

Complications - Hospital

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Introduction

I will analyze the Complications-Hospital dataset, which is an official dataset used on the Medicare.gov Hospital Compare Website provided by the Centers for Medicare & Medicaid Services. This dataset allows you to compare the quality of care on complications at over 4,000 Medicare-certified hospitals across the country. It is from <https://data.medicare.gov/data/hospital-compare>. It was accessed on October 9, 2017 by clicking on the “Export - Download As CSV for Excel” button. I used the library dplyr in the analysis.

Data Acquisition and Selection

After downloading the csv file, I imported the dataset into R and kept only the columns needed for analysis. The file includes 81804 rows and 19 variables, which includes:

1. Provider ID
2. Hospital Name
3. Address
4. City
5. State
6. ZIP Code
7. County Name
8. Phone Number
9. Measure Name
10. Measure ID
11. Compared to National
12. Denominator
13. Score
14. Lower Estimate
15. Higher Estimate
16. Footnote
17. Measure Start Date
18. Measure End State
19. Location

```
library(readr)
Complications_and_Deaths_Hospital <- read_csv("C:/Users/linds/OneDrive/Fall 2017/Fall 2017/STAT-612 R/HW

## Parsed with column specification:
## cols(
##   `Provider ID` = col_character(),
##   `Hospital Name` = col_character(),
##   Address = col_character(),
##   City = col_character(),
##   State = col_character(),
##   `ZIP Code` = col_character(),
##   `County Name` = col_character(),
##   `Phone Number` = col_double(),
##   `Measure Name` = col_character(),
```

```
## `Measure ID` = col_character(),
## `Compared to National` = col_character(),
## Denominator = col_integer(),
## Score = col_double(),
## `Lower Estimate` = col_double(),
## `Higher Estimate` = col_double(),
## Footnote = col_character(),
## `Measure Start Date` = col_character(),
## `Measure End Date` = col_character(),
## Location = col_character()
## )

#calculate the size of the dataset
nrow(Complications_and_Deaths_Hospital)

## [1] 81804

ncol(Complications_and_Deaths_Hospital)

## [1] 19

#Create a new dataset, rename the variables and keep the variables needed for analysis
comps <- Complications_and_Deaths_Hospital %>%
  rename(hospital = 'Hospital Name',
         compare = 'Compared to National',
         lower = 'Lower Estimate',
         higher = 'Higher Estimate',
         measure_id = 'Measure ID',
         state = State,
         score = Score,
         city = City,
         measure_name = 'Measure Name') %>%
  filter(!is.na(score)) %>% #choose those that don't have na
  select(hospital, compare, lower, higher, measure_id, state, city, score, measure_name)
```

After filtering the records with no score and selecting the variables needed for analysis, there are 48281 records and 9 variables left in the new dataset “comp”.

For the complication “Broken hip from a fall after surgery”, I selected the data and write out a csv file, which includes hospital name, city, state, compared to national, score, lower estimate, and higher estimate.

After filtering the dataset with the measure ID of “Broken hip from a fall after surgery”, the resulting file has 2850 records for each of the 7 variables that I chose.

```
comps_hip <- comps %>%
  filter(measure_id == "PSI_8_POST_HIP") %>%
  select(hospital, city, state, compare, score, lower, higher)

write.csv(comps_hip, file = "comps_hip.csv", row.names = FALSE, na="")
```

