Project 2: Building a Safer Health System

if(!require(pacman)) install.packages(pacman)

## Loading required package: pacman

library(pacman)  
pacman::p\_load(tidyverse, psych, readxl, RColorBrewer, lubridate, dplyr)

#Plugs file into variable  
ICUEvents <- read\_excel("ICUEvents.xlsx")

## New names:  
## \* `` -> ...11

newICU <- ICUEvents

* Using R, perform a complete analysis of the dataset (with graphs) representing, for example,
* frequencies of medical errors
* medical errors correlation with
  + day of the week
  + time of the day
  + staff member who made the error
* Since the dependent attribute Type\_of\_Error has multiple values (levels), select one type of error, you will train your classifier
* Check that the error is sufficiently represented in the dataset.
* Clean and prepare your data, using the methods seen in class
* Train your classifier.
* Write a report documenting your work: Dataset description, machine learning method and why it is suitable, Training and testing datasets, and the model evaluation.

# Lets you view document  
# view(newICU)

# Remove useless column  
newICU <- subset(newICU, select= -...11)

#Summarizes doc  
summary(newICU)

## Report-number Facility-ID Error-category Date-of-error   
## Min. : 9475 Min. :11466296 Length:32992 Length:32992   
## 1st Qu.: 14161 1st Qu.:35414425 Class :character Class :character   
## Median : 16865 Median :54716378 Mode :character Mode :character   
## Mean : 20006 Mean :55350119   
## 3rd Qu.: 20340 3rd Qu.:74455222   
## Max. :249347 Max. :99276649   
## Time-of-error Day-of-week Type-of-error Cause-of-error   
## Length:32992 Length:32992 Length:32992 Length:32992   
## Class :character Class :character Class :character Class :character   
## Mode :character Mode :character Mode :character Mode :character   
##   
##   
##   
## Contributing-factor Location-of-error Description-of-error  
## Length:32992 Length:32992 Length:32992   
## Class :character Class :character Class :character   
## Mode :character Mode :character Mode :character   
##   
##   
##   
## Medication-process-node Staff-type-initiated-error  
## Length:32992 Length:32992   
## Class :character Class :character   
## Mode :character Mode :character   
##   
##   
##   
## Staff-type-perpetuated-error Staff-type-discovered-error Action-taken   
## Length:32992 Length:32992 Length:32992   
## Class :character Class :character Class :character   
## Mode :character Mode :character Mode :character   
##   
##   
##   
## Action-taken-detail Date-record-was-entered  
## Length:32992 Length:32992   
## Class :character Class :character   
## Mode :character Mode :character   
##   
##   
##

#Gives you the data types of features  
str(newICU)

## tibble[,18] [32,992 × 18] (S3: tbl\_df/tbl/data.frame)  
## $ Report-number : num [1:32992] 9475 9475 9477 9477 9498 ...  
## $ Facility-ID : num [1:32992] 71778745 71778745 71778745 71778745 33299661 ...  
## $ Error-category : chr [1:32992] "C" "C" "B" "B" ...  
## $ Date-of-error : chr [1:32992] "01/03/2000" "01/03/2000" "01/03/2000" "01/03/2000" ...  
## $ Time-of-error : chr [1:32992] "00:00" "00:00" "14:00" "14:00" ...  
## $ Day-of-week : chr [1:32992] "Monday" "Monday" "Monday" "Monday" ...  
## $ Type-of-error : chr [1:32992] "Omission error" "Omission error" "Omission error" "Omission error" ...  
## $ Cause-of-error : chr [1:32992] "Contraindicated, drug allergy" "Documentation" "Contraindicated, drug allergy" "Documentation" ...  
## $ Contributing-factor : chr [1:32992] NA NA NA NA ...  
## $ Location-of-error : chr [1:32992] "Nursing (Patient Care) Unit" "Nursing (Patient Care) Unit" "Nursing (Patient Care) Unit" "Nursing (Patient Care) Unit" ...  
## $ Description-of-error : chr [1:32992] "Allergy missing on doctor's order" "Allergy missing on doctor's order" "Allegy missing on doctor's orders" "Allegy missing on doctor's orders" ...  
## $ Medication-process-node : chr [1:32992] "Prescribing" "Prescribing" "Documenting" "Documenting" ...  
## $ Staff-type-initiated-error : chr [1:32992] "Physician" "Physician" "Physician" "Physician" ...  
## $ Staff-type-perpetuated-error: chr [1:32992] NA NA NA NA ...  
## $ Staff-type-discovered-error : chr [1:32992] NA NA NA NA ...  
## $ Action-taken : chr [1:32992] NA NA NA NA ...  
## $ Action-taken-detail : chr [1:32992] NA NA NA NA ...  
## $ Date-record-was-entered : chr [1:32992] "01/04/2000" "01/04/2000" "01/04/2000" "01/04/2000" ...

