
mutate(IVUSTEE=factor(IVUSTEE, levels = c(0:5), labels = c('No', 'IVUS', 'TEE', 'Both', 'No', 'IVUS')) %>%
## merge ACCESS_L and ACCESS_R
mutate(ACCESS = ifelse(ACCESS_L == 1 & ACCESS_R ==1, 'Percutaneous', 'Open')) %>%
mutate(ACCESS=factor(ACCESS)) %>%
mutate(ARMNECK_ACCESS=factor(ARMNECK_ACCESS, levels = c(0,1,2,3),
        labels = c('No', 'For branch treatment',
          'For femoral-brachial wire', 'For both')) %>%
mutate(AORDEV_NUM=factor(AORDEV_NUM)) %>%

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mutate(AORDEV_CMED=factor(AORDEV_CMED,levels=c(0,1),labels=c('No','Yes'))) %>%
mutate(STAGEDAORTRT=factor(STAGEDAORTRT,levels=c(0,1),labels=c('No','Yes'))) %>%
## DEV_GTYPE: merge DEV1_GTYPE, DEV2_GTYPE, DEV3_GTYPE
mutate(DEV_GTYPE = case_when(DEV1_GTYPE==2|DEV2_GTYPE==2|DEV3_GTYPE==2 ~ 'Custom',
                             DEV1_GTYPE==3|DEV2_GTYPE==3|DEV3_GTYPE==3 ~ 'Physician modified',
                             TRUE ~ 'Standard')) %>%
mutate(DEV1_GTYPE=factor(DEV1_GTYPE,levels=c(1,2,3),
                             labels=c('Standard','Custom','Physician modified'))) %>%
mutate(DEV2_GTYPE=factor(DEV2_GTYPE,levels=c(1,2,3),
                             labels=c('Standard','Custom','Physician modified'))) %>%
mutate(DEV3_GTYPE=factor(DEV3_GTYPE,levels=c(1,2,3),
                             labels=c('Standard','Custom','Physician modified')))

TEVAR = TEVAR %>%
mutate(ILIACDEV_END_R= factor(ILIACDEV_END_R, levels = c(0,1,2,3),
                             labels = c('None','Common',
                                           'External,Intended','External, Unintended')))) %>%
mutate(ILIACDEV_END_L= factor(ILIACDEV_END_L, levels = c(0,1,2,3),
                             labels = c('None','Common',
                                           'External,Intended','External, Unintended')))) %>%
mutate(BRANCH_STAGED=factor(BRANCH_STAGED,levels=c(0,1),labels=c('No','Yes'))) %>%
mutate(BRANCH_LSUB=factor(BRANCH_LSUB,levels=c(0,1),labels=c('No','Yes'))) %>%
mutate(BRANCH_CELIAC=factor(BRANCH_CELIAC,levels=c(0,1),labels=c('No','Yes'))) %>%
mutate(BRANCH_SMA=factor(BRANCH_SMA,levels=c(0,1),labels=c('No','Yes'))) %>%
mutate(BRANCH_RRENAL=factor(BRANCH_RRENAL,levels=c(0,1),labels=c('No','Yes'))) %>%
mutate(BRANCH_LRENAL=factor(BRANCH_LRENAL,levels=c(0,1),labels=c('No','Yes'))) %>%
mutate(BRANCH_INNO_POST=factor(BRANCH_INNO_POST,levels=c(1,2,3),
                             labels=c('Patent','Stenosis/Partial Coverage > 50%','Occluded')))) %>%
mutate(BRANCH_LSUB_VERTPAT=
       factor(BRANCH_LSUB_VERTPAT,levels=c(1:7),
              labels=c('Patent bilat','Patent bilat, L dominant','Patent bilat, R dominant',
                        'Occluded L, patent R','Occluded R, patent L','Occluded bilat',
                        'Not imaged')))) %>%
mutate(ANESTHESIA_GEN_TIMEEXT=factor(ANESTHESIA_GEN_TIMEEXT,levels=c(1,2,4,5),
                             labels=c('In OR','<12 hrs','12-24 hrs','>24 hrs')))) %>%
mutate(POSTOP_SPINALDRAIN=factor(POSTOP_SPINALDRAIN,levels=c(0,1,2,3),
                             labels=c('None','Pre-op','Post-op, prophylactic',
                                       'Post-op for spinal ischemia'))))