Data Analysis

Find the best hospital in state for a specific complication

To figure out if a high score or low score is better, I first found the national rate for the complication we selected, looked at the hospitals with rates below the national average, and arranged it by score or higher estimate.

```
comps_hip %>%
  select(score,compare,lower,higher) %>%
  arrange(score)
```

```
## # A tibble: 2,850 x 4
##   score                                compare lower higher
##   <dbl>                                <chr> <dbl> <dbl>
## 1  0.06 No Different than the National Rate  0.06  0.06
## 2  0.06 No Different than the National Rate  0.06  0.06
## 3  0.06 No Different than the National Rate  0.06  0.06
## 4  0.06 No Different than the National Rate  0.06  0.06
## 5  0.06 No Different than the National Rate  0.06  0.06
## 6  0.06 No Different than the National Rate  0.06  0.06
## 7  0.06 No Different than the National Rate  0.06  0.06
## 8  0.06 No Different than the National Rate  0.06  0.06
## 9  0.06 No Different than the National Rate  0.06  0.06
## 10 0.06 No Different than the National Rate  0.06  0.06
## # ... with 2,840 more rows
```

```
comps_hip %>%
  select(score,compare,lower,higher) %>%
  arrange(higher)
```

```
## # A tibble: 2,850 x 4
##   score                                compare lower higher
##   <dbl>                                <chr> <dbl> <dbl>
## 1  0.06 No Different than the National Rate  0.06  0.06
## 2  0.06 No Different than the National Rate  0.06  0.06
## 3  0.06 No Different than the National Rate  0.06  0.06
## 4  0.06 No Different than the National Rate  0.06  0.06
## 5  0.06 No Different than the National Rate  0.06  0.06
## 6  0.06 No Different than the National Rate  0.06  0.06
## 7  0.06 No Different than the National Rate  0.06  0.06
## 8  0.06 No Different than the National Rate  0.06  0.06
## 9  0.06 No Different than the National Rate  0.06  0.06
## 10 0.06 No Different than the National Rate  0.06  0.06
## # ... with 2,840 more rows
```

According to the results above, the best hospitals should be judged as those with the lowest high estimate score.

Based on the results above, I wrote a best function that will take the id of a complication and a state as inputs, and return the hospital in the specified state with the lowest high estimate score for the complication.

```
best <- function(ST, Complication) {

  FindST <- comps$state == ST
  if (sum(FindST)==0) stop ("invalid state entered")

  FindComplication <- comps$measure_id == Complication
  if (sum(FindComplication)==0) stop ("invalid complication entered")

  FindBoth <- FindComplication & FindST
  if (sum(FindBoth)==0) stop ("No entries found for the requested complication/state combination")

  BestDataOut <- comps %>%
```

```

  filter(state == ST, measure_id == Complication) %>%
  select(hospital, state, higher, score, measure_id) %>%
  arrange(higher, score)

BestDataOut <- BestDataOut[1,]
}

```

To test the best function for both valid and invalid inputs, I inserted a few inputs into the function.

```

(bestdata1 <- best("DC" , "PSI_4_SURG_COMP"))

## # A tibble: 1 x 5
##           hospital state higher  score  measure_id
##           <chr> <chr>  <dbl> <dbl>      <chr>
## 1 MEDSTAR WASHINGTON HOSPITAL CENTER    DC 175.06 151.52 PSI_4_SURG_COMP
(bestdata2 <- best("AP" , "PSI_4_SURG_COMP"))

## Error in best("AP", "PSI_4_SURG_COMP"): invalid state entered
(bestdata3 <- best("DC", "pneumonia"))

## Error in best("DC", "pneumonia"): invalid complication entered

```

Find the best hospitals in state for a specific complication

I then ranked the top n hospitals in a state with a given complication, if the number n is not inserted in the function or if n is larger than the number of hospitals in the state, the function will rank all the hospitals in the state.

```

rankhospitalsinstate <- function(ST, Complication, n) {

  FindST <- comps$state == ST
  if (sum(FindST) == 0) stop ("invalid state entered")

  FindComplication <- comps$measure_id == Complication
  if (sum(FindComplication) == 0) stop ("invalid complication entered")

  FindBoth <- FindComplication & FindST
  if (sum(FindBoth) == 0) stop ("No entries found for the requested state and complication combination")
  StateData <- comps %>%
    filter(state == ST, measure_id == Complication) %>%
    select(hospital, state, higher, score)

  if (missing(n)) {
    n <- length(StateData$state)
  }

  if (n > length(StateData$state)) {
    n <- length(StateData$state)
  }

  StateData <- arrange(StateData, higher, score)
  knitr::kable(StateData[1:n,]) #:: <- specify which package you want to use with the function
                                #kable - create a table

```

```
}
```

To test the function, I inserted “VA”, “PSI_15_ACC_LAC”,10 to check for the top 10 hospitals in Virginia with the complication “Accidental cuts and tears from medical treatment”. In addition to top 10 hospitals, I also tried inserting 500 hospitals and omitting the number of hospitals in the function.

```
rankhospitalsinstate("VA","PSI_15_ACC_LAC",10)
```