#Displays doc  
newICU

## # A tibble: 32,992 x 18  
## `Report-number` `Facility-ID` `Error-category` `Date-of-error`  
## <dbl> <dbl> <chr> <chr>   
## 1 9475 71778745 C 01/03/2000   
## 2 9475 71778745 C 01/03/2000   
## 3 9477 71778745 B 01/03/2000   
## 4 9477 71778745 B 01/03/2000   
## 5 9498 33299661 C 01/02/2000   
## 6 9498 33299661 C 01/02/2000   
## 7 9509 71778745 C 01/01/2000   
## 8 9542 37744453 C 01/02/2000   
## 9 9542 37744453 C 01/02/2000   
## 10 9618 33299661 B 01/06/2000   
## # … with 32,982 more rows, and 14 more variables: Time-of-error <chr>,  
## # Day-of-week <chr>, Type-of-error <chr>, Cause-of-error <chr>,  
## # Contributing-factor <chr>, Location-of-error <chr>,  
## # Description-of-error <chr>, Medication-process-node <chr>,  
## # Staff-type-initiated-error <chr>, Staff-type-perpetuated-error <chr>,  
## # Staff-type-discovered-error <chr>, Action-taken <chr>,  
## # Action-taken-detail <chr>, Date-record-was-entered <chr>

#Gives you names of features  
names(newICU)

## [1] "Report-number" "Facility-ID"   
## [3] "Error-category" "Date-of-error"   
## [5] "Time-of-error" "Day-of-week"   
## [7] "Type-of-error" "Cause-of-error"   
## [9] "Contributing-factor" "Location-of-error"   
## [11] "Description-of-error" "Medication-process-node"   
## [13] "Staff-type-initiated-error" "Staff-type-perpetuated-error"  
## [15] "Staff-type-discovered-error" "Action-taken"   
## [17] "Action-taken-detail" "Date-record-was-entered"

# Factor   
newICU$`Date-of-error` <- as.Date(newICU$`Date-of-error`, tryFormats = c("%d-%m-%Y", "%d/%m/%y"))  
#newICU$`Time-of-error` <- as.Date(newICU$`Time-of-error`, tryFormats = c("%h:%m"))  
#newICU

newICU$`Error-category` <- factor(newICU$`Error-category`)

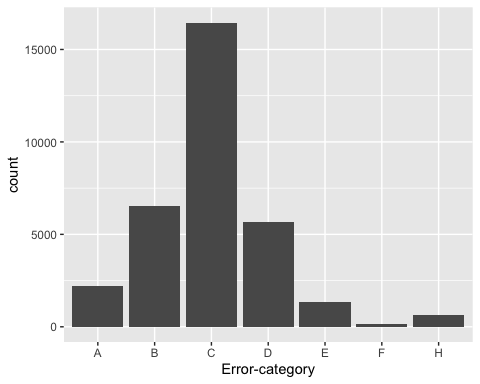
newICU$`Type-of-error` <- factor(newICU$`Type-of-error`)  
newICU$`Cause-of-error` <- factor(newICU$`Cause-of-error`)

newICU$`Contributing-factor` <- factor(newICU$`Contributing-factor`)  
newICU$`Medication-process-node` <- factor(newICU$`Medication-process-node`)  
newICU$`Staff-type-initiated-error` <- factor(newICU$`Staff-type-initiated-error`)  
newICU$`Staff-type-perpetuated-error` <- factor(newICU$`Staff-type-perpetuated-error`)  
newICU$`Action-taken` <- factor(newICU$`Action-taken`)  
newICU$`Staff-type-discovered-error` <- factor(newICU$`Staff-type-discovered-error`)

summary(newICU)