## ----- BRANCH_TRT filtering-----
TEVAR<-TEVAR %>%
mutate(lrenal = ifelse(BRANCH_LRENAL_TRT %in% c(0,6,7), 0,
                      ifelse(BRANCH_LRENAL_TRT %in% c(9,10,11,12,13,14), 1,
                              ifelse(BRANCH_LRENAL_TRT %in% c(1,2,3,4), 2,
                                      ifelse(BRANCH_LRENAL_TRT == 8, 3,NA))))),
       rrenal = ifelse(BRANCH_RRENAL_TRT %in% c(0,6,7), 0,
                      ifelse(BRANCH_LRENAL_TRT %in% c(9,10,11,12,13,14), 1,
                              ifelse(BRANCH_LRENAL_TRT %in% c(1,2,3,4), 2,
                                      ifelse(BRANCH_LRENAL_TRT == 8, 3,NA))))),
       sma = ifelse(BRANCH_SMA_TRT %in% c(0,6,7), 0,
                    ifelse(BRANCH_SMA_TRT %in% c(9,10,11,12,13,14), 1,
                            ifelse(BRANCH_SMA_TRT %in% c(1,2,3,4), 2,
                                    ifelse(BRANCH_SMA_TRT == 8,3,NA))))),

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    celiac = ifelse(BRANCH_CELIAC_TRT %in% c(0,6,7), 0,
                    ifelse(BRANCH_CELIAC_TRT %in% c(9,10,11,12,13,14), 1,
                            ifelse(BRANCH_CELIAC_TRT %in% c(1,2,3,4), 2,
                                    ifelse(BRANCH_CELIAC_TRT == 8,3,NA))))),
    lsub = ifelse(BRANCH_LSUB_TRT %in% c(0,6,7), 0,
                  ifelse(BRANCH_LSUB_TRT %in% c(9,10,11,12,13,14), 1,
                          ifelse(BRANCH_LSUB_TRT %in% c(1,2,3,4), 2,
                                  ifelse(BRANCH_LSUB_TRT == 8,3,NA))))))

## ----- FBVAR filtering-----
TEVAR = TEVAR %>%
  filter(lrenal == 1 | rrenal== 1 | sma== 1 | celiac== 1 | lsub== 1)

TEVAR = TEVAR %>%
  mutate(lrenal=factor(lrenal,levels=c(0,1,2,3),
                           labels=c('None','Scallop/Fen/Branch','Occluded/Covered','Chimney')) %>%
  mutate(rrenal=factor(rrenal,levels=c(0,1,2,3),
                           labels=c('None','Scallop/Fen/Branch','Occluded/Covered','Chimney')))%>%
  mutate(sma=factor(sma,levels=c(0,1,2,3),
                           labels=c('None','Scallop/Fen/Branch','Occluded/Covered','Chimney')))%>%
  mutate(celiac=factor(celiac,levels=c(0,1,2,3),
                           labels=c('None','Scallop/Fen/Branch','Occluded/Covered','Chimney')))%>%
  mutate(lsub=factor(lsub,levels=c(0,1,2,3),
                           labels=c('None','Scallop/Fen/Branch','Occluded/Covered','Chimney'))))