hospital	state	higher	score
UNIVERSITY OF VIRGINIA MEDICAL CENTER	VA	1.18	0.79
MEDICAL COLLEGE OF VIRGINIA HOSPITALS	VA	1.34	0.82
SENTARA VIRGINIA BEACH GENERAL HOSPITAL	VA	1.37	0.70
INOVA ALEXANDRIA HOSPITAL	VA	1.49	0.74
HENRICO DOCTORS' HOSPITAL	VA	1.49	0.97
SENTARA OBICI HOSPITAL	VA	1.51	0.63
SENTARA WILLIAMSBURG REGIONAL MEDICAL CENTER	VA	1.52	0.63
SENTARA LEIGH HOSPITAL	VA	1.55	0.85
INOVA FAIRFAX HOSPITAL	VA	1.55	1.14
SENTARA CAREPLEX HOSPITAL	VA	1.62	0.85

```
rankhospitalsinstate("VA","PSI_15_ACC_LAC",500)
```

hospital	state	higher	score
UNIVERSITY OF VIRGINIA MEDICAL CENTER	VA	1.18	0.79
MEDICAL COLLEGE OF VIRGINIA HOSPITALS	VA	1.34	0.82
SENTARA VIRGINIA BEACH GENERAL HOSPITAL	VA	1.37	0.70
INOVA ALEXANDRIA HOSPITAL	VA	1.49	0.74
HENRICO DOCTORS' HOSPITAL	VA	1.49	0.97
SENTARA OBICI HOSPITAL	VA	1.51	0.63
SENTARA WILLIAMSBURG REGIONAL MEDICAL CENTER	VA	1.52	0.63
SENTARA LEIGH HOSPITAL	VA	1.55	0.85
INOVA FAIRFAX HOSPITAL	VA	1.55	1.14
SENTARA CAREPLEX HOSPITAL	VA	1.62	0.85
VIRGINIA HOSPITAL CENTER	VA	1.63	0.99
JOHNSTON MEMORIAL HOSPITAL	VA	1.65	0.64
INOVA FAIR OAKS HOSPITAL	VA	1.65	0.80
CENTRA HEALTH, INC	VA	1.66	1.13
SENTARA NORFOLK GENERAL HOSPITAL	VA	1.66	1.19
INOVA LOUDOUN HOSPITAL	VA	1.71	0.80
CJW MEDICAL CENTER	VA	1.73	1.21
LEWISGALE MEDICAL CENTER	VA	1.75	1.10
MEMORIAL HOSPITAL OF MARTINSVILLE & HENRY COUNTY	VA	1.78	0.79
RESTON HOSPITAL CENTER	VA	1.81	0.95
CHESAPEAKE GENERAL HOSPITAL	VA	1.82	1.11
NOVANT HEALTH UVA PRINCE WILLIAM MEDICAL CENTER	VA	1.86	0.90
AUGUSTA HEALTH	VA	1.86	1.10
WINCHESTER MEDICAL CENTER	VA	1.88	1.35
RIVERSIDE REGIONAL MEDICAL CENTER	VA	1.90	1.32
BON SECOURS MARYVIEW MEDICAL CENTER	VA	1.91	1.12
INOVA MOUNT VERNON HOSPITAL	VA	2.00	0.92
CARILION ROANOKE MEMORIAL HOSPITAL	VA	2.02	1.59
SENTARA PRINCESS ANNE HOSPITAL	VA	2.05	1.22

