

HospitalMonopoly

```
library(ggplot2)
library(tidyverse)
```

```
library(reshape2)
```

```
inpatient = read.csv("VTINP16_upd.TXT")
RR_map = read.csv('RR_mapping.csv')
hsa_map = read.csv('hsa_mapping.csv')
mdc_map = read.csv('MDC_mapping.csv')
```

```
# preprocessing
inpatient_RR = merge(inpatient, RR_map[c('hnum2', 'RR')])
inpatient_RR = merge(inpatient_RR, hsa_map[c('HSA.Health.Service.Area', 'RR.Collapsed.Referral.Region')], by.x = 'hsa', by.y = 'HSA.Health.Service.Area')
names(inpatient_RR)[names(inpatient_RR)=='RR'] = 'RR_destination'
names(inpatient_RR)[names(inpatient_RR)=='RR.Collapsed.Referral.Region'] = 'RR_origin'

inpatient_RR = inpatient_RR %>% filter(RR_origin %in% paste('RR', 1:5, sep = ''))
```

```

odmatrix_drg_count = function(inpatient_RR, drg, pay_type = NA) {
  if(is.na(pay_type)) {
    inpatient = inpatient_RR %>% filter(DRG == drg)
  } else if(pay_type %in% c('g', 'c')) {
    if(pay_type == 'g') inpatient = inpatient_RR %>% filter(DRG == drg) %>% filter(PPAY == 1)
    if(pay_type == 'c') inpatient = inpatient_RR %>% filter(DRG == drg) %>% filter(PPAY == 6 | PPAY == 7)
  } else {
    stop('Invalid pay_type.')
  }

  if(dim(inpatient)[1] == 0) return(NA)

  crosstab = dcast(inpatient, RR_origin ~ RR_destination, length)
  crosstab = crosstab[!is.na(crosstab$RR_origin),]

  return(crosstab)
}

odmatrix_share = function(tab) {
  if(is.na(tab)) return(NA)

  cols = paste('RR', 1:5, sep = '')
  for (row in cols) {
    if (! (row %in% tab$RR_origin)) tab[row, ] = c(row, rep(0, 5))
  }
  for (col in cols) {
    if (! (col %in% colnames(tab))) tab[, col] = 0
    tab[, col] = as.numeric(tab[, col])
  }

  tab = tab[order(tab$RR_origin), c('RR_origin', cols)]
  tab[6, cols] = apply(tab[, cols], 2, sum)
  tab$RR_origin = c(cols, 'Total')

  rownames(tab) <- NULL

  print(cbind(tab, Total = apply(tab[, cols], 1, sum)))

  tab$RR_origin = c(cols, 'Market share %')

  denom = apply(tab[, cols], 1, sum)
  denom[denom == 0] = 1
  tab[, cols] = tab[, cols] / denom

  for (col in cols) {
    tab[, col] = sapply(tab[, col], function(x) paste(100*round(x, 4), '%', sep = ''))
  }

  print('\n')
  print(tab)
}

odmatrix = function(inpatient_RR, drg, pay_type) {
  odmatrix_share(odmatrix_drg_count(inpatient_RR, drg, pay_type))
}

HHI = function(tab) {
  if(is.na(tab)) return(NA)

  cols = intersect(paste('RR', 1:5, sep = ''), colnames(tab))
  if(length(cols) == 1) return(NA)
  mkt_share = apply(tab[, cols], 2, sum) / sum(tab[, cols])
  hhi = sum(mkt_share^2)
  return(hhi)
}

```

```

drg_map <- read.csv('DRG_mapping.csv')
drg_map$MDC_NO = sapply(drg_map$MDC_NO, function(x) {
  if(x %in% mdc_map$MDC) {
    return(mdc_map[mdc_map$MDC == x, 'MDC_CAT_NAME'])
  } else {
    return(x)
  }
})
colnames(drg_map) = c("MSDRG", "MDC", "MSDRG_DESC")
drg = inpatient_RR %>% group_by(DRG) %>% tally()
drg_map = merge(drg, drg_map, by.x = 'DRG', by.y = 'MSDRG')

```

```

drg_map$HHI_g = sapply(drg_map$DRG, function(x) HHI(odmatrix_drg_count(inpatient_RR, x, 'g'))))