## ----- variables cleaning, outcomes-----
TEVAR = TEVAR %>%
  mutate(DEAD=factor(DEAD,levels=c(0,1),labels = c('No','Yes')) %>%
  mutate(AORDEV_TECHSUCC=factor(AORDEV_TECHSUCC,levels=c(0,1),labels=c('No','Yes')) %>%
  mutate(CONVTOOPEN=factor(CONVTOOPEN,levels=c(0,1),labels=c('No','Yes')) %>%
  mutate(LEAKATCOMP_NONE=factor(LEAKATCOMP_NONE,levels=c(0,1),labels = c('No','Yes')) %>%
  mutate(POSTOP_VASO=factor(POSTOP_VASO,levels=c(0,1,2,3),labels=c('No','Yes','Yes','Yes')) %>%
  mutate(POSTOP_COMPLICATIONS=factor(POSTOP_COMPLICATIONS,levels=c(0,1),labels=c('No','Yes')) %>%
  # ACCESS_COMPLICATION
  mutate (ACCESS_COMPLICATION=case_when(ACCESS_HEMATOMA_R!=0 | ACCESS_HEMATOMA_L!=0 |
                                         ACCESS_OCCLUSION_R !=0 | ACCESS_OCCLUSION_L !=0 ~ "Yes",
                                         TRUE ~ "No")) %>%

## POSTOP_AH: merge POSTOP_MI,POSTOP_DYSRHYTHMIA,POSTOP_CHF
  mutate(POSTOP_MI=factor(POSTOP_MI,levels=c(0,1,2),labels=c('No','Yes','Yes')) %>%
  mutate(POSTOP_DYSRHYTHMIA=factor(POSTOP_DYSRHYTHMIA,levels=c(0,1),labels=c('No','Yes')) %>%
  mutate(POSTOP_CHF=factor(POSTOP_CHF,levels=c(0,1),labels=c('No','Yes')) %>%
  mutate(POSTOP_AH=case_when(POSTOP_MI=='Yes'|POSTOP_DYSRHYTHMIA=='Yes'|POSTOP_CHF=='Yes' ~ "Yes",
                             POSTOP_MI=='No'|POSTOP_DYSRHYTHMIA=='No'|POSTOP_CHF=='No' ~ "No")) %>%

  mutate(POSTOP_RESPIRATORY=factor(POSTOP_RESPIRATORY,levels = c(0:3),
                                   labels = c('No','Yes','Yes','Yes')) %>%
  mutate(POSTOP_DIALYSIS=factor(POSTOP_DIALYSIS,levels = c(0:2),
                                   labels = c('No','Yes','Yes')) %>%
  mutate(POSTOP_ARMEMBO=factor(POSTOP_ARMEMBO,levels = c(0:5),
                                   labels = c('No','Yes','Yes','Yes','Yes','Yes')) %>%
  mutate(POSTOP_LEGEMBO=factor(POSTOP_LEGEMBO,levels = c(0:5),
                                   labels = c('No','Yes','Yes','Yes','Yes','Yes')) %>%

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mutate(POSTOP_LEGCOMPART=factor(POSTOP_LEGCOMPART,levels = c(0:4),
                                labels = c('No','Yes','Yes','Yes','Yes')) %>%
mutate(POSTOP_RENALISCH=factor(POSTOP_RENALISCH,levels = c(0:3),
                                labels = c('No','Yes','Yes','Yes')) %>%
mutate(POSTOP_SPINAL_ISCHEMIA=factor(POSTOP_SPINAL_ISCHEMIA,levels = c(0:2),
                                labels = c('No','Yes','Yes')) %>%

## RETX_R_RTOR: merge RETX, R_RTOR
mutate(RETX=factor(RETX,levels = c(0:2),labels = c('No','Yes','Yes')) %>%
mutate(R_RTOR=factor(R_RTOR,levels = c(0:5),labels = c('No','Yes','Yes','Yes','Yes')) %>%
mutate (RETX_R_RTOR=case_when(RETX=="Yes"|R_RTOR=="Yes" ~ "Yes",
                              RETX=="No" & R_RTOR=="No" ~ "No",
                              RETX=="No"&is.na(R_RTOR) ~ "No",
                              R_RTOR=="No"&is.na(RETX) ~ "No",
                              is.na(R_RTOR) & is.na(RETX) ~ NA_character_) %>%
mutate(DC_STATUS=factor(DC_STATUS,levels = c(1:6),
                        labels = c('Home','Rehab Unit','Nursing Home',
                                   'Dead','Other Hospital','Homeless')) %>%

