Alcohol and Other Drugs and Traumatic Injury: Notes and Code

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July 21, 2017

Contents

1 Load Files

Establish a connection to the out-of-memory Monet database containing the NEDS injury file. Check the file and fields. Create a sqlsurvey object from the MonetDB injury table.[1] for details. Source and create a dplyr table from the MonetDB file.

```
# connect MonetDB
neds <- dbConnect(MonetDBLite(), "~/HCUP/NEDSMonet")
dbListTables(neds)


dbListFields(neds, "neds_0612")
dbGetQuery(neds, "SELECT COUNT(*) FROM neds_0612")  # 198,102,435

# check data types
dbGetQuery(neds, "SELECT c.id, c.name, c.type, c.type_digits
    FROM sys.columns c LEFT JOIN sys.tables t ON c.table_id = t.id
    WHERE t.name = 'neds_0612';")


# sqlsurvey object from MonetDB table.  identify factors
fax <- c("ecode1", "ecode2", "ecode3", "ecode4", "hcupfile",
    "agegrp", "isrcodedescr", "isrsitedescr", "isrsite2descr",
    "isrsite3descr")

monInj <- sqlsurvey(id = "key_ed", strata = "neds_stratum", weights = "discwt",
   key = "id", check.factors = fax, database = "/Volumes/Promise Pegasus/DATA/HCUP/NEDSMonet",
    driver = MonetDBLite(), table.name = "neds_0612")

# connect database to R via dplyr
NEDScon <- src_monetdb(embedded = "/Volumes/Promise Pegasus/DATA/HCUP/NEDSMonet")
NEDStab <- tbl(NEDScon, "neds_0612")
glimpse(NEDStab)
summarise(NEDStab, mean_age = mean(age))  # 38.35852
count(NEDStab, drug_or_alcohol)  # 7,372,821
count(NEDStab, traumacenter)
```

2 Descriptive Epidemiology

The study data consisted of 890,613,941 (s.e. = 9,332) survey-adjusted emergency department (ED) discharges for the 7-year period of 2006 to 2012. There were a total of 181,194,431 (s.e. = 9344) discharges with a primary ICD9 diagnostic code related to traumatic injury, accounting for 20.3% (0.001) of all discharges. A total of 3,499,134 (9,328) or 1.9% (0.005) of

[1] See http://rpackages.ianhowson.com/rforge/sqlsurvey/ and http://rpackages.ianhowson.com/rforge/sqlsurvey/man/sqlsurvey.html

these traumatic injury discharges had a secondary diagnostic code for alcohol or substance use as defined for the study. The majority of these, 2,791,471 (8,362) were alcohol related. While overall ED population-based injury discharges rates declined during the study period, discharge rates for alcohol and drug-related injuries increased. (Figure 1) The mean population-based rate of all ED injury discharged decreased 6.5% from the first 3 years of the study period to the final 3 year, while alcohol and substance-related injury discharges increased 9.8% during the same comparison period.

```
# TOTAL NUMBERS

# all ED visits
(yrCountTot <- svytotal(~count, monInj, na.rm = T, se = TRUE,
    multicore = T))
# SE _count 890613941 9332.646

# injury visits
(yrCountInj <- svytotal(~cnt, monInj, na.rm = T, se = TRUE, multicore = T))
# SE _cnt 181194431 9344.209



# proportion total injury visits

mean(rnorm(1000, mean = 181194431, sd = 9344.209)/rnorm(1000,
    mean = 890613941, sd = 9332.646)) * 100  # 20.34487
sd(rnorm(1000, mean = 181194431, sd = 9344.209)/rnorm(1000, mean = 890613941,
    sd = 9332.646)) * 100  # 0.001051054


# any drug-etoh visits
(yrCountAny <- svytotal(~drug_or_alcohol, monInj, na.rm = T,
    se = TRUE, multicore = T))
# SE _drug_or_alcohol 33433395 12619.91

# alcohol visits
(yrCountETOH <- svytotal(~alcohol, monInj, na.rm = T, se = TRUE,
    multicore = T))
# SE _alcohol 20769789 10056.5

# drug visits
(yrCountDRUG <- svytotal(~anydrug, monInj, na.rm = T, se = TRUE,
    multicore = T))
# SE _anydrug 16091011 8802.623

# any substance injury visits
(yrCountDRUGinj <- svytotal(~drug_or_alcohol, subset(monInj,
    inj == 1), na.rm = T, se = TRUE, multicore = T))
# SE _drug_or_alcohol 3499134 9327.534
```