```

```
drg_map$HHI_c = sapply(drg_map$DRG, function(x) HHI(odmatrix_drg_count(inpatient_RR, x, 'c')))
```

```
rownames(drg_map) <- NULL
drg_map$HHI_d = drg_map$HHI_c - drg_map$HHI_g
```

```
HHI_rank = drg_map[!is.na(drg_map$HHI_d), c('DRG', 'MDC', 'MSDRG_DESC', 'HHI_d', 'n')]
HHI_rank = HHI_rank[order(HHI_rank$HHI_d), ]
rownames(HHI_rank) = NULL
HHI_rank = HHI_rank[HHI_rank$n > 500, ]
HHI_rank = HHI_rank[HHI_rank$HHI_d > 0, ]
HHI_rank
```

```
# DRG:      470
# DRG_DESC: Major joint replacement or reattachment of lower extremity w/o MCC
# MDC:      MUSCULOSKELETAL
# PAY:      GOVERNMENT
# PATIENTS: 2151
odmatrix(inpatient_RR, 470, 'g')
```

```
##   RR_origin RR1 RR2 RR3 RR4 RR5 Total
## 1      RR1 352  61   0   0  20   433
## 2      RR2  11 155   4  17   4   191
## 3      RR3   5  8  91   0   0   104
## 4      RR4   4   5   2 102  42   155
## 5      RR5  15   0   0   6 281   302
## 6      Total 387 229  97 125 347  1185
## [1] "\n"
##   RR_origin   RR1   RR2   RR3   RR4   RR5
## 1      RR1 81.29% 14.09%   0%   0%  4.62%
## 2      RR2  5.76% 81.15%  2.09%  8.9%  2.09%
## 3      RR3  4.81%  7.69% 87.5%   0%   0%
## 4      RR4  2.58%  3.23%  1.29% 65.81% 27.1%
## 5      RR5  4.97%   0%   0%  1.99% 93.05%
## 6 Market share % 32.66% 19.32%  8.19% 10.55% 29.28%
```

```
# DRG:      189
# DRG_DESC: Pulmonary edema & respiratory failure
# MDC:      RESPIRATORY
# PAY:      GOVERNMENT
# PATIENTS: 594
odmatrix(inpatient_RR, 189, 'g')
```

```
##   RR_origin RR1 RR2 RR3 RR4 RR5 Total
## 1      RR1 165   0   0   1   2   168
## 2      RR2   9  95   1   0   0   105
## 3      RR3   0   0  25   0   0    25
## 4      RR4   1   0   0  36   0    37
## 5      RR5   2   0   0   0  62    64
## 6      Total 177  95  26  37  64   399
## [1] "\n"
##   RR_origin   RR1   RR2   RR3   RR4   RR5
## 1      RR1 98.21%   0%   0%  0.6%  1.19%
## 2      RR2  8.57% 90.48%  0.95%   0%   0%
## 3      RR3   0%   0% 100%   0%   0%
## 4      RR4  2.7%   0%   0% 97.3%   0%
## 5      RR5  3.12%   0%   0%  0% 96.88%
## 6 Market share % 44.36% 23.81%  6.52%  9.27% 16.04%
```

```
# DRG:      470
# DRG_DESC: Major joint replacement or reattachment of lower extremity w/o MCC
# MDC:      MUSCULOSKELETAL
# PAY:      COMMERCIAL
# PATIENTS: 2151
odmatrix(inpatient_RR, 470, 'c')
```

```
##   RR_origin RR1 RR2 RR3 RR4 RR5 Total
## 1         RR1 299  59   0   0  12  370
## 2         RR2  17  71   3   9   1  101
## 3         RR3   2   6  32   0   0   40
## 4         RR4   1   3   1  50  18   73
## 5         RR5   6   1   0   4 118  129
## 6         Total 325 140  36  63 149  713
## [1] "\n"
##           RR_origin      RR1      RR2      RR3      RR4      RR5
## 1           RR1 80.81% 15.95%    0%    0%  3.24%
## 2           RR2 16.83%  70.3%  2.97%  8.91%  0.99%
## 3           RR3    5%    15%   80%    0%    0%
## 4           RR4  1.37%  4.11%  1.37% 68.49% 24.66%
## 5           RR5  4.65%  0.78%    0%   3.1% 91.47%
## 6 Market share % 45.58% 19.64%  5.05%  8.84% 20.9%
```

```
# DRG:      189
# DRG_DESC: Pulmonary edema & respiratory failure
# MDC:      RESPIRATORY
# PAY:      COMMERCIAL
# PATIENTS: 594
odmatrix(inpatient_RR, 189, 'c')
```

```
##   RR_origin RR1 RR2 RR3 RR4 RR5 Total
## 1         RR1  49   0   0   0   0   49
## 2         RR2   2   7   0   0   0    9
## 3         RR3   0   0   1   0   0    1
## 4         RR4   0   0   0   3   0    3
## 5         RR5   1   0   0   0   9   10
## 6         Total  52   7   1   3   9   72
## [1] "\n"
##           RR_origin      RR1      RR2      RR3      RR4      RR5
## 1           RR1 100%    0%    0%    0%    0%
## 2           RR2 22.22% 77.78%    0%    0%    0%
## 3           RR3    0%    0% 100%    0%    0%
## 4           RR4    0%    0%    0% 100%    0%
## 5           RR5  10%    0%    0%    0%  90%
## 6 Market share % 72.22%  9.72%  1.39%  4.17% 12.5%
```