hospital	state	higher	score
SPOTSYLVANIA REGIONAL MEDICAL CENTER	VA	2.09	0.99
COMMUNITY MEMORIAL HEALTHCENTER, INC	VA	2.13	0.93
RIVERSIDE WALTER REED HOSPITAL	VA	2.13	1.01
RIVERSIDE DOCTORS' HOSPITAL OF WILLIAMSBURG	VA	2.26	1.00
BON SECOURS MEMORIAL REGIONAL MEDICAL CENTER	VA	2.26	1.63
WYTHE COUNTY COMMUNITY HOSPITAL	VA	2.31	1.04
SENTARA RMH MEDICAL CENTER	VA	2.31	1.57
CARILION NEW RIVER VALLEY MEDICAL CENTER	VA	2.32	1.39
MARY WASHINGTON HOSPITAL, INC	VA	2.32	1.74
JOHN RANDOLPH MEDICAL CENTER	VA	2.35	1.15
SOUTHSIDE COMMUNITY HOSPITAL, INC	VA	2.36	1.16
LEWISGALE HOSPITAL PULASKI	VA	2.41	1.10
MARTHA JEFFERSON HOSPITAL	VA	2.42	1.66
SOUTHAMPTON MEMORIAL HOSPITAL	VA	2.44	1.12
NOVANT HEALTH UVA HEALTH HAYMARKET MEDICAL CENTER	VA	2.50	1.16
RIVERSIDE SHORE MEMORIAL HOSPITAL	VA	2.53	1.27
DANVILLE REGIONAL MEDICAL CENTER	VA	2.53	1.64
SENTARA HALIFAX REGIONAL HOSPITAL	VA	2.55	1.56
CLINCH VALLEY MEDICAL CENTER	VA	2.60	1.46
FAUQUIER HOSPITAL	VA	2.62	1.52
LONESOME PINE HOSPITAL	VA	2.63	1.34
TWIN COUNTY REGIONAL HOSPITAL	VA	2.63	1.48
SOUTHERN VIRGINIA REGIONAL MEDICAL CENTER	VA	2.64	1.25
BON SECOURS RICHMOND COMMUNITY HOSPITAL	VA	2.65	1.25
WARREN MEMORIAL HOSPITAL	VA	2.65	1.26
LEWISGALE HOSPITAL ALLEGHANY	VA	2.65	1.35
BON SECOURS ST MARYS HOSPITAL	VA	2.72	2.16
BON SECOURS DEPAUL MEDICAL CENTER	VA	2.75	1.82
SMYTH COUNTY COMMUNITY HOSPITAL	VA	2.81	1.46
SENTARA NORTHERN VIRGINIA MEDICAL CENTER	VA	2.81	1.94
LEWISGALE HOSPITAL MONTGOMERY	VA	2.82	1.73
RUSSELL COUNTY MEDICAL CENTER	VA	2.86	1.39
CARILION TAZEWEEL COMMUNITY HOSPITAL	VA	2.87	1.40
NOVANT HEALTH UVA HEALTH SYSTEM CULPEPER MED CENTE	VA	2.90	1.67
SOUTHSIDE REGIONAL MEDICAL CENTER	VA	2.91	2.08
BEDFORD MEMORIAL HOSPITAL	VA	2.96	1.56
BUCHANAN GENERAL HOSPITAL	VA	2.98	1.58
NORTON COMMUNITY HOSPITAL	VA	2.99	1.74
CARILION FRANKLIN MEMORIAL HOSPITAL	VA	3.07	1.72
RIVERSIDE TAPPAHANNOCK HOSPITAL	VA	3.19	1.89
STAFFORD HOSPITAL, LLC	VA	3.25	2.05
MARY IMMACULATE HOSPITAL	VA	3.54	2.61
BON SECOURS ST FRANCIS MEDICAL CENTER	VA	3.60	2.78

```
rankhospitalsinstate("VA","PSI_15_ACC_LAC")
```

hospital	state	higher	score
UNIVERSITY OF VIRGINIA MEDICAL CENTER	VA	1.18	0.79
MEDICAL COLLEGE OF VIRGINIA HOSPITALS	VA	1.34	0.82
SENTARA VIRGINIA BEACH GENERAL HOSPITAL	VA	1.37	0.70
INOVA ALEXANDRIA HOSPITAL	VA	1.49	0.74