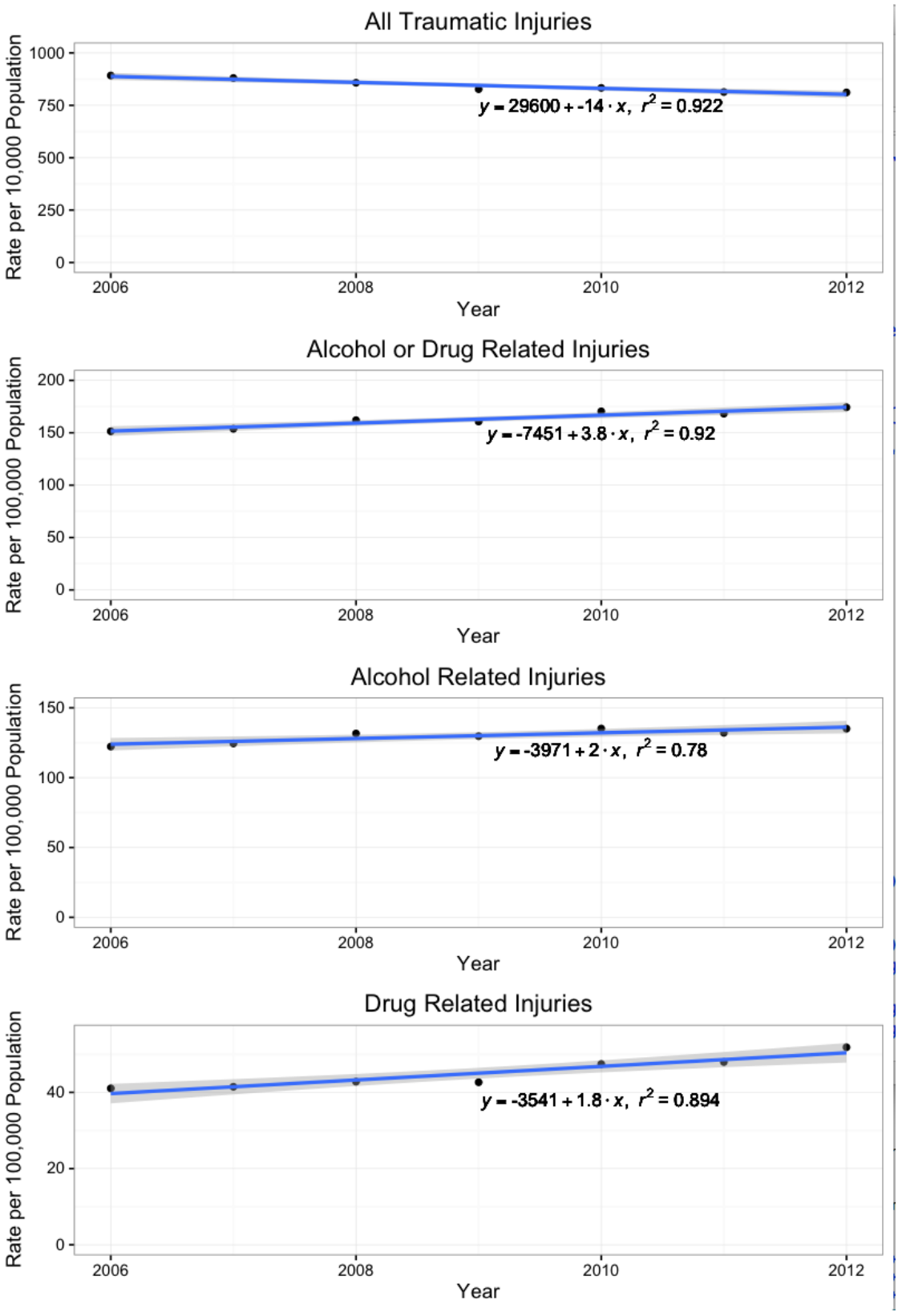

Figure 1: Total, Alcohol or Drug, Alcohol Only and Drug Only US Population-Based Emergency Department Discharges for Traumatic Injury with Regression Line for Effect of Year on Rate. United States Hospitals, 2006-2012.

```r
# proportion of injury visits that were substance related

mean(rnorm(1000, mean = 3499134, sd = 9327.534)/rnorm(1000, mean = 181194431,
    sd = 9344.209)) * 100  # 1.931065
sd(rnorm(1000, mean = 3499134, sd = 9327.534)/rnorm(1000, mean = 181194431,
    sd = 9344.209)) * 100  # 0.005211934


# etoh-associated injury visits
(yrCountETOHinj <- svytotal(~alcohol, subset(monInj, inj == 1),
    na.rm = T, se = TRUE, multicore = T))
# SE _alcohol 2791471 8362.373

# drug-associated injury visits
(yrCountDRUGinj <- svytotal(~anydrug, subset(monInj, inj == 1),
    na.rm = T, se = TRUE, multicore = T))
# _anydrug 967481.1 4946.37




# YEARLY NUMBERS

# yearly ED visits
(yrCountTot <- svytotal(~count, monInj, byvar = ~yr, na.rm = T,
    se = TRUE, multicore = T))

# SE _count_2006 120033750 22246.85 _count_2007 122331739
# 22466.32 _count_2008 124945264 21546.83 _count_2009
# 128885040 23007.43 _count_2010 128970364 21935.49
# _count_2011 131048605 20112.18 _count_2012 134399179
# 21244.58



# yearly injury visits
(yrCountInj <- svytotal(~cnt, monInj, byvar = ~yr, na.rm = T,
    se = TRUE, multicore = T))
# SE _cnt_2006 26624017 22867.11 _cnt_2007 26519522 22899.04
# _cnt_2008 26084855 21632.38 _cnt_2009 25376355 22658.54
# _cnt_2010 25771892 21768.06 _cnt_2011 25347338 19845.75
# _cnt_2012 25470453 20879.10


# yearly any drug-etoh visits
```

```
(yrCountAny <- svytotal(~drug_or_alcohol, monInj, byvar = ~yr,
    na.rm = T, se = TRUE, multicore = T))
# SE _drug_or_alcohol_2006 4110748 4571.044
# _drug_or_alcohol_2007 4232415 4638.056
# _drug_or_alcohol_2008 4449910 4615.886
# _drug_or_alcohol_2009 4712759 4886.519
# _drug_or_alcohol_2010 5093415 5041.156
# _drug_or_alcohol_2011 5256527 5007.217
# _drug_or_alcohol_2012 5577620 5102.240


# yearly alcohol visits
(yrCountETOH <- svytotal(~alcohol, monInj, byvar = ~yr, na.rm = T,
    se = TRUE, multicore = T))
# SE _alcohol_2006 2545968 3610.964 _alcohol_2007 2678515
# 3719.903 _alcohol_2008 2845921 3709.191 _alcohol_2009
# 2973638 3895.697 _alcohol_2010 3162462 3998.879
# _alcohol_2011 3191046 3914.851 _alcohol_2012 3372240
# 3989.654


# yearly drug visits
(yrCountDRUG <- svytotal(~anydrug, monInj, byvar = ~yr, na.rm = T,
    se = TRUE, multicore = T))
# SE _anydrug_2006 1996298 3174.931 _anydrug_2007 2024817
# 3181.134 _anydrug_2008 2068608 3134.868 _anydrug_2009
# 2230521 3352.288 _anydrug_2010 2442132 3481.014
# _anydrug_2011 2574578 3517.367 _anydrug_2012 2754059
# 3584.831



# any substance associated yearly injury visits
(yrCountDRUGinj <- svytotal(~drug_or_alcohol, subset(monInj,
    inj == 1), byvar = ~yr, na.rm = T, se = TRUE, multicore = T))
# SE _drug_or_alcohol_2006 451694.1 3437.151
# _drug_or_alcohol_2007 463296.5 3406.839
# _drug_or_alcohol_2008 492682.5 3456.612
# _drug_or_alcohol_2009 492949.7 3563.324
# _drug_or_alcohol_2010 527200.2 3699.716
# _drug_or_alcohol_2011 524064.1 3644.802
# _drug_or_alcohol_2012 547246.4 3687.790

# yearly etoh-associated injury visits
(yrCountETOHinj <- svytotal(~alcohol, subset(monInj, inj == 1),
    byvar = ~yr, na.rm = T, se = TRUE, multicore = T))
# SE _alcohol_2006 364793.3 3087.257 _alcohol_2007 375012.7
```

```
# 3068.880 _alcohol_2008 400203.2 3122.145 _alcohol_2009
# 397874.6 3204.011 _alcohol_2010 418095.5 3311.354
# _alcohol_2011 411566.9 3230.225 _alcohol_2012 423924.6
# 3257.512


# yearly drug-associated injury visits
(yrCountDRUGinj <- svytotal(~anydrug, subset(monInj, inj == 1),
    byvar = ~yr, na.rm = T, se = TRUE, multicore = T))
# SE _anydrug_2006 122504.0 1803.579 _anydrug_2007 124943.5
# 1770.460 _anydrug_2008 130205.0 1776.169 _anydrug_2009
# 130877.8 1840.960 _anydrug_2010 146758.6 1939.884
# _anydrug_2011 149469.9 1964.380 _anydrug_2012 162722.1
# 2013.093



# calculate yearly rates, create dataframes, plot

# total US population from MS2014-02 Population Denominator
# Data Tables - Appendix A 08152014.xlsx
natPop <- c(313873685, 311582564, 309326295, 306771529, 304093966,
    301231207, 298379912)
natPop <- natPop[7:1]  # arrange in increasing years
total <- c(120033750, 122331739, 124945264, 128885040, 128970364,
    131048605, 134399179)
injury <- c(26624017, 26519522, 26084855, 25376355, 25771892,
    25347338, 25470453)
drugETOHInjury <- c(451694, 463296, 492682, 492949, 527200, 524064,
    547246)
ETOHInjury <- c(364793, 375012, 400203, 397874, 418095, 411566,
    423924)
drugInjury <- c(122504, 124943, 130205, 130877, 146758, 149469,
    162722)


# NB: Note different scales....
total <- total/natPop * 10000
injury <- injury/natPop * 10000
drugETOHInjury <- drugETOHInjury/natPop * 1e+05
ETOHInjury <- ETOHInjury/natPop * 1e+05
drugInjury <- drugInjury/natPop * 1e+05

total <- as.data.frame(total)
injury <- as.data.frame(injury)
drugETOHInjury <- as.data.frame(drugETOHInjury)
ETOHInjury <- as.data.frame(ETOHInjury)
```

```r
drugInjury <- as.data.frame(drugInjury)

total$Type <- "All Discharges"
injury$Type <- "Any Injury"
drugETOHInjury$Type <- "Drug or ETOH Injuries"
ETOHInjury$Type <- "ETOH Injuries"
drugInjury$Type <- "Drug Injuries"

names(total)[1] <- "Rate"
names(injury)[1] <- "Rate"
names(drugETOHInjury)[1] <- "Rate"
names(ETOHInjury)[1] <- "Rate"
names(drugInjury)[1] <- "Rate"



total$Year <- 2006:2012
injury$Year <- 2006:2012
drugETOHInjury$Year <- 2006:2012
ETOHInjury$Year <- 2006:2012
drugInjury$Year <- 2006:2012

rateDat1 <- rbind(total, injury, drugETOHInjury, ETOHInjury,
    drugInjury)
rateDat2 <- rbind(injury, drugETOHInjury, ETOHInjury, drugInjury)

# function to add regression equation to ggplot
lm_eqn <- function(df) {
    m <- lm(Rate ~ Year, df)
    eq <- substitute(italic(y) == a + b %.% italic(x) * "," ~
        ~italic(r)^2 ~ "=" ~ r2, list(a = format(coef(m)[1],
      digits = 2), b = format(coef(m)[2], digits = 2), r2 = format(summary(m)$r.squared,
        digits = 3)))
    as.character(as.expression(eq))
}



# separate plot for each data type
p.tot1 <- ggplot(data = total, aes(x = Year, y = Rate))
p.tot2 <- p.tot1 + geom_point() + geom_smooth(method = "lm") +
    ylim(0, 5000)
p.tot <- p.tot2 + geom_text(x = 2010, y = 3500, label = lm_eqn(total),
    parse = TRUE) + ylab("Rate per 10,000 Population") + theme_bw() +
    ggtitle("All ED Discharges")
p.tot
p.inj1 <- ggplot(data = injury, aes(x = Year, y = Rate))
p.inj2 <- p.inj1 + geom_point() + geom_smooth(method = "lm") +
```

```
    ylim(0, 1000)
p.inj <- p.inj2 + geom_text(x = 2010, y = 750, label = lm_eqn(injury),
    parse = TRUE) + ylab("Rate per 10,000 Population") + theme_bw() +
    ggtitle("All Traumatic Injuries")

p.etohdrug1 <- ggplot(data = drugETOHInjury, aes(x = Year, y = Rate))
p.etohdrug2 <- p.etohdrug1 + geom_point() + geom_smooth(method = "lm") +
    ylim(0, 200)
p.etohdrug <- p.etohdrug2 + geom_text(x = 2010, y = 150, label = lm_eqn(drugETOHInjury),
    parse = TRUE) + ylab("Rate per 100,000 Population") + theme_bw() +
    ggtitle("Alcohol or Drug Related Injuries")

p.etoh1 <- ggplot(data = ETOHInjury, aes(x = Year, y = Rate))
p.etoh2 <- p.etoh1 + geom_point() + geom_smooth(method = "lm") +
    ylim(0, 150)
p.etoh <- p.etoh2 + geom_text(x = 2010, y = 120, label = lm_eqn(ETOHInjury),
    parse = TRUE) + ylab("Rate per 100,000 Population") + theme_bw() +
    ggtitle("Alcohol Related Injuries")

p.drug1 <- ggplot(data = drugInjury, aes(x = Year, y = Rate))
p.drug2 <- p.drug1 + geom_point() + geom_smooth(method = "lm") +
    ylim(0, 55)
p.drug <- p.drug2 + geom_text(x = 2010, y = 38, label = lm_eqn(drugInjury),
    parse = TRUE) + ylab("Rate per 100,000 Population") + theme_bw() +
    ggtitle("Drug Related Injuries")



# group plots together with grid
library(grid)
grid.newpage()
grid.draw(rbind(ggplotGrob(p.inj), ggplotGrob(p.etohdrug), ggplotGrob(p.etoh),
    ggplotGrob(p.drug), size = "first"))
# (take screen shot...)



# calculate percent decrease ED injury visits

(mean(injury[1:3, 1]) - mean(injury[5:7, 1]))/mean(injury[1:3,
    1]) * 100  # -6.5%
(mean(drugETOHInjury[1:3, 1]) - mean(drugETOHInjury[5:7, 1]))/mean(drugETOHInjury[1:3,
    1]) * 100  # 9.8%
```

The mean age for a person with a primary diagnosis of traumatic injury was 34.7 (0.009) years. By contrast, the mean age for a person with a primary injury diagnosis and secondary alcohol or drug diagnosis was 41.0 (0.05) years. The average age for injured individuals

with secondary alcohol diagnoses was 41.8 (0.05) years, compared to 37.4 (0.08) for injured individuals with secondary drug diagnoses. 46.3% (0.02) of all persons with primary injury diagnoses were female, compared to 26.6% (0.13) of injured persons with a secondary alcohol or drug diagnosis.

```
# AGE mean age all ED
(svymean(~age, monInj, na.rm = T, multicore = T, se = T))
# SE _age 38.36632 0.001812635

# mean age any substance ED
(svymean(~age, subset(monInj, drug_or_alcohol == 1), na.rm = T,
    multicore = T, se = T))
# SE _age 42.28421 0.005899099

# mean age injured ED
(svymean(~age, subset(monInj, inj == 1), na.rm = T, multicore = T,
    se = T))
# SE _age 34.7461 0.008552669

# mean age injured any substance
(svymean(~age, subset(monInj, inj == 1), byvar = ~drug_or_alcohol,
    na.rm = T, multicore = T, se = T))
# SE _age_0 34.62365 0.008670463 _age_1 40.96445 0.044459792


# mean age injured etoh
(svymean(~age, subset(monInj, inj == 1), byvar = ~alcohol, na.rm = T,
    multicore = T, se = T))
# SE _age_0 34.63590 0.008646254 _age_1 41.78871 0.048724951

# mean age injured drug
(svymean(~age, subset(monInj, inj == 1), byvar = ~anydrug, na.rm = T,
    multicore = T, se = T))
# SE _age_0 34.73187 0.008586384 _age_1 37.39529 0.084461611



# GENDER mean female all ED
(svymean(~female, monInj, na.rm = T, multicore = T, se = T))
# SE _female 0.5479561 3.87068e-05

# mean female any substance ED
(svymean(~female, subset(monInj, drug_or_alcohol == 1), na.rm = T,
    multicore = T, se = T))
# SE _female 0.3397906 0.0001886147


# mean female injured ED
```

```
(svymean(~female, subset(monInj, inj == 1), na.rm = T, multicore = T,
    se = T))
# SE _female 0.4632816 0.00019114

# mean female injured any substance
(svymean(~female, subset(monInj, inj == 1), byvar = ~drug_or_alcohol,
    na.rm = T, multicore = T, se = T))
# SE _female_0 0.4671692 0.0001929737 _female_1 0.2658628
# 0.0012930756
0.0012930756 * 100

# mean female injured etoh
(svymean(~female, subset(monInj, inj == 1), byvar = ~alcohol,
    na.rm = T, multicore = T, se = T))
# SE _female_0 0.4667042 0.0001925975 _female_1 0.2445421
# 0.0014207767

# mean female injured drug
(svymean(~female, subset(monInj, inj == 1), byvar = ~anydrug,
    na.rm = T, multicore = T, se = T))
# SE _female_0 0.4640649 0.0001916374 _female_1 0.3173610
# 0.0025701254
```