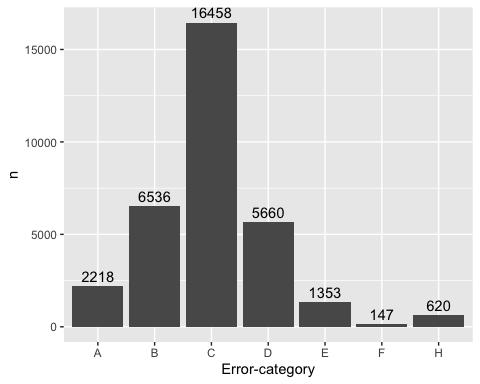
## Report-number Facility-ID Error-category Date-of-error   
## Min. : 9475 Min. :11466296 A: 2218 Min. :2020-01-01   
## 1st Qu.: 14161 1st Qu.:35414425 B: 6536 1st Qu.:2020-03-01   
## Median : 16865 Median :54716378 C:16458 Median :2020-06-02   
## Mean : 20006 Mean :55350119 D: 5660 Mean :2020-05-31   
## 3rd Qu.: 20340 3rd Qu.:74455222 E: 1353 3rd Qu.:2020-09-02   
## Max. :249347 Max. :99276649 F: 147 Max. :2020-12-03   
## H: 620 NA's :19079   
## Time-of-error Day-of-week Type-of-error   
## Length:32992 Length:32992 Omission error :7404   
## Class :character Class :character Improper dose/quantity:6319   
## Mode :character Mode :character Unauthorized drug :3752   
## Prescribing error :2255   
## Extra dose :2014   
## (Other) :8864   
## NA's :2384   
## Cause-of-error Contributing-factor  
## Performance (human) deficit : 7661 Distractions : 5383   
## Procedure/protocol not followed : 3927 Workload increase : 1912   
## Transcription inaccurate/omitted: 1875 Staff, inexperienced : 1604   
## Communication : 1853 Staffing, insufficient: 1005   
## Knowledge deficit : 1801 Shift change : 971   
## (Other) :13485 (Other) : 5661   
## NA's : 2390 NA's :16456   
## Location-of-error Description-of-error Medication-process-node  
## Length:32992 Length:32992 Administering :12349   
## Class :character Class :character Dispensing : 5976   
## Mode :character Mode :character Documenting : 7614   
## Does not apply: 2218   
## Monitoring : 447   
## Prescribing : 4388   
##   
## Staff-type-initiated-error Staff-type-perpetuated-error  
## Nurse, Registered :13053 Nurse, Registered : 8297   
## Pharmacist : 4672 Pharmacist : 2661   
## Physician : 3048 Pharmacy Technician : 841   
## Pharmacy Technician : 1727 Physician : 805   
## Unit Secretary/Clerk: 1510 Unit Secretary/Clerk: 743   
## (Other) : 6057 (Other) : 2794   
## NA's : 2925 NA's :16851   
## Staff-type-discovered-error  
## Nurse, Registered :16789   
## Pharmacist : 4686   
## Physician : 1968   
## Nurse, Licensed Practical: 1048   
## Pharmacy Technician : 992   
## (Other) : 2659   
## NA's : 4850   
## Action-taken Action-taken-detail  
## Informed staff who made the initial error : 9766 Length:32992   
## Informed staff who was also involved in error: 3975 Class :character   
## Education/Training provided : 2937 Mode :character   
## None : 2119   
## Communication process enhanced : 1812   
## (Other) : 1371   
## NA's :11012   
## Date-record-was-entered  
## Length:32992   
## Class :character   
## Mode :character   
##   
##   
##   
##

ggplot(data = newICU, mapping = aes(`Error-category`)) +   
 geom\_bar() +   
 scale\_fill\_brewer(palette="Dark2")

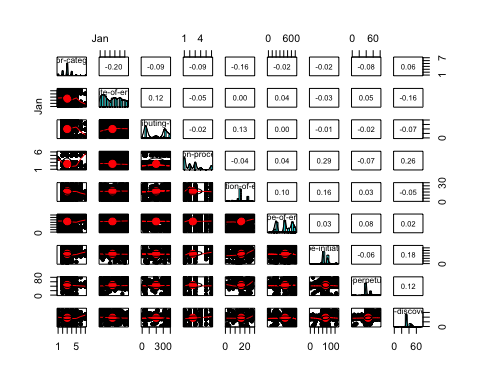


count\_error\_category <- newICU %>%  
 count(`Error-category`)  
?palette

ggplot(count\_error\_category, aes(x = `Error-category`, y = n)) +  
 geom\_bar(stat = 'identity') + geom\_text(aes(label = n, vjust = -.45) )