## BRANCH_XXX_POST
mutate(BRANCH_LSUB_POST=factor(BRANCH_LSUB_POST,levels=c(1,2,3),
                              labels=c('No','Yes','Yes')) %>%
mutate(BRANCH_CELIAC_POST=factor(BRANCH_CELIAC_POST,levels=c(1,2,3),
                              labels=c('No','Yes','Yes')) %>%
mutate(BRANCH_SMA_POST=factor(BRANCH_SMA_POST,levels=c(1,2,3),
                              labels=c('No','Yes','Yes')) %>%
mutate(BRANCH_RRENAL_POST=factor(BRANCH_RRENAL_POST,levels=c(1,2,3),
                              labels=c('No','Yes','Yes')) %>%
mutate(BRANCH_LRENAL_POST=factor(BRANCH_LRENAL_POST,levels=c(1,2,3),
                              labels=c('No','Yes','Yes')) %>%
mutate(BRANCH_RCOMILI_POST=factor(BRANCH_RCOMILI_POST,levels=c(1,2,3),
                              labels=c('No','Yes','Yes')) %>%
mutate(BRANCH_LCOMILI_POST=factor(BRANCH_LCOMILI_POST,levels=c(1,2,3),
                              labels=c('No','Yes','Yes')) %>%

## BRANCH_POST: merge BRANCH_XXX_POST
mutate(BRANCH_POST=case_when(BRANCH_LSUB_POST=="Yes"|BRANCH_CELIAC_POST=="Yes"|BRANCH_SMA_POST=="Yes"

# TEVAR = TEVAR %>%
#   mutate(R_PREOP_AMBUL = factor(R_PREOP_AMBUL,levels = c(1,2,3,4),
#                                   labels=c("Amb","Amb w/ Assistance","Wheelchair","Bedridden")) %>%
#   mutate(SURGYEAR=factor(SURGYEAR)) %>%
#   mutate(PRIOR_AORSURG_OPENLOC1=factor(PRIOR_AORSURG_OPENLOC1,
#                                         levels=c(0,1),labels=c('No','Yes')) %>%
#   mutate(PRIOR_AORSURG_OPENLOC2=factor(PRIOR_AORSURG_OPENLOC2,
#                                         levels=c(0,1),labels=c('No','Yes')) %>%
#   mutate(PRIOR_AORSURG_OPENLOC3=factor(PRIOR_AORSURG_OPENLOC3,
#                                         levels=c(0,1),labels=c('No','Yes')) %>%
#   mutate(PRIOR_AORSURG_OPENLOC4=factor(PRIOR_AORSURG_OPENLOC4,
#                                         levels=c(0,1),labels=c('No','Yes')) %>%
#   mutate(PRIOR_AORSURG_ENDOLOC1=factor(PRIOR_AORSURG_ENDOLOC1,
#                                         levels=c(0,1),labels=c('No','Yes')) %>%
#   mutate(PRIOR_AORSURG_ENDOLOC2=factor(PRIOR_AORSURG_ENDOLOC2,
#                                         levels=c(0,1),labels=c('No','Yes')) %>%
#   mutate(PRIOR_AORSURG_ENDOLOC3=factor(PRIOR_AORSURG_ENDOLOC3,