The most common external cause of injury codes for discharges with a secondary alcohol or drug diagnosis involved falls 747,483 (4335) or an unarmed fight or brawl 256,853 (2548) which respectively accounted for 21.4% (0.14) and 7.3% (0.08) of alcohol or drug related injury discharges. This pattern held for those injury diagnoses with a secondary diagnosis limited to alcohol where there were 648,225 (4041) falls or 23.2% (0.16) and 219,296 (2357) or 7.9% (0.08) unarmed fights. And the same pattern held for injuries with a secondary diagnosis limited to drugs with the addition of motor vehicle crashes as an additional important cause, accounting for 36,047 (967) or 3.8% (0.10) such injuries.

```
# identify the top codes top 5 e codes injury
dbGetQuery(neds, "
SELECT ecode1, COUNT(ecode1) FROM neds0612
WHERE inj = 1
GROUP BY ecode1
ORDER BY COUNT(ecode1) DESC
LIMIT 6;
")
# 1 E8859 3673080 - Fall from other slipping, tripping, or
# stumbling 2 E8889 2578808 - Unspecified fall 3 E9179
# 2519949 - Obj W-W/O Sub Fall NEC (Other Accident Caused By
# Striking Against Or Being Struck Accidentally By Objects Or
# Persons) 4 2336178 5 E9289 2026368 - Accident NOS
# (Unspecified accident) 6 E9208 1783060 - Accidents caused
# by other specified cutting and piercing instruments or
```

```
# objects




# top 5 ecodes any substance
dbGetQuery(neds, "
SELECT ecode1, COUNT(ecode1) FROM neds0612
WHERE inj = 1 AND drug_or_alcohol=1
GROUP BY ecode1
ORDER BY COUNT(ecode1) DESC
LIMIT 6;
")
# ecode1 L1 1 E8889 70499 - Unspecified fall 2 E8859 66758 -
# Fall from other slipping, tripping, or stumbling 3 E9600
# 55473 - Unarmed fight or brawl 4 38177 5 E9289 29992 -
# Accident NOS (Unspecified accident) 6 E8809 26038 - Fall On
# Stair/Step NEC (Accidental Fall On Or From Other Stairs Or
# Steps)


# count them up falls
svytotal(~inj, subset(monInj, ecode1 %in% c("E8889", "E8859",
    "E8809") & drug_or_alcohol == 1), na.rm = T, se = TRUE, multicore = T)
# SE _inj 747483 4334.935

# fights
svytotal(~inj, subset(monInj, ecode1 == "E9600" & drug_or_alcohol ==
    1), na.rm = T, se = TRUE, multicore = T)
# SE _inj 256852.6 2547.55

# proportion falls among all etoh or drug injuries
mean(rnorm(1000, mean = 747483, sd = 4334.935)/rnorm(1000, mean = 3499134,
    sd = 9327.534)) * 100  # 21.36309
sd(rnorm(1000, mean = 747483, sd = 4334.935)/rnorm(1000, mean = 3499134,
    sd = 9327.534)) * 100  #  0.1389782

# proportion brawls among all etoh or drug injuries
mean(rnorm(1000, mean = 256852.6, sd = 2547.55)/rnorm(1000, mean = 3499134,
    sd = 9327.534)) * 100  # 7.335033
sd(rnorm(1000, mean = 256852.6, sd = 2547.55)/rnorm(1000, mean = 3499134,
    sd = 9327.534)) * 100  #  0.07576045
```

```
# top 5 ecodes alcohol


dbGetQuery(neds, "
SELECT ecode1, COUNT(ecode1) FROM neds0612
WHERE inj = 1 AND alcohol=1
GROUP BY ecode1
ORDER BY COUNT(ecode1) DESC
LIMIT 6;
")

# ecode1 L1 1 E8889 61770 - Unspecified fall 2 E8859 56852 -
# Fall from other slipping, tripping, or stumbling 3 E9600
# 47216 - Unarmed fight or brawl 4 28638 5 E9289 22833 -
# Accident NOS (Unspecified accident) 6 E8809 22697 Fall On
# Stair/Step NEC (Accidental Fall On Or From Other Stairs Or
# Steps)



# count them up falls
svytotal(~inj, subset(monInj, ecode1 %in% c("E8889", "E8859",
    "E8809") & alcohol == 1), na.rm = T, se = TRUE, multicore = T)
# SE _inj 648225.1 4040.069

# fights
svytotal(~inj, subset(monInj, ecode1 == "E9600" & alcohol ==
    1), na.rm = T, se = TRUE, multicore = T)
# SE _inj 219295.7 2357.25

# proportion falls among all etoh injuries
mean(rnorm(1000, mean = 648225.1, sd = 4040.069)/rnorm(1000,
    mean = 2791471, sd = 8362.373)) * 100  # 23.22189
sd(rnorm(1000, mean = 648225.1, sd = 4040.069)/rnorm(1000, mean = 2791471,
    sd = 8362.373)) * 100  #  0.1567615

# proportion brawls among all etoh injuries
mean(rnorm(1000, mean = 219295.7, sd = 2357.25)/rnorm(1000, mean = 2791471,
    sd = 8362.373)) * 100  # 7.851987
sd(rnorm(1000, mean = 219295.7, sd = 2357.25)/rnorm(1000, mean = 2791471,
    sd = 8362.373)) * 100  #  0.08463459



# top 5 ecodes any drug
dbGetQuery(neds, "
```

```
SELECT ecode1, COUNT(ecode1) FROM neds0612
WHERE inj = 1 AND anydrug=1
GROUP BY ecode1
ORDER BY COUNT(ecode1) DESC
LIMIT 6;
")



# ecode1 L1 1 E9600 12669 - Unarmed fight or brawl 2 12516 3
# E8859 12208 - Fall from other slipping, tripping, or
# stumbling 4 E8889 11688 - Unspecified fall 5 E9289 8915 -
# Accident NOS (Unspecified accident) 6 E8120 7795 - Mv
# Collision NOS-Driver (Other Motor V
icle Traffic Accident
# Involving Collision With Motor V
icle Injuring Driver Of
# Motor V
icle Other Than Motorcycle)



# count them up falls
svytotal(~inj, subset(monInj, ecode1 %in% c("E8889", "E8859") &
    anydrug == 1), na.rm = T, se = TRUE, multicore = T)
# SE _inj 108049.3 1652.992 fights
svytotal(~inj, subset(monInj, ecode1 == "E9600" & anydrug ==
    1), na.rm = T, se = TRUE, multicore = T)
# SE _inj 58013.12 1209.623

# MVC
svytotal(~inj, subset(monInj, ecode1 == "E8120" & anydrug ==
    1), na.rm = T, se = TRUE, multicore = T)
# SE _inj 36047.02 966.568

# proportion mvcs among drug injuries
mean(rnorm(1000, mean = 36047.02, sd = 966.568)/rnorm(1000, mean = 967481.1,
    sd = 4946.37)) * 100  # 3.730709
sd(rnorm(1000, mean = 36047.02, sd = 966.568)/rnorm(1000, mean = 967481.1,
    sd = 4946.37)) * 100  #  0.1054449



# E_CCS not very helpful

# look at e_ccs variable top 5 eccs any substance
dbGetQuery(neds, "
```

```
SELECT e_ccs1, COUNT(e_ccs1) FROM neds0612
WHERE inj = 1 AND drug_or_alcohol=1
GROUP BY e_ccs1
ORDER BY COUNT(e_ccs1) DESC
LIMIT 6;
")
# e_ccs1 L1 1 2603 234588 2 2607 123265 3 2614 108856 4 2620
# 64297 5 2601 38238 6 -999 38177

# top 5 eccs alcohol
dbGetQuery(neds, "
SELECT e_ccs1, COUNT(e_ccs1) FROM neds0612
WHERE inj = 1 AND alcohol=1
GROUP BY e_ccs1
ORDER BY COUNT(e_ccs1) DESC
LIMIT 6;
")
# e_ccs1 L1 1 2603 201492 2 2607 98096 3 2614 88400 4 2620
# 50849 5 2601 28902 6 -999 28638

# top 5 eccs any drug
dbGetQuery(neds, "
SELECT e_ccs1, COUNT(e_ccs1) FROM neds0612
WHERE inj = 1 AND anydrug=1
GROUP BY e_ccs1
ORDER BY COUNT(e_ccs1) DESC
LIMIT 6;
")
# e_ccs1 L1 1 2603 43623 2 2607 36711 3 2614 28978 4 2620
# 18158 5 2601 13018 6 -999 12516
```

A total of 3,880,647 (9846) or 2.1% (0.01) of discharges with a primary injury diagnosis were classified as "severe" or likely to result in death. Of these 3,880,647 severe injuries, 476,582 (3539) or 12.3% (0.10) had a secondary alcohol or drug diagnosis.

```
# all injury visits severe injuries
(svytotal(~severe, subset(monInj, inj == 1), na.rm = T, se = TRUE,
    multicore = T))
# SE _severe 3880647 9846.029


# proportion all injury that were severe
mean(rnorm(1000, mean = 3880647, sd = 9846.029)/rnorm(1000, mean = 181194431,
    sd = 9344.209)) * 100  # 2.141756
sd(rnorm(1000, mean = 3880647, sd = 9846.029)/rnorm(1000, mean = 181194431,
    sd = 9344.209)) * 100  # 0.005444507
```

```
# any substance visit injury severe injuries
(svytotal(~severe, subset(monInj, (inj == 1 & drug_or_alcohol ==
    1)), na.rm = T, se = TRUE, multicore = T))
# SE _severe 476581.5 3539.317



# proportion of severe injuries with etoh or substance
mean(rnorm(1000, mean = 476581.5, sd = 3539.317)/rnorm(1000,
    mean = 3880647, sd = 9846.029)) * 100  #
sd(rnorm(1000, mean = 476581.5, sd = 3539.317)/rnorm(1000, mean = 3880647,
    sd = 9846.029)) * 100  #



# etoh-associated injury visits severe injuries
(svytotal(~severe, subset(monInj, (inj == 1 & alcohol == 1)),
    na.rm = T, se = TRUE, multicore = T))
# SE _severe 384001.5 3174.923



# drug-associated injury visits severe injuries
(svytotal(~severe, subset(monInj, (inj == 1 & anydrug == 1)),
    na.rm = T, se = TRUE, multicore = T))
# SE _severe 154600.2 2031.884
```