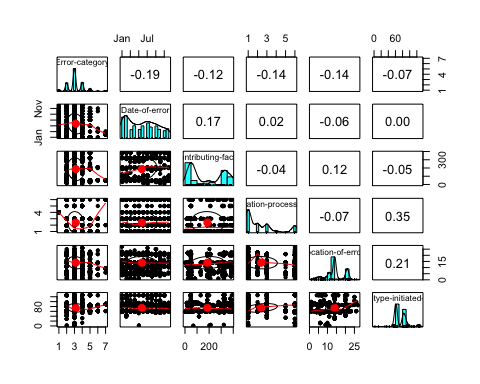


pairs.panels(newICU[c('Error-category', 'Date-of-error', 'Contributing-factor', 'Medication-process-node', 'Location-of-error', 'Type-of-error', 'Staff-type-initiated-error', 'Staff-type-perpetuated-error', 'Staff-type-discovered-error')])



Improper\_doseICU <- subset(newICU, `Type-of-error` =='Improper dose/quantity')  
Improper\_doseICU <- subset(Improper\_doseICU, select= c(`Error-category`, `Date-of-error`, `Contributing-factor`, `Medication-process-node`, `Location-of-error`, `Staff-type-initiated-error`, `Staff-type-perpetuated-error`, `Staff-type-discovered-error`))

pairs.panels(Improper\_doseICU[c('Error-category', 'Date-of-error', 'Contributing-factor', 'Medication-process-node', 'Location-of-error', 'Staff-type-initiated-error')])



fit\_Improper\_dose <- lm(`Error-category` ~ `Date-of-error` + `Contributing-factor` + `Medication-process-node` + `Location-of-error` + `Staff-type-initiated-error` + `Staff-type-perpetuated-error` + `Staff-type-discovered-error`, data= Improper\_doseICU)

## Warning in model.response(mf, "numeric"): using type = "numeric" with a factor  
## response will be ignored

## Warning in Ops.factor(y, z$residuals): '-' not meaningful for factors

fit\_Improper\_dose2 <- lm(`Error-category` ~ `Location-of-error` + `Staff-type-initiated-error` + `Staff-type-perpetuated-error` + `Staff-type-discovered-error`, data= Improper\_doseICU)