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#                                     levels=c(0,1),labels=c('No','Yes')) %>%
# mutate(PRIOR_AORSURG_ENDOLOC4=factor(PRIOR_AORSURG_ENDOLOC4,
#                                     levels=c(0,1),labels=c('No','Yes')) %>%
# mutate(ARMNECK_ACCESS_LOC=factor(ARMNECK_ACCESS_LOC,levels =c(1:7),
#                                labels = c('Right arm','Left arm','Right axillary',
#                                'Left axillary','Right carotid',
#                                'Left carotid','Multiple')) %>%
# ## retired branch variables
# mutate(R_CELIAC=factor(R_CELIAC,levels=c(0:9),
#                        labels=c('Patent, no intervention','Chronically Occluded',
#                        'Purposely Occluded','De-branch','Stent Only','Chimney',
#                        'Fen/scallop Only','Stented-fen',
#                        'Fenestrated Stentgraft Branch (Branched TEVAR)',
#                        'Side-arm Stent-graft Branch')) %>%
# mutate(R_LT_RENAL=factor(R_LT_RENAL,levels=c(0:9),
#                        labels=c('Patent, no intervention','Chronically Occluded',
#                        'Purposely Occluded','De-branch','Stent Only','Chimney',
#                        'Fen/scallop Only','Stented-fen',
#                        'Fenestrated Stentgraft Branch (Branched TEVAR)',
#                        'Side-arm Stent-graft Branch')) %>%
# mutate(R_RT_RENAL=factor(R_RT_RENAL,levels=c(0:9),
#                        labels=c('Patent, no intervention','Chronically Occluded',
#                        'Purposely Occluded','De-branch','Stent Only','Chimney',
#                        'Fen/scallop Only','Stented-fen',
#                        'Fenestrated Stentgraft Branch (Branched TEVAR)',
#                        'Side-arm Stent-graft Branch')) %>%
# mutate(R_SMA=factor(R_SMA,levels=c(0:9),
#                    labels=c('Patent, no intervention','Chronically Occluded',
#                    'Purposely Occluded','De-branch','Stent Only','Chimney',
#                    'Fen/scallop Only','Stented-fen',
#                    'Fenestrated Stentgraft Branch (Branched TEVAR)',
#                    'Side-arm Stent-graft Branch'))
#
# ## ----- DEV_PROXZONE and DEV_DISTZONE filtering-----
# TEVAR<-TEVAR %>%
#   mutate(distal_seal= DEV1_DISTZONE,prox_seal= DEV1_PROXZONE)
#
# for (i in 1:nrow(TEVAR)){
#   if ((!(is.na(TEVAR$DEV2_DISTZONE[i])) && !(is.na(TEVAR$DEV2_DISTZONE[i]>TEVAR$DEV1_DISTZONE[i]))&&
#   (TEVAR$DEV2_DISTZONE[i]>TEVAR$DEV1_DISTZONE[i]))) {
#     TEVAR$distal_seal[i] = TEVAR$DEV2_DISTZONE[i]}
#   else if((is.na(TEVAR$DEV1_DISTZONE[i])) && !(is.na(TEVAR$DEV2_DISTZONE[i]))){
#     TEVAR$distal_seal[i] = TEVAR$DEV2_DISTZONE[i]}
#   if ((!(is.na(TEVAR$DEV3_DISTZONE[i])) && !(is.na(TEVAR$DEV3_DISTZONE[i]>TEVAR$DEV2_DISTZONE[i]))&&
#   (TEVAR$DEV3_DISTZONE[i]>TEVAR$DEV2_DISTZONE[i]))) {
#     TEVAR$distal_seal[i] = TEVAR$DEV3_DISTZONE[i]}
#   if ((!(is.na(TEVAR$DEV4_DISTZONE[i])) && !(is.na(TEVAR$DEV4_DISTZONE[i]>TEVAR$DEV3_DISTZONE[i]))&&
#   (TEVAR$DEV4_DISTZONE[i]>TEVAR$DEV3_DISTZONE[i]))) {
#     TEVAR$distal_seal[i] = TEVAR$DEV4_DISTZONE[i]}
#   if ((!(is.na(TEVAR$DEV5_DISTZONE[i])) && !(is.na(TEVAR$DEV5_DISTZONE[i]>TEVAR$DEV4_DISTZONE[i]))&&
#   (TEVAR$DEV5_DISTZONE[i]>TEVAR$DEV4_DISTZONE[i]))) {
#     TEVAR$distal_seal[i] = TEVAR$DEV5_DISTZONE[i]}
#   if ((!(is.na(TEVAR$DEV6_DISTZONE[i])) && !(is.na(TEVAR$DEV6_DISTZONE[i]>TEVAR$DEV5_DISTZONE[i]))&&