There were a total of 1,344,950 (2581) pre-admission fatalities during the study period of which 73,655 (1396) or 5.5% (0.10) had a primary diagnosis of traumatic injury. Of the 73,655 pre-admission deaths with a primary injury diagnosis, 999 (77) or 1.4% (0.11) had a secondary alcohol or drug diagnosis.

```
# death counts (use to calculate CFR's using total numbers as
# denominators) NB: looking at deaths in the ED, *not*
# including after admitted

# all ED visits pre-admission deaths
(svytotal(~died_ed, monInj, na.rm = T, se = TRUE, multicore = T))
# SE _died_ed 1344950 2581.965

# all injury visits pre-admission deaths
(svytotal(~died_ed, subset(monInj, inj == 1), na.rm = T, se = TRUE,
    multicore = T))
# SE _died_ed 73655.85 1396.164

# percent pre-admit deaths due to primary injury dx:
```

```
mean(rnorm(1000, mean = 73655.85, sd = 1396.164)/rnorm(1000,
    mean = 1344950, sd = 2581.965)) * 100  # 5.468167
sd(rnorm(1000, mean = 73655.85, sd = 1396.164)/rnorm(1000, mean = 1344950,
    sd = 2581.965)) * 100  #  0.1037812

# any drug-etoh visits pre-admission deaths
(svytotal(~died_ed, subset(monInj, drug_or_alcohol == 1), na.rm = T,
    se = TRUE, multicore = T))
# SE _died_ed 18968.64 309.3534


# any alcohol visits pre-admission deaths
(svytotal(~died_ed, subset(monInj, alcohol == 1), na.rm = T,
    se = TRUE, multicore = T))
# SE _died_ed 10908.8 239.8667



# any substance visit injury pre-admission deaths
(svytotal(~died_ed, subset(monInj, (inj == 1 & drug_or_alcohol ==
    1)), na.rm = T, se = TRUE, multicore = T))
# SE _died_ed 999.1259 76.88494

# percent injury deaths with etoh or drug secondary dx

mean(rnorm(1000, mean = 999.1259, sd = 76.88494)/rnorm(1000,
    mean = 73655.85, sd = 1396.164)) * 100  # 1.359425
sd(rnorm(1000, mean = 999.1259, sd = 76.88494)/rnorm(1000, mean = 73655.85,
    sd = 1396.164)) * 100  # 0.1125233

# etoh-associated injury visits pre-admission deaths
(svytotal(~died_ed, subset(monInj, (inj == 1 & alcohol == 1)),
    na.rm = T, se = TRUE, multicore = T))
# SE _died_ed 838.106 70.91475


# drug-associated injury visits pre-admission deaths
(svytotal(~died_ed, subset(monInj, (inj == 1 & anydrug == 1)),
    na.rm = T, se = TRUE, multicore = T))
# SE _died_ed 215.5928 32.83588
```

The total cost over the study period of emergency department care for discharges with a primary injury diagnoses was $99.70 (0.06) Billion. Traumatic injuries with a secondary diagnosis of alcohol or drugs accounted for $4.14 (0.01) Billion or 4.2% (0.01) of the cost of injury care in the United States. The total cost of alcohol-related injuries increased 67.2% from the first three years of the study period compared to the final three years. In a similar comparison the total cost of drug-related injuries increased 63.5%. (Figure 2)

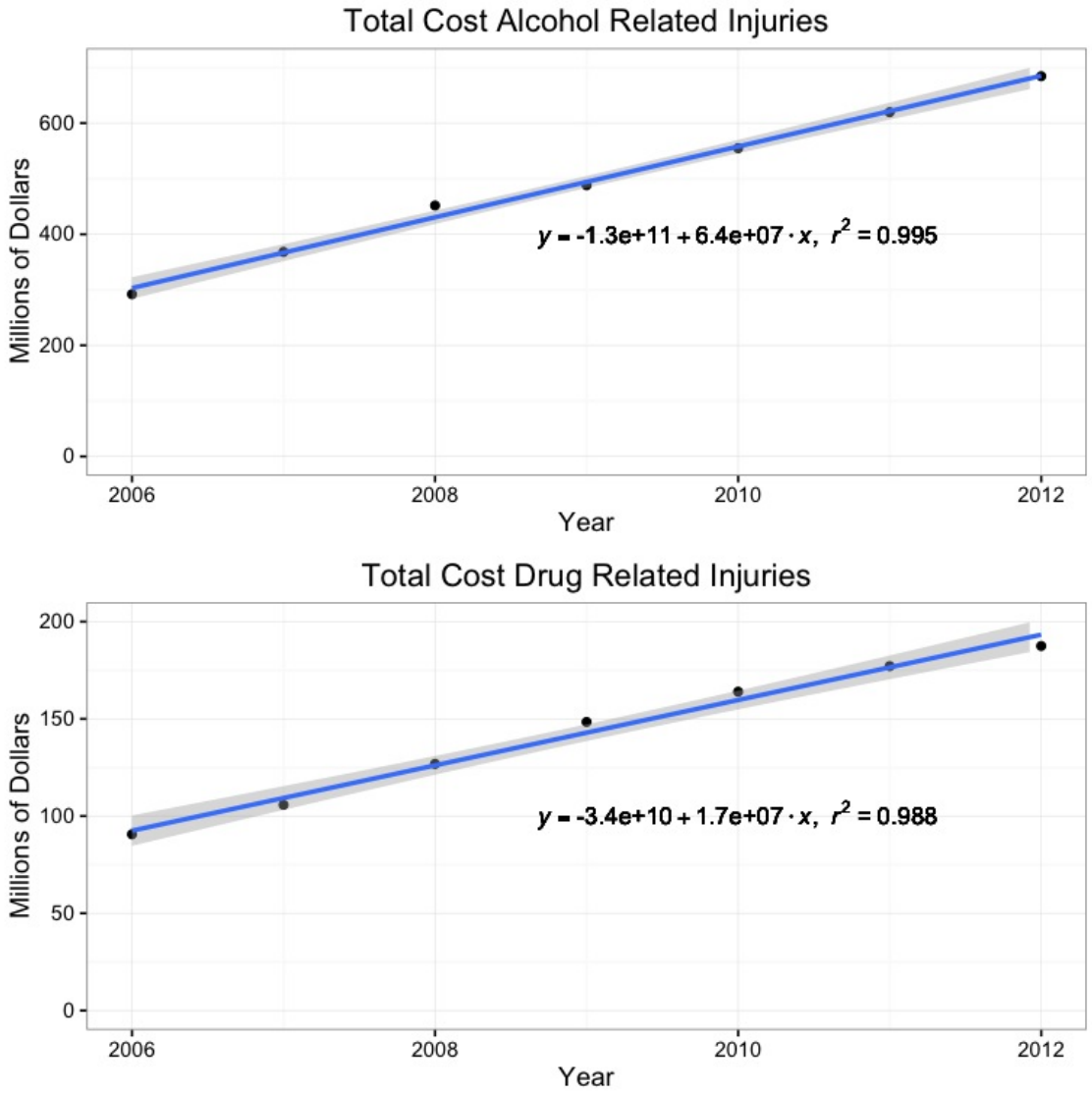

Figure 2: Total Yearly Cost of Emergency Department Discharges for Primary Injury Diagnoses with Secondary Alcohol or Drug Diagnoses in Millions of Dollars. US Hospitals 2006 - 2011.

```r
# total all injury adjusted costs
svytotal(~cost_disc_adj, subset(monInj, inj == 1 & cost_disc_adj >
    0), na.rm = T, se = TRUE, multicore = T)
# SE _cost_disc_adj 99696322631 56274508

99696322631/1e+09
56274508/1e+09

# mean any injury

# total any substance adjusted cost
(svytotal(~cost_disc_adj, subset(monInj, (drug_or_alcohol ==
    1 & cost_disc_adj > 0)), na.rm = T, se = TRUE, multicore = T))
# SE _cost_disc_adj 25813446017 18563870



# total any alcohol adjusted costs
(svytotal(~cost_disc_adj, subset(monInj, (alcohol == 1 & cost_disc_adj >
    0)), na.rm = T, se = TRUE, multicore = T))
# SE _cost_disc_adj 16592136619 14929976







# total any drug adjusted costs
(svytotal(~cost_disc_adj, subset(monInj, (anydrug == 1 & cost_disc_adj >
    0)), na.rm = T, se = TRUE, multicore = T))
# SE _cost_disc_adj 11719434453 12501723


# total any substance injury costs
(svytotal(~cost_disc_adj, subset(monInj, (inj == 1 & drug_or_alcohol ==
    1 & cost_disc_adj > 0)), na.rm = T, se = TRUE, multicore = T))
# SE _cost_disc_adj 4146776374 9019633

4146776374/1e+09  # 4.146776
9019633/1e+09  # 0.009019633


# proportion any etoh or drug injury among all injury

mean(rnorm(1000, mean = 4146776374, sd = 9019633)/rnorm(1000,
    mean = 99696322631, sd = 56274508)) * 100  # 4.159072 %
sd(rnorm(1000, mean = 4146776374, sd = 9019633)/rnorm(1000, mean = 99696322631,
    sd = 56274508)) * 100  # 0.00928682 %
```

```r
# total any etoh-associated injury visits costs
(svytotal(~cost_disc_adj, subset(monInj, (inj == 1 & alcohol ==
    1 & cost_disc_adj > 0)), na.rm = T, se = TRUE, multicore = T))
# SE _cost_disc_adj 3459399794 8198605



# total drug-associated injury visits costs
(svytotal(~cost_disc_adj, subset(monInj, (inj == 1 & anydrug ==
    1 & cost_disc_adj > 0)), na.rm = T, se = TRUE, multicore = T))
# SE _cost_disc_adj 1000195759 4444744



# yearly alcohol assoicated injury costs

# etoh-associated injury visits costs
(svytotal(~cost_disc_adj, subset(monInj, (inj == 1 & alcohol ==
    1 & cost_disc_adj > 0)), byvar = ~yr, na.rm = T, se = TRUE,
    multicore = T))
# SE _cost_disc_adj_2006 292083860 1934768
# _cost_disc_adj_2007 368254684 2422232 _cost_disc_adj_2008
# 451711718 2706459 _cost_disc_adj_2009 488238214 2966552
# _cost_disc_adj_2010 554875829 3272112 _cost_disc_adj_2011
# 619711789 3669876 _cost_disc_adj_2012 684523700 4168857



# yearly drug-associated injury costs
(svytotal(~cost_disc_adj, subset(monInj, (inj == 1 & anydrug ==
    1 & cost_disc_adj > 0)), byvar = ~yr, na.rm = T, se = TRUE,
    multicore = T))

# SE _cost_disc_adj_2006 90631093 1105210 _cost_disc_adj_2007
# 105760777 1298331 _cost_disc_adj_2008 126838870 1461987
# _cost_disc_adj_2009 148410416 1721981 _cost_disc_adj_2010
# 163957967 1787740 _cost_disc_adj_2011 177115696 2051771
# _cost_disc_adj_2012 187480940 2085169



# plot costs
```

```r
etoh <- data.frame(Cost = c(292083860, 368254684, 451711718,
    488238214, 554875829, 619711789, 684523700), Year = 2006:2012)
drug <- data.frame(Cost = c(90631093, 105760777, 126838870, 148410416,
    163957967, 177115696, 187480940), Year = 2006:2012)

etoh$Rate <- etoh$Cost/c(364793, 375012, 400203, 397874, 418095,
    411566, 423924)
drug$Rate <- drug$Cost/c(122504, 124943, 130205, 130877, 146758,
    149469, 162722)

# plot total costs
lm_eqn1 <- function(df) {
    m <- lm(Cost ~ Year, df)
    eq <- substitute(italic(y) == a + b %.% italic(x) * "," ~
        ~italic(r)^2 ~ "=" ~ r2, list(a = format(coef(m)[1],
      digits = 2), b = format(coef(m)[2], digits = 2), r2 = format(summary(m)$r.squared,
        digits = 3)))
    as.character(as.expression(eq))
}

totcost.etoh1 <- ggplot(data = etoh, aes(x = Year, y = Cost/1e+06))
totcost.etoh2 <- totcost.etoh1 + geom_point() + geom_smooth(method = "lm") +
    ylim(0, 700)
totcost.etoh <- totcost.etoh2 + geom_text(x = 2010, y = 400,
    label = lm_eqn1(etoh), parse = TRUE) + ylab("Millions of Dollars") +
    theme_bw() + ggtitle("Total Cost Alcohol Related Injuries")

totcost.drug1 <- ggplot(data = drug, aes(x = Year, y = Cost/1e+06))
totcost.drug2 <- totcost.drug1 + geom_point() + geom_smooth(method = "lm") +
    ylim(0, 200)
totcost.drug <- totcost.drug2 + geom_text(x = 2010, y = 100,
    label = lm_eqn1(drug), parse = TRUE) + ylab("Millions of Dollars") +
    theme_bw() + ggtitle("Total Cost Drug Related Injuries")
totcost.drug
totcost.etoh

library(grid)
grid.newpage()
grid.draw(rbind(ggplotGrob(totcost.etoh), ggplotGrob(totcost.drug),
    size = "first"))

# calculate percent increase total costs

(mean(etoh[5:7, 1]) - mean(etoh[1:3, 1]))/mean(etoh[1:3, 1]) *
    100  #
```

```r
(mean(drug[5:7, 1]) - mean(drug[1:3, 1]))/mean(drug[1:3, 1]) *
    100  #

(mean(drugETOHInjury[1:3, 1]) - mean(drugETOHInjury[5:7, 1]))/mean(drugETOHInjury[1:3,
    1]) * 100  # 9.8%
```

```r
# plot costs per visit

lm_eqn2 <- function(df) {
    m <- lm(Rate ~ Year, df)
    eq <- substitute(italic(y) == a + b %.% italic(x) * "," ~
        ~italic(r)^2 ~ "=" ~ r2, list(a = format(coef(m)[1],
      digits = 2), b = format(coef(m)[2], digits = 2), r2 = format(summary(m)$r.squared,
        digits = 3)))
    as.character(as.expression(eq))
}

percost.etoh1 <- ggplot(data = etoh, aes(x = Year, y = Rate))
percost.etoh2 <- percost.etoh1 + geom_point() + geom_smooth(method = "lm") +
    ylim(0, 1900)
percost.etoh <- percost.etoh2 + geom_text(x = 2010, y = 1200,
    label = lm_eqn2(etoh), parse = TRUE) + ylab("Dollars") +
    theme_bw() + ggtitle("Cost per Discharge Alcohol Related Injuries")

percost.drug1 <- ggplot(data = drug, aes(x = Year, y = Rate))
percost.drug2 <- percost.drug1 + geom_point() + geom_smooth(method = "lm") +
    ylim(0, 1500)
percost.drug <- percost.drug2 + geom_text(x = 2010, y = 800,
    label = lm_eqn2(drug), parse = TRUE) + ylab("Dollars") +
    theme_bw() + ggtitle(" Cost per Discharge Drug Related Injuries")
percost.etoh
percost.drug

grid.newpage()
grid.draw(rbind(ggplotGrob(totcost.drug), ggplotGrob(totcost.etoh),
    ggplotGrob(percost.etoh), ggplotGrob(percost.drug), size = "first"))
```