## Warning in model.response(mf, "numeric"): using type = "numeric" with a factor  
## response will be ignored

## Warning in Ops.factor(y, z$residuals): '-' not meaningful for factors

fit\_Improper\_dose

##   
## Call:  
## lm(formula = `Error-category` ~ `Date-of-error` + `Contributing-factor` +   
## `Medication-process-node` + `Location-of-error` + `Staff-type-initiated-error` +   
## `Staff-type-perpetuated-error` + `Staff-type-discovered-error`,   
## data = Improper\_doseICU)  
##   
## Coefficients:  
## (Intercept)   
## 5.847e+00   
## `Date-of-error`   
## -2.444e-04   
## `Contributing-factor`Cross coverage   
## 8.151e-01   
## `Contributing-factor`Distractions   
## 3.297e-02   
## `Contributing-factor`Failure to detect dosage change in Clozaril orders.   
## -1.904e+00   
## `Contributing-factor`Failure to follow medication preparation and administration procedure.   
## -1.710e+00   
## `Contributing-factor`Failure to use/read med records and follow procedure.   
## -7.445e-01   
## `Contributing-factor`Failure to use/read med records.   
## -9.319e-02   
## `Contributing-factor`Failure to use/read med reocrds.   
## -9.319e-02   
## `Contributing-factor`Human error   
## -1.574e-01   
## `Contributing-factor`No 24-hour pharmacy   
## -4.569e-02   
## `Contributing-factor`No access to patient information   
## -2.287e-01   
## `Contributing-factor`None apparent   
## -1.236e+00   
## `Contributing-factor`not applicable   
## -1.260e+00   
## `Contributing-factor`not known   
## -3.147e-01   
## `Contributing-factor`not stated   
## 2.272e-01   
## `Contributing-factor`Poor lighting   
## -2.925e-01   
## `Contributing-factor`Previous therapy   
## -2.688e-01   
## `Contributing-factor`remote nurse unit   
## -3.303e-01   
## `Contributing-factor`scheduled labs in ER difficult because all ER labs stat, labels come off together.   
## 1.079e+00   
## `Contributing-factor`Shift change   
## -1.109e-01   
## `Contributing-factor`Staff, agency/temporary   
## -3.297e-02   
## `Contributing-factor`Staff, floating   
## -1.538e-01   
## `Contributing-factor`Staff, inexperienced   
## -5.591e-02   
## `Contributing-factor`Staffing, insufficient   
## 1.499e-02   
## `Contributing-factor`TELEPHONE ORDER   
## 8.555e-02   
## `Contributing-factor`transfer patient   
## -7.697e-02   
## `Contributing-factor`weather did not permit pharmacy staff to be on site.   
## -3.933e-02   
## `Contributing-factor`Workload increase   
## -1.931e-01   
## `Medication-process-node`Dispensing   
## -2.592e-01   
## `Medication-process-node`Documenting   
## 5.486e-02   
## `Medication-process-node`Monitoring   
## NA   
## `Medication-process-node`Prescribing   
## -1.846e-01   
## `Location-of-error`Emergency Department   
## -1.789e+00   
## `Location-of-error`Intensive Care Unit, Coronary   
## -6.759e-01   
## `Location-of-error`Intensive Care Unit, Medical   
## 3.243e-01   
## `Location-of-error`Intensive Care Unit, Surgical   
## 7.171e-01   
## `Location-of-error`Labor/Delivery   
## 6.174e-02   
## `Location-of-error`Long-term care facility   
## 3.458e-02   
## `Location-of-error`Maternity   
## NA   
## `Location-of-error`Nursing (Patient Care) Unit   
## 2.557e-01   
## `Location-of-error`Pediatrics   
## 7.417e-01   
## `Location-of-error`Pharmacy, inpatient   
## 1.594e+00   
## `Location-of-error`Pharmacy, outpatient   
## 1.647e+00   
## `Staff-type-initiated-error`Nurse, Licensed Practical   
## 1.348e-14   
## `Staff-type-initiated-error`Nurse, Licensed Vocational   
## -7.686e-01   
## `Staff-type-initiated-error`Nurse, Registered   
## -6.507e-01   
## `Staff-type-initiated-error`Nursing Assistant/Aide   
## -6.829e-16   
## `Staff-type-initiated-error`Patient/Family Member/Caregiver   
## -2.830e-01   
## `Staff-type-initiated-error`Pharmacist   
## -1.159e+00   
## `Staff-type-initiated-error`Pharmacy Technician   
## -1.402e+00   
## `Staff-type-initiated-error`Physician   
## 7.927e-01   
## `Staff-type-initiated-error`Physician, Resident   
## NA   
## `Staff-type-initiated-error`Podiatrist   
## NA   
## `Staff-type-initiated-error`QMA   
## NA   
## `Staff-type-initiated-error`Student   
## -9.035e-02   
## `Staff-type-initiated-error`Student Nurse   
## -9.035e-02   
## `Staff-type-initiated-error`Unit Secretary/Clerk   
## -1.049e+00   
## `Staff-type-perpetuated-error`none   
## 7.787e-01   
## `Staff-type-perpetuated-error`None apparent   
## NA   
## `Staff-type-perpetuated-error`not applicable   
## NA   
## `Staff-type-perpetuated-error`Nurse, Licensed Practical   
## 3.290e-01   
## `Staff-type-perpetuated-error`Nurse, Licensed Vocational   
## 2.096e+00   
## `Staff-type-perpetuated-error`Nurse, Registered   
## 8.984e-01   
## `Staff-type-perpetuated-error`Nurse,Travel   
## 1.635e+00   
## `Staff-type-perpetuated-error`Nursing Assistant/Aide   
## 8.984e-01   
## `Staff-type-perpetuated-error`Other QMA's   
## 8.984e-01   
## `Staff-type-perpetuated-error`Pharmacist   
## 5.849e-01   
## `Staff-type-perpetuated-error`Pharmacy Technician   
## -5.821e-01   
## `Staff-type-perpetuated-error`Physician   
## 8.522e-01   
## `Staff-type-perpetuated-error`QMA   
## 8.984e-01   
## `Staff-type-perpetuated-error`Student Nurse's Instructor   
## NA   
## `Staff-type-perpetuated-error`Unit Secretary/Clerk   
## 9.014e-01   
## `Staff-type-discovered-error`Nurse, Licensed Practical   
## 5.729e-01   
## `Staff-type-discovered-error`Nurse, Licensed Vocational   
## -9.341e-01   
## `Staff-type-discovered-error`Nurse, Registered   
## 4.351e-01   
## `Staff-type-discovered-error`Nursing Assistant/Aide   
## -7.615e-15   
## `Staff-type-discovered-error`Pharmacist   
## -5.962e-03   
## `Staff-type-discovered-error`Pharmacy Technician   
## 3.461e-01   
## `Staff-type-discovered-error`Physician   
## 2.160e+00   
## `Staff-type-discovered-error`QMA   
## NA