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#       (TEVAR$DEV6_DISTZONE[i]>TEVAR$DEV5_DISTZONE[i])) {
#       TEVAR$distal_seal[i] = TEVAR$DEV6_DISTZONE[i]}
#   }
#
# for (i in 1:nrow(TEVAR)){
#   if ((!(is.na(TEVAR$DEV2_PROXZONE[i])) && !(is.na(TEVAR$DEV2_PROXZONE[i]<TEVAR$DEV1_PROXZONE[i]))&&
#     (TEVAR$DEV2_PROXZONE[i]<TEVAR$DEV1_PROXZONE[i]))) {
#     TEVAR$prox_seal[i] = TEVAR$DEV2_PROXZONE[i]}
#   else if((!(is.na(TEVAR$DEV1_PROXZONE[i])) && !(is.na(TEVAR$DEV2_PROXZONE[i])))){
#     TEVAR$prox_seal[i] = TEVAR$DEV2_PROXZONE[i]}
#   if ((!(is.na(TEVAR$DEV3_PROXZONE[i])) && !(is.na(TEVAR$DEV3_PROXZONE[i]<TEVAR$DEV2_PROXZONE[i]))&&
#     (TEVAR$DEV3_PROXZONE[i]<TEVAR$DEV2_PROXZONE[i]))) {
#     TEVAR$prox_seal[i] = TEVAR$DEV3_PROXZONE[i]}
#   if ((!(is.na(TEVAR$DEV4_PROXZONE[i])) && !(is.na(TEVAR$DEV4_PROXZONE[i]<TEVAR$DEV3_PROXZONE[i]))&&
#     (TEVAR$DEV4_PROXZONE[i]<TEVAR$DEV3_PROXZONE[i]))) {
#     TEVAR$prox_seal[i] = TEVAR$DEV4_PROXZONE[i]}
#   if ((!(is.na(TEVAR$DEV5_PROXZONE[i])) && !(is.na(TEVAR$DEV5_PROXZONE[i]<TEVAR$DEV4_PROXZONE[i]))&&
#     (TEVAR$DEV5_PROXZONE[i]<TEVAR$DEV4_PROXZONE[i]))) {
#     TEVAR$prox_seal[i] = TEVAR$DEV5_PROXZONE[i]}
#   if ((!(is.na(TEVAR$DEV6_PROXZONE[i])) && !(is.na(TEVAR$DEV6_PROXZONE[i]<TEVAR$DEV5_PROXZONE[i]))&&
#     (TEVAR$DEV6_PROXZONE[i]<TEVAR$DEV5_PROXZONE[i]))) {
#     TEVAR$prox_seal[i] = TEVAR$DEV6_PROXZONE[i]}
#   }
# }
#

## ----- variables cleaning, volume variables-----
TEVAR = TEVAR %>%
  mutate(REGIONID=factor(REGIONID)) %>%
  mutate(CENTERID=factor(CENTERID)) %>%
  mutate(PHYSICIANID=factor(PHYSICIANID))

## -----variables selection-----
FBVAR = TEVAR %>% select(
  PRESENTATION,
  # Patient demographic and co-morbidities
  AGE, AGECAT, GENDER, ETHNICITY, RACE, TRANSFER, PRIMARYINSURER, LIVINGSTATUS, PREOP_FUNCSTATUS, PRIOR,
  # Operative Variables
  PRIOR_AORSURG, PATHOLOGY, PREOP_MAXAADI, URGENCY, PATHOLOGY_ANEURYSM_TYPE, PATHOLOGY_DISSECT_TYPE,
  # Outcomes
  DEAD, PROC_SURVIVALDAYS, LTF_NUM_REINT,TOTAL_LOS, POSTOP_LOS, AORDEV_TECHSUCC, CONVTOOPEN, LEAKATCOMP,
  # Volume variables,
  REGIONID,CENTERID,PHYSICIANID)

## ----- store as new dataset 'FBVAR' to ensure easier access for modelling-----
write.csv(FBVAR,path_lily[5])
#write.csv(FBVAR,path_jenn[5])

```