3 Interaction of Injury and Substance Use

The statistically significant interaction term for substance use and injury for the risk of mortality, means conceptually that we cannot statistically consider the effect of injury without considering the absence or presence of substance use and vice versa. Because it "makes a difference" it is causally "important".[CITE Mervyn Susser, cause is "something that makes a difference"] More practically, a model must retain both the variables that make up the interaction (whether they themselves are individually statistically significant or not).

To assessed the interaction between injury and any substance use two ways. First, we tested the direction and statistical significance of an interaction term for the two variables into a logistic regression equation with death as the outcome and variables to control for confounding by age in years and gender:

$death_i = \beta_{intercept} + \beta_{age} + \beta_{gender} + \beta injury + \beta_{substance} + \beta_{injury \cdot substance}$

Where, "age" was measured continuously in years, "gender" was an indicator variable for male (0) vs. female (1), "injury" was an indicator variable for the presence (1) or absence (0) of a primary diagnostic code indicating traumatic injury, "substance" was an indicator variable for the presence (1) or absence (0) of a secondary diagnostic code indicating either alcohol or drug as defined above. The interaction term, $injury \cdot substance$ indicates the presence of both a primary diagnostic code for traumatic injury and a secondary diagnostic code for alcohol or drug.

We also assessed the interaction of injury and substance use on the risk of pre-admission emergency department fatality using an approach proposed by Darroch (1997) and Rothman and Greenland (1998) within the framework of component causes, where

- ¥ $R_{injury \cdot substance \cdot unknown}$ - the risk of fatality when traumatic injury and substance use are both present
- ¥ $R_{injury \cdot unknown}$ - the risk of fatality when injury but not substance use is present
- ¥$R_{substance \cdot unknown}$ - the risk of fatality when substance use but not injury is present
- ¥ $R_unknown$ - the "background" experience when fatality occurs in the absence of either injury or substance use

To determine if the observed $R_{injury \cdot substance \cdot unknown}$ exceeds what we might expect if the two risks did not interact, we subtract out $R_{injury \cdot unknown}$ and $R_{substance \cdot unknown}$ and then add back $R_unknown$ which we subtracted twice, setting up an equality to test the independence of causes:

$R_{injury \cdot substance \cdot unknown} = R_{injury \cdot unknown} + R_{substance \cdot unknown} - R_unknown$

Any excess risk beyond these inequalities is due to interaction.

We assessed interaction on both an unadjusted additive scale, in terms of absolute risk differences:

$(Risk_{injury \cdot substance} - Risk_u nknown) = (Risk_i njury - Risk_u nknown) + (Risk_s ubstance - R_u nknown)$

We took into account survey variation by running simulation or bootstrap estimates of this equation using point estimates and standard errors returned by survey procedures.

And on a multiplicative scale using the results of a logistic regression equation that controlled for age, gender and injury severity:

$(RR_{injury \cdot substance} - 1) = (RR_i njury - 1) + (RR_s ubstance - 1)$

3.1 Regression and Interaction on Multiplicative Scale

In a logistic regression on the risk of pre-admission emergency department fatality, controlling for age and gender both the presence of a primary injury diagnosis or a secondary alcohol or drug diagnosis were independently associated with a decreased risk of death. But an interaction term for the presence of both a traumatic injury and a secondary diagnosis of alcohol or drug use was highly significant for an increased risk of death (OR = 1.76, 95% CI = 1.53, 2.03). (Table 1)

Variable	Odds Ratio (95% CI)
	(Intercept)
0 (0, 0)	
Age	1.04 (1.04, 1.04)
Female	0.64 (0.64, 0.65)
Drug or Alcohol	0.35 (0.34, 0.36)
Injury	0.25 (0.25, 0.25)
Drug or Alcohol*Injury	1.76 (1.53, 2.03)