fit\_Improper\_dose2

##   
## Call:  
## lm(formula = `Error-category` ~ `Location-of-error` + `Staff-type-initiated-error` +   
## `Staff-type-perpetuated-error` + `Staff-type-discovered-error`,   
## data = Improper\_doseICU)  
##   
## Coefficients:  
## (Intercept)   
## 2.59318   
## `Location-of-error`Dialysis Unit   
## 0.20728   
## `Location-of-error`Emergency Department   
## 0.95514   
## `Location-of-error`Intensive Care Unit, Coronary   
## 0.03847   
## `Location-of-error`Intensive Care Unit, Medical   
## 0.15426   
## `Location-of-error`Intensive Care Unit, Neonatal   
## 0.41984   
## `Location-of-error`Intensive Care Unit, Pediatric   
## -0.24649   
## `Location-of-error`Intensive Care Unit, Surgical   
## 0.30867   
## `Location-of-error`Labor/Delivery   
## -0.38025   
## `Location-of-error`Long-term care facility   
## 0.53832   
## `Location-of-error`Maternity   
## -0.36799   
## `Location-of-error`Nursing (Patient Care) Unit   
## 0.08788   
## `Location-of-error`Oncology Department   
## -0.23881   
## `Location-of-error`Operating Room   
## 2.13996   
## `Location-of-error`Outpatient Surgery Department   
## -0.05141   
## `Location-of-error`Pediatrics   
## -0.01851   
## `Location-of-error`Pharmacy, inpatient   
## 1.17669   
## `Location-of-error`Pharmacy, outpatient   
## 1.26469   
## `Location-of-error`Post-Anesthesia Care Unit   
## 0.63201   
## `Location-of-error`Psychiatric   
## -1.02362   
## `Location-of-error`Psychiatric, outpatient   
## 0.18563   
## `Staff-type-initiated-error`and Registered Nurse   
## -0.44153   
## `Staff-type-initiated-error`Anesthesiologist   
## 1.68893   
## `Staff-type-initiated-error`Lab Tech   
## 0.22079   
## `Staff-type-initiated-error`LPN   
## 1.07868   
## `Staff-type-initiated-error`MD prescribed in ml; but then nurse drew up wrong amt.   
## -0.31676   
## `Staff-type-initiated-error`Nurse   
## -0.63992   
## `Staff-type-initiated-error`Nurse Anesthetist   
## NA   
## `Staff-type-initiated-error`Nurse Practitioner/Advanced Practice Nurse   
## 1.64032   
## `Staff-type-initiated-error`Nurse, Licensed Practical   
## 0.62814   
## `Staff-type-initiated-error`Nurse, Licensed Vocational   
## 1.00071   
## `Staff-type-initiated-error`Nurse, Registered   
## 0.67667   
## `Staff-type-initiated-error`Nursing Assistant/Aide   
## 0.49402   
## `Staff-type-initiated-error`Patient/Family Member/Caregiver   
## 2.37550   
## `Staff-type-initiated-error`Pharmacist   
## -0.13049   
## `Staff-type-initiated-error`Pharmacy Technician   
## -0.65054   
## `Staff-type-initiated-error`Physician   
## 0.36008   
## `Staff-type-initiated-error`Physician Assistant   
## -0.88061   
## `Staff-type-initiated-error`Physician, Intern   
## -0.06374   
## `Staff-type-initiated-error`Physician, Resident   
## 2.80810   
## `Staff-type-initiated-error`Podiatrist   
## NA   
## `Staff-type-initiated-error`QMA   
## 0.54833   
## `Staff-type-initiated-error`Radiology Technician   
## -0.43455   
## `Staff-type-initiated-error`Student   
## 0.22079   
## `Staff-type-initiated-error`Student Nurse   
## 0.22079   
## `Staff-type-initiated-error`student nurse and Instructor.   
## 0.22079   
## `Staff-type-initiated-error`Therapist   
## -0.37676   
## `Staff-type-initiated-error`Unit Secretary/Clerk   
## 0.43365   
## `Staff-type-perpetuated-error`Corpman   
## NA   
## `Staff-type-perpetuated-error`NA   
## -0.27817   
## `Staff-type-perpetuated-error`none   
## -0.43974   
## `Staff-type-perpetuated-error`None   
## -0.33836   
## `Staff-type-perpetuated-error`None apparent   
## -1.17788   
## `Staff-type-perpetuated-error`not applicable   
## -1.20925   
## `Staff-type-perpetuated-error`Nurse Anesthetist   
## 0.46660   
## `Staff-type-perpetuated-error`Nurse Practitioner/Advanced Practice Nurse   
## 0.92600   
## `Staff-type-perpetuated-error`Nurse, Graduate   
## -0.32670   
## `Staff-type-perpetuated-error`Nurse, Licensed Practical   
## -0.50728   
## `Staff-type-perpetuated-error`Nurse, Licensed Vocational   
## -0.11606   
## `Staff-type-perpetuated-error`Nurse, Registered   
## 0.12918   
## `Staff-type-perpetuated-error`Nurse,Travel   
## 0.67330   
## `Staff-type-perpetuated-error`Nursing Assistant/Aide   
## -1.25425   
## `Staff-type-perpetuated-error`Nursing Instructor   
## 0.97310   
## `Staff-type-perpetuated-error`Other QMA's   
## -1.28136   
## `Staff-type-perpetuated-error`Patient/Family Member/Caregiver   
## -0.63946   
## `Staff-type-perpetuated-error`PCT   
## 0.67330   
## `Staff-type-perpetuated-error`Pharmacist   
## -0.04115   
## `Staff-type-perpetuated-error`Pharmacist missed opportunity to intervene   
## -0.70194   
## `Staff-type-perpetuated-error`Pharmacy Technician   
## -0.95597   
## `Staff-type-perpetuated-error`Pharmacy?   
## -0.04115   
## `Staff-type-perpetuated-error`Physician   
## -0.16463   
## `Staff-type-perpetuated-error`Physician, Resident   
## 0.75418   
## `Staff-type-perpetuated-error`QMA   
## -1.10405   
## `Staff-type-perpetuated-error`Student   
## -0.05524   
## `Staff-type-perpetuated-error`Student Nurse's Instructor   
## 0.24064   
## `Staff-type-perpetuated-error`Unit Secretary/Clerk   
## 0.08840   
## `Staff-type-discovered-error`Nurse Anesthetist   
## -1.03104   
## `Staff-type-discovered-error`Nurse, Graduate   
## -2.07819   
## `Staff-type-discovered-error`Nurse, Licensed Practical   
## -1.25396   
## `Staff-type-discovered-error`Nurse, Licensed Vocational   
## -1.65580   
## `Staff-type-discovered-error`Nurse, Registered   
## -1.03104   
## `Staff-type-discovered-error`Nursing Assistant/Aide   
## -2.32785   
## `Staff-type-discovered-error`Nursing?   
## NA   
## `Staff-type-discovered-error`Patient/Family Member/Caregiver   
## -1.38709   
## `Staff-type-discovered-error`PCT   
## -1.03104   
## `Staff-type-discovered-error`Pharmacist   
## -0.92964   
## `Staff-type-discovered-error`Pharmacy Technician   
## -1.37131   
## `Staff-type-discovered-error`Physician   
## 0.16086   
## `Staff-type-discovered-error`Physician Assistant   
## -0.62166   
## `Staff-type-discovered-error`QMA   
## -2.32785   
## `Staff-type-discovered-error`Student   
## -1.76856   
## `Staff-type-discovered-error`Therapist   
## NA   
## `Staff-type-discovered-error`Unit Secretary/Clerk   
## -1.11547

Improper\_doseICU$`Staff-type-initiated-error` <- as.factor(Improper\_doseICU$`Staff-type-initiated-error`)  
  
count\_2 <- Improper\_doseICU %>%  
 count(`Staff-type-initiated-error`)  
frequency(Improper\_doseICU$`Staff-type-initiated-error`)

## [1] 1

# predict\_Improper\_dose <- predict(fit\_Improper\_dose, Improper\_doseICU)

# x <- Improper\_doseICU[c('Error-category', 'Location-of-error', 'Staff-type-initiated-error', 'Staff-type-perpetuated-error', 'Staff-type-discovered-error')]  
#   
# predict\_Improper\_dose2 <- predict(fit\_Improper\_dose2, x)