Table 1: Logistic Regression Effect of Primary Injury Diagnosis and Secondary Alcohol or Drug Diagnosis on the Risk of Pre-admission Emergency Department Fatality, Controlling for Age and Gender. US Emergency Department Discharges 2006-2012.

```
regDat <- select(NEDStab, inj, age, female, alcohol, anydrug,
    drug_or_alcohol, traumacenter, severe, died_ed, discwt, neds_stratum)
regDat <- as.data.frame(regDat)

# fix injury variable so NA's are 0 (recall injury variable
# came from initial injury file)
regDat$inj[is.na(regDat$inj)] <- 0
nrow(regDat)  # 198,102,435
table(regDat$inj)  # 40,073,358
# 0 1 158029077 40073358

d <- datadist(regDat)
options(datadist = "d")
```

```r
# overall association any substance with mortality: decreased
# association with death prior to admission
fatalOR1 <- lrm(died_ed ~ drug_or_alcohol, data = regDat, x = T,
    y = T, weight = discwt)
fatalOR1robust <- robcov(fatalOR1, cluster = regDat$neds_stratum)
summary(fatalOR1robust)
# Effects Response : died_ed Factor Low High Diff. Effect
# S.E.  Lower 0.95 Upper 0.95 drug_or_alcohol 0 1 1 -1.00510
# 0.0084423 -1.0216 -0.98854 Odds Ratio 0 1 1 0.36601 NA
# 0.3600 0.37212



# add injury variable: even less association in the setting
# of any substance use
fatalOR2 <- lrm(died_ed ~ drug_or_alcohol + inj, data = regDat,
    x = T, y = T, weight = discwt)
fatalOR2robust <- robcov(fatalOR2, cluster = regDat$neds_stratum)
summary(fatalOR2robust)
# Effects Response : died_ed Factor Low High Diff. Effect
# S.E.  Lower 0.95 Upper 0.95 drug_or_alcohol 0 1 1 -1.09590
# 0.0079568 -1.11150 -1.08030 Odds Ratio 0 1 1 0.33425 NA
# 0.32908 0.33950 inj 0 1 1 -1.49890 0.0275260 -1.55290
# -1.44500 Odds Ratio 0 1 1 0.22337 NA 0.21164 0.23576

# put in interaction term
fatalOR3 <- lrm(died_ed ~ drug_or_alcohol + inj + drug_or_alcohol *
    inj, data = regDat, x = T, y = T, weight = discwt)
fatalOR3robust <- robcov(fatalOR3, cluster = regDat$neds_stratum)
summary(fatalOR3robust)
# Effects Response : died_ed Factor Low High Diff. Effect
# S.E.  Lower 0.95 Upper 0.95 drug_or_alcohol 0 1 1 -1.12460
# 0.0079985 -1.14030 -1.10900 Odds Ratio 0 1 1 0.32477 NA
# 0.31972 0.32990 inj 0 1 1 -1.50640 0.0276790 -1.56070
# -1.45220 Odds Ratio 0 1 1 0.22171 NA 0.21000 0.23407
# Adjusted to: drug_or_alcohol=0 inj=0


# glm model interaction injury and subtance
fatalORglm1 <- glm(died_ed ~ drug_or_alcohol + inj + drug_or_alcohol *
    inj, data = regDat, family = "binomial")
summary(fatalORglm1)

# Call: glm(formula = died_ed ~ drug_or_alcohol + inj +
# drug_or_alcohol * inj, family = 'binomial', data = regDat)
# Deviance Residuals: Min 1Q Median 3Q Max -0.0613 -0.0613
# -0.0613 -0.0613 4.0490 Coefficients: Estimate Std. Error z
```

```r
# value Pr(>|z|) (Intercept) -6.276718 0.001887 -3325.63
# <2e-16 *** drug_or_alcohol -1.119521 0.015893 -70.44 <2e-16
# *** inj -1.555270 0.008272 -188.01 <2e-16 ***
# drug_or_alcohol:inj 0.754658 0.071728 10.52 <2e-16 *** ---
# Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' '
# 1 (Dispersion parameter for binomial family taken to be 1)
# Null deviance: 4500745 on 196098650 degrees of freedom
# Residual deviance: 4437411 on 196098647 degrees of freedom
# (2003784 observations deleted due to missingness) AIC:
# 4437419 Number of Fisher Scoring iterations: 10

# exponentiate
fatalGLMmod <- exp(cbind(OR = coef(fatalOR3), confint(fatalOR3)))

point <- c(-6.276718, -1.119521, -1.55527, 0.754658)

se <- c(0.001887, 0.015893, 0.008272, 0.071728)

ci.low <- point - (1.96 * se)

ci.high <- point + (1.96 * se)

# here, really is the answer, the ***combination**** of
# substances and injury increases the risk of fatality
exp(cbind(OR = point, lower95 = ci.low, upper96 = ci.high))
# OR lower95 upper96 [1,] 0.001879559 0.00187262 0.001886524
# [2,] 0.326436120 0.31642429 0.336764731 [3,] 0.211132369
# 0.20773686 0.214583384 [4,] 2.126884005 1.84793929
# 2.447935166


# glm model interaction injury and subtance c control for
# age, gender

fatalORglm2 <- glm(died_ed ~ age + female + drug_or_alcohol +
    inj + drug_or_alcohol * inj, data = regDat, family = "binomial")
summary(fatalORglm2)


# Call: glm(formula = died_ed ~ age + female +
# drug_or_alcohol + inj + drug_or_alcohol * inj, family =
# 'binomial', data = regDat) Deviance Residuals: Min 1Q
# Median 3Q Max -1.4940 -0.0600 -0.0377 -0.0261 5.2898
# Coefficients: Estimate Std. Error z value Pr(>|z|)
# (Intercept) -8.149e+00 5.551e-03 -1468.232 < 2e-16 *** age
# 4.055e-02 8.205e-05 494.188 < 2e-16 *** female -4.402e-01
# 1.923e-03 -228.931 < 2e-16 *** drug_or_alcohol -1.046e+00
```

```
# 1.593e-02 -65.641 < 2e-16 *** inj -1.387e+00 8.285e-03
# -167.361 < 2e-16 *** drug_or_alcohol:inj 5.666e-01
# 7.175e-02 7.896 2.87e-15 *** --- Signif. codes: 0 '***'
# 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 (Dispersion
# parameter for binomial family taken to be 1) Null deviance:
# 4500745 on 196098650 degrees of freedom Residual deviance:
# 4125646 on 196098645 degrees of freedom (2003784
# observations deleted due to missingness) AIC: 4125658
# Number of Fisher Scoring iterations: 10

exp(0.5666)  # 1.762265


point <- c(-8.149, 0.04055, -0.4402, -1.046, -1.387, 0.5666)

se <- c(0.005551, 8.205e-05, 0.001923, 0.01593, 0.008285, 0.07175)

vars <- c("(Intercept)", "Age", "Female", "Drug_or_alcohol",
    "Inj", "Drug_or_alcohol*Inj")

ci.low <- point - (1.96 * se)

ci.high <- point + (1.96 * se)

cbind(vars, round(exp(cbind(OR = point, lower95 = ci.low, upper96 = ci.high)),
    2))

# vars OR lower95 upper96 [1,] '(Intercept)' '0' '0' '0' [2,]
# 'Age' '1.04' '1.04' '1.04' [3,] 'Female' '0.64' '0.64'
# '0.65' [4,] 'Drug_or_alcohol' '0.35' '0.34' '0.36' [5,]
# 'Inj' '0.25' '0.25' '0.25' [6,] 'Drug_or_alcohol*Inj'
# '1.76' '1.53' '2.03'

# INTERACTION CALCULATION: $(RR_{injury \cdot substance} -
# 1) = (RR_injury - 1) + (RR_substance - 1)$

(0.25 - 1) + (0.35 - 1)  # -1.4, does not equal 1.76, so interaction is present on multiplicative scale

# percentage of contribution on multiplicative scale


((1.76 - (-1.4))/1.76) * 100  # 179.5455
(1.76 - 1.4)/1.76 * 100  # 20.45455 # changing sign give reasonable result...



# run glm model including injury severity (note using the
```

```r
# inj2 variable)

regDat <- select(NEDStab, inj2, age, female, alcohol, anydrug,
    drug_or_alcohol, traumacenter, severe, died_ed, discwt, neds_stratum)
regDat <- as.data.frame(regDat)

fatalORglm3 <- glm(died_ed ~ age + female + severe + drug_or_alcohol +
    inj2 + drug_or_alcohol * inj2, data = regDat, family = "binomial")
summary(fatalORglm3)


# Call: glm(formula = died_ed ~ age + female + severe +
# drug_or_alcohol + inj2 + drug_or_alcohol * inj2, family =
# 'binomial', data = regDat) Deviance Residuals: Min 1Q
# Median 3Q Max -1.1697 -0.0197 -0.0185 -0.0162 4.6835
# Coefficients: Estimate Std. Error z value Pr(>|z|)
# (Intercept) -8.915e+05 6.612e+07 -0.013 0.989 age 5.849e-03
# 3.306e-04 17.690 <2e-16 *** female -4.322e-01 8.259e-03
# -52.332 <2e-16 *** severe 4.201e+00 1.680e-02 250.125
# <2e-16 *** drug_or_alcohol -4.852e+07 4.106e+09 -0.012
# 0.991 inj2 8.915e+05 6.612e+07 0.013 0.989
# drug_or_alcohol:inj2 4.852e+07 4.106e+09 0.012 0.991 ---
# Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' '
# 1 (Dispersion parameter for binomial family taken to be 1)
# Null deviance: 276241 on 39626867 degrees of freedom
# Residual deviance: 223183 on 39626861 degrees of freedom
# (158475567 observations deleted due to missingness) AIC:
# 223197 Number of Fisher Scoring iterations: 11


point <- c(-891500, 0.005849, -0.4322, 4.201, -48520000, 891500,
    48520000)

se <- c(66120000, 0.0003306, 0.008259, 0.0168, 4.106e+09, 66120000,
    4.106e+09)

vars <- c("(Intercept)", "Age", "Female", "Severe", "Drug_or_alcohol",
    "Inj2", "Drug_or_alcohol:Inj2")

ci.low <- point - (1.96 * se)

ci.high <- point + (1.96 * se)

cbind(vars, round(exp(cbind(OR = point, lower95 = ci.low, upper96 = ci.high)),
    2))
# vars OR lower95 upper96 [1,] '(Intercept)' '0' '0' 'Inf'
# [2,] 'Age' '1.01' '1.01' '1.01' [3,] 'Female' '0.65' '0.64'
```

```
# '0.66' [4,] 'Severe' '66.75' '64.59' '68.99' [5,]
# 'Drug_or_alcohol' '0' '0' 'Inf' [6,] 'Inj2' 'Inf' '0' 'Inf'
# [7,] 'Drug_or_alcohol:Inj2' 'Inf' '0' 'Inf'

# NB: adding injury severity to a model that included an
# interaction term for etoh and substance made the model
# highly unstable, indicating a high degree of covariation
```

3.2 Interaction on Additive Scale

Pre-Admission Fatality Rates per 100,000 population as outlined in table 2 were entered into an equation to test for inequality indicative of additive interaction for the presence of injury and alcohol or substance. The resulting calculation was positive for additive interaction: (28.6 - 184.5) $(40.9 - 184.5) + (60.0 - 184.5)$.

	Alcohol/Drug	No Alcohol/Drug
Injury	28.6	40.9
No Injury	60.0	184.5

Table 2: Contingency Table of Pre-Admission Fatality Rates per 100,000 population for Test of Additive Interaction Between Primary Injury Diagnosis and Secondary Alcohol or Drug Diagnosis. US Emergency Department Discharges 2006-2012.

```
# CALCULATE MUTUALLY EXCLUSIVE CATEGORIES



# NUMERATORS


# ED pre-admission deaths NOT INJURY OR SUBSTANCE
(svytotal(~died_ed, subset(monInj, inj2 == 0 & drug_or_alcohol ==
    0), na.rm = T, se = TRUE, multicore = T))
died_ed <- 1253325
died_ed.se <- 2488.296

# all injury pre-admission deaths NOT SUBSTANCE
(svytotal(~died_ed, subset(monInj, inj == 1 & drug_or_alcohol ==
    0), na.rm = T, se = TRUE, multicore = T))
died_inj <- 72656.72
died_inj.se <- 1270.741

# any drug-etoh visits pre-admission deaths NOT INJURY
(svytotal(~died_ed, subset(monInj, drug_or_alcohol == 1 & inj2 ==
    0), na.rm = T, se = TRUE, multicore = T))
died_subst <- 17969.52
```

```
died_subst.se <- 299.9898

# any substance visit injury pre-admission deaths
(svytotal(~died_ed, subset(monInj, (inj == 1 & drug_or_alcohol ==
    1)), na.rm = T, se = TRUE, multicore = T))
died_inj_substance <- 999.1259
died_inj_substance.se <- 76.88494



# DENOMINATORS

# ED pre-admission visits NOT INJURY OR SUBSTANCE
(svytotal(~count, subset(monInj, inj2 == 0 & drug_or_alcohol ==
    0), na.rm = T, se = TRUE, multicore = T))
count_ed <- 679485248
count_ed.se <- 29081.6

# all injury pre-admission visits NOT substance
(svytotal(~count, subset(monInj, inj == 1 & drug_or_alcohol ==
    0), na.rm = T, se = TRUE, multicore = T))
count_inj <- 177695298
count_inj.se <- 25310.9

# any drug-etoh visits pre-admission visits NOT INJURY
(svytotal(~count, subset(monInj, drug_or_alcohol == 1 & inj2 ==
    0), na.rm = T, se = TRUE, multicore = T))
count_subst <- 29934261
count_subst.se <- 11952.35

# any substance injury visits
(yrCountDRUGinj <- svytotal(~drug_or_alcohol, subset(monInj,
    inj == 1), na.rm = T, se = TRUE, multicore = T))
count_inj_substance <- 3499134
count_inj_substance.se <- 9327.534




# calculation for additive interaction $(Risk_{injury \cdot
# substance} - Risk_unknown) = (Risk_injury - Risk_unknown) +
# (Risk_substance - R_unknown)$

((died_inj/count_inj) - (died_ed/count_ed)) + ((died_subst/count_subst) -
    (died_ed/count_ed))  # - 0.002679859

# VS
```

```
((died_inj_substance/count_inj_substance) - (died_ed/count_ed))  # -0.001558986

# higher (less negative) number on left side of equation vs
# right side indicating additive interaction

# calculate proportion due to interaction on additive scale

(((-0.002679859) - (-0.001558986))/-0.001558986) * 100  #  71.89757 %

(((-0.001558986) - (-0.002679859))/-0.001558986) * 100  #  71.89757 %


# so, 72% percent of injury-substance fatalities are due to
# the interaction of those two factors


# look at risks per 100,000 population

died_inj/count_inj * 1e+05  # Risk_{injury} 40.88838 per 100,000

died_ed/count_ed * 1e+05  # Risk_unknown 184.4521  (NB:  risk of overall non-drug/injury fatalty high,

died_subst/count_subst * 1e+05  # Risk_substance  60.02994

died_inj_substance/count_inj_substance * 1e+05  # Risk_{injury AND substance} # 28.55352

# recalculate additive interaction using population-based
# rates:

# right side of equation (Risk_injury - Risk_unknown) +
# (Risk_substance - R_unknown)

(40.88838 - 184.4521) + (60.02994 - 184.4521)  # -267.9859

# left side of equation (Risk_{injury AND substance} -
# Risk_unknown)

28.55352 - 184.4521  # -155.8986

# -155 > - 268, as expected, differs only on scale, but
# perhap a bit easier to understand how the left side of the
# equation 'exceeds' the right



# SIMULATION FOR STATISTICAL SIGNIFICANCE
```

```r
# NUMERATORS


# ED pre-admission deaths NOT INJURY OR SUBSTANCE
died_ed <- 1253325
died_ed.se <- 2488.296
died_ed.sim <- rnorm(1000, died_ed, died_ed.se)

# all injury pre-admission deaths NOT SUBSTANCE
died_inj <- 72656.72
died_inj.se <- 1270.741
died_inj.sim <- rnorm(1000, died_inj, died_inj.se)

# any drug-etoh visits pre-admission deaths NOT INJURY
died_subst <- 17969.52
died_subst.se <- 299.9898
died_subst.sim <- rnorm(1000, died_subst, died_subst.se)

# any substance visit injury pre-admission deaths
died_inj_substance <- 999.1259
died_inj_substance.se <- 76.88494
died_inj_substance.sim <- rnorm(1000, died_inj_substance, died_inj_substance.se)



# DENOMINATORS

# ED pre-admission visits NOT INJURY OR SUBSTANCE
count_ed <- 679485248
count_ed.se <- 29081.6
count_ed.sim <- rnorm(1000, count_ed, count_ed.se)

# all injury pre-admission visits NOT substance
count_inj <- 177695298
count_inj.se <- 25310.9
count_inj.sim <- rnorm(1000, count_inj, count_inj.se)

# any drug-etoh visits pre-admission visits NOT INJURY
count_subst <- 29934261
count_subst.se <- 11952.35
count_subst.sim <- rnorm(1000, count_subst, count_subst.se)

# any substance injury visits
count_inj_substance <- 3499134
count_inj_substance.se <- 9327.534
count_inj_substance.sim <- rnorm(1000, count_inj_substance, count_inj_substance.se)
```

```
L.sim <- ((died_inj_substance.sim/count_inj_substance.sim) -
    (died_ed.sim/count_ed.sim))

R.sim <- ((died_inj.sim/count_inj.sim) - (died_ed.sim/count_ed.sim)) +
    ((died_subst.sim/count_subst.sim) - (died_ed.sim/count_ed.sim))


sum(L.sim > R.sim)  # 1000, essentially certainty

mean(L.sim)  # -0.00155741
mean(R.sim)  # -0.00268035

sd(L.sim)  # 2.167944e-05
sd(R.sim)  # 1.468617e-05
```

Sensitivity analysis: Redo calculations restricted to age categories 2 and 3 (ages 18 to 54) so as to keep the deaths in the "neither" category lower.

```
# NUMERATORS


# ED pre-admission deaths NOT INJURY OR SUBSTANCE
# (svytotal(~died_ed, subset(monInj, inj==0 &
# drug_or_alcohol==0 & (agecat==2 | agecat==3)), na.rm=T,
# se=TRUE, multicore=T))
died_ed <- 290974.2
died_ed.se <- 1199.598

# all injury pre-admission deaths NOT SUBSTANCE
# (svytotal(~died_ed, subset(monInj, inj==1 &
# drug_or_alcohol==0 & (agecat==2 | agecat==3)), na.rm=T,
# se=TRUE, multicore=T))
died_inj <- 43151.4
died_inj.se <- 474.8858

# any drug-etoh visits pre-admission deaths NOT INJURY
# (svytotal(~died_ed, subset(monInj, drug_or_alcohol==1 &
# inj==0 & (agecat==2 | agecat==3)), na.rm=T, se=TRUE,
# multicore=T))
died_subst <- 12456.99
died_subst.se <- 249.7501

# any substance visit injury pre-admission deaths
# (svytotal(~died_ed, subset(monInj, inj==1 &
# drug_or_alcohol==1 & (agecat==2 | agecat==3)), na.rm=T,
# se=TRUE, multicore=T))
```

```
died_inj_substance <- 701.7562
died_inj_substance.se <- 64.64795



# DENOMINATORS

# ED pre-admission visits NOT INJURY OR SUBSTANCE
# (svytotal(~count, subset(monInj, inj==0 &
# drug_or_alcohol==0 & (agecat==2 | agecat==3)), na.rm=T,
# se=TRUE, multicore=T))
count_ed <- 351509450
count_ed.se <- 32525.16

# all injury pre-admission visits NOT substance
# (svytotal(~count, subset(monInj, inj==1 &
# drug_or_alcohol==0 & (agecat==2 | agecat==3)), na.rm=T,
# se=TRUE, multicore=T))
count_inj <- 92283087
count_inj.se <- 20265.55

# any drug-etoh visits pre-admission visits NOT INJURY
# (svytotal(~count, subset(monInj, drug_or_alcohol==1 &
# inj==0 & (agecat==2 | agecat==3)), na.rm=T, se=TRUE,
# multicore=T))
count_subst <- 23009978
count_subst.se <- 10509.19

# any substance injury visits
# (yrCountDRUGinj<-svytotal(~drug_or_alcohol, subset(monInj,
# inj==1 & (agecat==2 | agecat==3)), na.rm=T, se=TRUE,
# multicore=T))
count_inj_substance <- 2728750
count_inj_substance.se <- 3714.772



# isks per 100,000 population

died_inj/count_inj * 1e+05  # Risk_{injury} 46.75981 per 100,000

died_ed/count_ed * 1e+05  # Risk_unknown 82.77849 # still a pretty high number, but maybe makes more se

died_subst/count_subst * 1e+05  # Risk_substance  54.13734

died_inj_substance/count_inj_substance * 1e+05  # Risk_{injury AND substance} # 25.71713

# recalculate additive interaction using population-based
```

```
# rates:

# right side of equation (Risk_injury - Risk_unknown) +
# (Risk_substance - R_unknown)

(46.75981 - 82.77849) + (54.13734 - 82.77849)  # -64.65983

# left side of equation (Risk_{injury AND substance} -
# Risk_unknown)

25.71713 - 82.77849  # -57.06136

# -57.06136 > -64.65983
```

4 Injury Severity

Look at the association of severity with mortality for AOD vs non-AOD

```
inj <- as.data.frame(select(NEDStab, died_ed, severe, drug_or_alcohol))

Severetab <- table(inj$severe, inj$died_ed, inj$drug_or_alcohol)

notAOD <- Severetab[, , 1]
notAOD
# died in ED 0 1 severe 0 38148114 6423 1 711818 8998

AOD <- Severetab[, , 2]

AOD
# died in ED 0 1 severe 0 651404 80 1 99904 127


library(epitools)

epitab((round(notAOD[2:1, 2:1])))


# 1 p0 0 p1 oddsratio lower upper p.value 1 8998 0.58349
# 711818 0.01831753 1.00000 NA NA NA 0 6423 0.41651 38148114
# 0.98168247 75.07791 72.70608 77.52712 0


epitab((round(AOD[2:1, 2:1])))

# 1 p0 0 p1 oddsratio lower upper p.value 1 127 0.6135266
```

```
# 99904 0.1329734 1.00000 NA NA NA 0 80 0.3864734 651404
# 0.8670266 10.35098 7.824353 13.69349 3.629988e-58
```

5 File Creation

Identify AOD diagnoses in the NEDS file.[2]

```
neds <- dbConnect(MonetDBLite(), "~/NEDSMonet")
dbListTables(neds)
dbListFields(neds, "neds_06_12")


# I. ETOH Variable

# count up all ETOH codes 4,563,654 entries
dbGetQuery(neds, [2644 chars quoted with '"'])

# create ETOH variable

dbGetQuery(neds, "alter table neds_06_12 add alcohol int default 0;")
dbSendQuery(neds, [2642 chars quoted with '"'])

dbGetQuery(neds, "select sum(count) from neds_06_12 where alcohol=1;")  # 4,563,654


# II. Opioid Variable count 761333
dbGetQuery(neds, [1204 chars quoted with '"'])

# create
dbGetQuery(neds, "alter table neds_06_12 add opioid int default 0;")
dbSendQuery(neds, [1201 chars quoted with '"'])

dbGetQuery(neds, "select sum(count) from neds_06_12 where opioid=1;")  # 761333



# III. Sedatives count 155882
dbGetQuery(neds, [1129 chars quoted with '"'])

# create
dbGetQuery(neds, "alter table neds_06_12 add sedative int default 0;")
dbSendQuery(neds, [1128 chars quoted with '"'])

dbGetQuery(neds, "select sum(count) from neds_06_12 where sedative=1;")  # 155882
```

[2]See full NEDS Notes for creating the original file.

```
# IV. Cocaine count 818316
dbGetQuery(neds, [1129 chars quoted with '"'])

# create
dbGetQuery(neds, "alter table neds_06_12 add cocaine int default 0;")
dbSendQuery(neds, [1127 chars quoted with '"'])

dbGetQuery(neds, "select sum(count) from neds_06_12 where cocaine=1;")  # 818316


# V. Cannabis count 856370
dbGetQuery(neds, [1129 chars quoted with '"'])

# create
dbGetQuery(neds, "alter table neds_06_12 add cannabis int default 0;")
dbSendQuery(neds, [1128 chars quoted with '"'])

dbGetQuery(neds, "select sum(count) from neds_06_12 where cannabis=1;")  # 856370




# VI. amphetamine count 209352
dbGetQuery(neds, [1129 chars quoted with '"'])

# create
dbGetQuery(neds, "alter table neds_06_12 add amphetamine int default 0;")
dbSendQuery(neds, [1131 chars quoted with '"'])

dbGetQuery(neds, "select sum(count) from neds_06_12 where amphetamine=1;")  # 209352


# VII. hallucinogen

# count 9418
dbGetQuery(neds, [1144 chars quoted with '"'])

# create
dbGetQuery(neds, "alter table neds_06_12 add hallucinogen int default 0;")
dbSendQuery(neds, [1147 chars quoted with '"'])

dbGetQuery(neds, "select sum(count) from neds_06_12 where hallucinogen=1;")  #  9418
```

```
# VIII combination drugs count 121353
dbGetQuery(neds, [1129 chars quoted with '"'])

# create
dbGetQuery(neds, "alter table neds_06_12 add drugcombo int default 0;")
dbSendQuery(neds, [1129 chars quoted with '"'])

dbGetQuery(neds, "select sum(count) from neds_06_12 where drugcombo=1;")  # 121353




# IX. antidepressant

# count 6658
dbGetQuery(neds, "select sum(count) from neds_06_12 where
dx1 in  (3058, 30580, 30581, 30582)  OR
dx2 in  (3058, 30580, 30581, 30582)  OR
dx3 in  (3058, 30580, 30581, 30582)  OR
dx4 in  (3058, 30580, 30581, 30582)  OR
dx5 in  (3058, 30580, 30581, 30582)  OR
dx6 in  (3058, 30580, 30581, 30582)  OR
dx7 in  (3058, 30580, 30581, 30582)  OR
dx8 in  (3058, 30580, 30581, 30582)  OR
dx9 in  (3058, 30580, 30581, 30582)  OR
dx10 in (3058, 30580, 30581, 30582)  OR
dx11 in (3058, 30580, 30581, 30582)  OR
dx12 in (3058, 30580, 30581, 30582)  OR
dx13 in (3058, 30580, 30581, 30582)  OR
dx14 in (3058, 30580, 30581, 30582)  OR
dx15 in (3058, 30580, 30581, 30582)
;")

# create
dbGetQuery(neds, "alter table neds_06_12 add antidepressant int default 0;")
dbSendQuery(neds, "update neds_06_12 set antidepressant=1 where
dx1 in  (3058, 30580, 30581, 30582)  OR
dx2 in  (3058, 30580, 30581, 30582)  OR
dx3 in  (3058, 30580, 30581, 30582)  OR
dx4 in  (3058, 30580, 30581, 30582)  OR
dx5 in  (3058, 30580, 30581, 30582)  OR
dx6 in  (3058, 30580, 30581, 30582)  OR
dx7 in  (3058, 30580, 30581, 30582)  OR
dx8 in  (3058, 30580, 30581, 30582)  OR
dx9 in  (3058, 30580, 30581, 30582)  OR
```

```
dx10 in (3058, 30580, 30581, 30582)  OR
dx11 in (3058, 30580, 30581, 30582)  OR
dx12 in (3058, 30580, 30581, 30582)  OR
dx13 in (3058, 30580, 30581, 30582)  OR
dx14 in (3058, 30580, 30581, 30582)  OR
dx15 in (3058, 30580, 30581, 30582)
;")

dbGetQuery(neds, "select sum(count) from neds_06_12 where antidepressant=1;")  # 6658


# X. Other Unspecified Drug count 1006487
dbGetQuery(neds, [1534 chars quoted with '"'])

# create
dbGetQuery(neds, "alter table neds_06_12 add otherdrug int default 0;")
dbSendQuery(neds, [1534 chars quoted with '"'])

dbGetQuery(neds, "select sum(count) from neds_06_12 where otherdrug=1;")  # 1006487


# XI. Drug-related mental disorder

# count 548566
dbGetQuery(neds, [1684 chars quoted with '"'])

# create
dbGetQuery(neds, "alter table neds_06_12 add mentaldrug int default 0;")
dbSendQuery(neds, [1685 chars quoted with '"'])

dbGetQuery(neds, "select sum(count) from neds_06_12 where mentaldrug=1;")  # 548566



# XII. Any Drug count 3,561,258
dbGetQuery(neds, "select sum(count) from neds_06_12 where
opioid = 1           OR
sedative = 1         OR
cocaine = 1          OR
cannabis = 1         OR
amphetamine = 1      OR
hallucinogen = 1     OR
drugcombo = 1        OR
antidepressant = 1   OR
otherdrug = 1        OR
mentaldrug = 1;")
```

```
# create
dbGetQuery(neds, "alter table neds_06_12 add anydrug int default 0;")
dbSendQuery(neds, "update neds_06_12 set anydrug=1 where
opioid = 1           OR
sedative = 1         OR
cocaine = 1          OR
cannabis = 1         OR
amphetamine = 1      OR
hallucinogen = 1     OR
drugcombo = 1        OR
antidepressant = 1   OR
otherdrug = 1        OR
mentaldrug = 1;")

dbGetQuery(neds, "select sum(count) from neds_06_12 where anydrug=1;")  # 3561258


# XII. Drug or Alcohol count 7,372,821
dbGetQuery(neds, "select sum(count) from neds_06_12 where
alcohol = 1 OR
anydrug = 1;")

# create
dbGetQuery(neds, "alter table neds_06_12 add drug_or_alcohol int default 0;")
dbSendQuery(neds, "update neds_06_12 set drug_or_alcohol=1 where
alcohol = 1 OR
anydrug = 1;")

dbGetQuery(neds, "select sum(count) from neds_06_12 where drug_or_alcohol=1;")  # 7372821
```

6 ICD9 Codes

6.1 Full Set of Codes

NB: Removed any codes that referred to "in remission".

- 304 Series - Drug Dependence
-
  - 3040 - Opioid type dependence
  - 30400 - Opioid type dependence, unspecified
  - 30401 - Opioid type dependence, continuous
  - 30402 - Opioid type dependence, episodic
  - 3041 - Sedative, hypnotic or anxiolytic dependence

- 30410 - Sedative, hypnotic or anxiolytic dependence, unspecified
- 30411 - Sedative, hypnotic or anxiolytic dependence, continuous
- 30412 - Sedative, hypnotic or anxiolytic dependence, episodic
- 3042 - Cocaine dependence
- 30420 - Cocaine dependence, unspecified
- 30421 - Cocaine dependence, continuous
- 30422 - Cocaine dependence, episodic
- 3043 - Cannabis dependence
- 30430 - Cannabis dependence, unspecified
- 30431 - Cannabis dependence, continuous
- 30432 - Cannabis dependence, episodic
- 3044 - Amphetamine and other psychostimulant dependence
- 30440 - Amphetamine and other psychostimulant dependence, unspecified
- 30441 - Amphetamine and other psychostimulant dependence, continuous
- 30442 - Amphetamine and other psychostimulant dependence, episodic
- 3045 - Hallucinogen dependence
- 30450 - Hallucinogen dependence, unspecified
- 30451 - Hallucinogen dependence, continuous
- 30452 - Hallucinogen dependence, episodic
- 3046 - Other specified drug dependence
- 30460 - Other specified drug dependence, unspecified
- 30461 - Other specified drug dependence, continuous
- 30462 - Other specified drug dependence, episodic
- 3047 - Combinations of opioid type drug with any other drug dependence
- 30470 - Combinations of opioid type drug with any other drug dependence, unspecified
- 30471 - Combinations of opioid type drug with any other drug dependence, continuous
- 30472 - Combinations of opioid type drug with any other drug dependence, episodic
- 3048 - Combinations of drug dependence excluding opioid type drug

  - 30480 - Combinations of drug dependence excluding opioid type drug, unspecified
  - 30481 - Combinations of drug dependence excluding opioid type drug, continuous
  - 30482 - Combinations of drug dependence excluding opioid type drug, episodic
  - 3049 - Unspecified drug dependence
  - 30490 - Unspecified drug dependence, unspecified
  - 30491 - Unspecified drug dependence, continuous
  - 30492 - Unspecified drug dependence, episodic
  -

- 305 Series - Nondependent abuse of drugs
-
  - 305 - Nondependent abuse of drugs
  - 3050 - Nondependent alcohol abuse
  - 30500 - Alcohol abuse, unspecified
  - 30501 - Alcohol abuse, continuous
  - 30502 - Alcohol abuse, episodic
  - 3051 - Tobacco use disorder
  - 3052 - Nondependent cannabis abuse
  - 30520 - Cannabis abuse, unspecified
  - 30521 - Cannabis abuse, continuous
  - 30522 - Cannabis abuse, episodic
  - 3053 - Nondependent hallucinogen abuse
  - 30530 - Hallucinogen abuse, unspecified
  - 30531 - Hallucinogen abuse, continuous
  - 30532 - Hallucinogen abuse, episodic
  - 3054 - Nondependent sedative, hypnotic or anxiolytic abuse
  - 30540 - Sedative, hypnotic or anxiolytic abuse, unspecified
  - 30541 - Sedative, hypnotic or anxiolytic abuse, continuous
  - 30542 - Sedative, hypnotic or anxiolytic abuse, episodic
  - 3055 - Nondependent opioid abuse
  - 30550 - Opioid abuse, unspecified
  - 30551 - Opioid abuse, continuous

  - 30552 - Opioid abuse, episodic
  - 3056 - Nondependent cocaine abuse
  - 30560 - Cocaine abuse, unspecified
  - 30561 - Cocaine abuse, continuous
  - 30562 - Cocaine abuse, episodic
  - 3057 - Nondependent amphetamine or related acting sympathomimetic abuse
  - 30570 - Amphetamine or related acting sympathomimetic abuse, unspecified
  - 30571 - Amphetamine or related acting sympathomimetic abuse, continuous
  - 30572 - Amphetamine or related acting sympathomimetic abuse, episodic
  - 3058 - Nondependent antidepressant type abuse
  - 30580 - Antidepressant type abuse, unspecified
  - 30581 - Antidepressant type abuse, continuous
  - 30582 - Antidepressant type abuse, episodic
  - 3059 - Nondependent other mixed or unspecified drug abuse
  - 30590 - Other, mixed, or unspecified drug abuse, unspecified
  - 30591 - Other, mixed, or unspecified drug abuse, continuous
  - 30592 - Other, mixed, or unspecified drug abuse, episodic
  -

- 303 Series - Alcohol Alcohol dependence syndrome
-
  - 303 - Alcohol dependence syndrome
  - 3030 - Acute alcoholic intoxication
  - 30300 - Acute alcoholic intoxication in alcoholism, unspecified
  - 30301 - Acute alcoholic intoxication in alcoholism, continuous
  - 30302 - Acute alcoholic intoxication in alcoholism, episodic
  - 3039 - Other and unspecified alcohol dependence
  - 30390 - Other and unspecified alcohol dependence, unspecified
  - 30391 - Other and unspecified alcohol dependence, continuous
  - 30392 - Other and unspecified alcohol dependence, episodic
  -

- 291 Series - Alcohol-induced mental disorders

- – 291 - Alcohol-induced mental disorders
  - – 2910 - Alcohol withdrawal delirium
  - – 2911 - Alcohol-induced persisting amnestic disorder
  - – 2912 - Alcohol-induced persisting dementia
  - – 2913 - Alcohol-induced psychotic disorder with hallucinations
  - – 2914 - Idiosyncratic alcohol intoxication
  - – 2915 - Alcohol-induced psychotic disorder with delusions
  - – 2918 - Other specified alcohol-induced mental disorders
  - – 29181 - Alcohol withdrawal
  - – 29182 - Alcohol induced sleep disorders
  - – 29189 - Other alcohol-induced mental disorders
  - – 2919 - Unspecified alcohol-induced mental disorders
  - –
- 292 Series - Drug-induced mental disorders
- – 292 - Drug-induced mental disorders
  - – 2920 - Drug withdrawal convert 2920 to ICD-10-CM
  - – 2921 - Drug-induced psychotic disorders
  - – 29211 - Drug-induced psychotic disorder with delusions
  - – 29212 - Drug-induced psychotic disorder with hallucinations
  - – 2922 - Pathological drug intoxication
  - – 2928 - Other specified drug-induced mental disorders
  - – 29281 - Drug-induced delirium
  - – 29282 - Drug-induced persisting dementia
  - – 29283 - Drug-induced persisting amnestic disorder
  - – 29284 - Drug-induced mood disorder
  - – 29285 - Drug induced sleep disorders
  - – 29289 - Other specified drug-induced mental disorders
  - – 2929 - Unspecified drug-induced mental disorder
  - –

6.2 Codes Categorized and Grouped

- Alcohol - 3050, 30500, 30501, 30502, 3030, 30300, 30301, 30302, 3039, 30390, 30391, 30392, 291, 2910, 2911, 2912, 2913, 2914, 2915, 2918, 29181, 29182, 29189, 2919
- Opioid - 304, 3040, 30400, 30401, 30402, 3055, 30550, 30551, 30552
- Sedative / Hypnotic - 3041, 30410, 30411, 30412, 3054, 30540, 30541, 30542
- Cocaine - 3042, 30420, 30421, 30422, 3056, 30560, 30561, 30562
- Cannabis - 3043, 30430, 30431, 30432, 3052, 30520, 30521, 30522
- Amphetamine / Stimulant -3044, 30440, 30441, 30442, 3057, 30570, 30571, 30572
- Hallucinogen - 3045, 30450, 30451, 30452, 3053, 30530, 30531, 30532
- Drug Combination - 3047, 30470, 30471, 30472, 3048, 30480, 30481, 30482
- Antidepressant - 3058, 30580, 30581, 30582
- Other Unspecified Drug - 3049, 30490, 30491, 30492, 3059, 30590, 30591, 30592, 3046, 30460, 30461, 30462
- Drug-Related Mental Disorder - 292, 2920, 2921, 29211, 29212, 2922, 2928, 29281, 29282, 29283, 29284, 29285, 29289, 2929