hospital	state	higher	score
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SENTARA WILLIAMSBURG REGIONAL MEDICAL CENTER	VA	1.52	0.63
SENTARA LEIGH HOSPITAL	VA	1.55	0.85
INOVA FAIRFAX HOSPITAL	VA	1.55	1.14
SENTARA CAREPLEX HOSPITAL	VA	1.62	0.85
VIRGINIA HOSPITAL CENTER	VA	1.63	0.99
JOHNSTON MEMORIAL HOSPITAL	VA	1.65	0.64
INOVA FAIR OAKS HOSPITAL	VA	1.65	0.80
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SENTARA NORFOLK GENERAL HOSPITAL	VA	1.66	1.19
INOVA LOUDOUN HOSPITAL	VA	1.71	0.80
CJW MEDICAL CENTER	VA	1.73	1.21
LEWISGALE MEDICAL CENTER	VA	1.75	1.10
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RESTON HOSPITAL CENTER	VA	1.81	0.95
CHESAPEAKE GENERAL HOSPITAL	VA	1.82	1.11
NOVANT HEALTH UVA PRINCE WILLIAM MEDICAL CENTER	VA	1.86	0.90
AUGUSTA HEALTH	VA	1.86	1.10
WINCHESTER MEDICAL CENTER	VA	1.88	1.35
RIVERSIDE REGIONAL MEDICAL CENTER	VA	1.90	1.32
BON SECOURS MARYVIEW MEDICAL CENTER	VA	1.91	1.12
INOVA MOUNT VERNON HOSPITAL	VA	2.00	0.92
CARILION ROANOKE MEMORIAL HOSPITAL	VA	2.02	1.59
SENTARA PRINCESS ANNE HOSPITAL	VA	2.05	1.22
SPOTSYLVANIA REGIONAL MEDICAL CENTER	VA	2.09	0.99
COMMUNITY MEMORIAL HEALTHCENTER, INC	VA	2.13	0.93
RIVERSIDE WALTER REED HOSPITAL	VA	2.13	1.01
RIVERSIDE DOCTORS' HOSPITAL OF WILLIAMSBURG	VA	2.26	1.00
BON SECOURS MEMORIAL REGIONAL MEDICAL CENTER	VA	2.26	1.63
WYTHE COUNTY COMMUNITY HOSPITAL	VA	2.31	1.04
SENTARA RMH MEDICAL CENTER	VA	2.31	1.57
CARILION NEW RIVER VALLEY MEDICAL CENTER	VA	2.32	1.39
MARY WASHINGTON HOSPITAL, INC	VA	2.32	1.74
JOHN RANDOLPH MEDICAL CENTER	VA	2.35	1.15
SOUTHSIDE COMMUNITY HOSPITAL, INC	VA	2.36	1.16
LEWISGALE HOSPITAL PULASKI	VA	2.41	1.10
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SOUTHAMPTON MEMORIAL HOSPITAL	VA	2.44	1.12
NOVANT HEALTH UVA HEALTH HAYMARKET MEDICAL CENTER	VA	2.50	1.16
RIVERSIDE SHORE MEMORIAL HOSPITAL	VA	2.53	1.27
DANVILLE REGIONAL MEDICAL CENTER	VA	2.53	1.64
SENTARA HALIFAX REGIONAL HOSPITAL	VA	2.55	1.56
CLINCH VALLEY MEDICAL CENTER	VA	2.60	1.46
FAUQUIER HOSPITAL	VA	2.62	1.52
LONESOME PINE HOSPITAL	VA	2.63	1.34
TWIN COUNTY REGIONAL HOSPITAL	VA	2.63	1.48
SOUTHERN VIRGINIA REGIONAL MEDICAL CENTER	VA	2.64	1.25
BON SECOURS RICHMOND COMMUNITY HOSPITAL	VA	2.65	1.25
WARREN MEMORIAL HOSPITAL	VA	2.65	1.26
LEWISGALE HOSPITAL ALLEGHANY	VA	2.65	1.35
BON SECOURS ST MARYS HOSPITAL	VA	2.72	2.16

hospital	state	higher	score
BON SECOURS DEPAUL MEDICAL CENTER	VA	2.75	1.82
SMYTH COUNTY COMMUNITY HOSPITAL	VA	2.81	1.46
SENTARA NORTHERN VIRGINIA MEDICAL CENTER	VA	2.81	1.94
LEWISGALE HOSPITAL MONTGOMERY	VA	2.82	1.73
RUSSELL COUNTY MEDICAL CENTER	VA	2.86	1.39
CARILION TAZEWEEL COMMUNITY HOSPITAL	VA	2.87	1.40
NOVANT HEALTH UVA HEALTH SYSTEM CULPEPER MED CENTE	VA	2.90	1.67
SOUTHSIDE REGIONAL MEDICAL CENTER	VA	2.91	2.08
BEDFORD MEMORIAL HOSPITAL	VA	2.96	1.56
BUCHANAN GENERAL HOSPITAL	VA	2.98	1.58
NORTON COMMUNITY HOSPITAL	VA	2.99	1.74
CARILION FRANKLIN MEMORIAL HOSPITAL	VA	3.07	1.72
RIVERSIDE TAPPAHANNOCK HOSPITAL	VA	3.19	1.89
STAFFORD HOSPITAL, LLC	VA	3.25	2.05
MARY IMMACULATE HOSPITAL	VA	3.54	2.61
BON SECOURS ST FRANCIS MEDICAL CENTER	VA	3.60	2.78

Rank all hospitals in the country for a specific complication

Lastly, I ranked the top hospitals in the country for a complication by selecting the records for all hospitals with a specific complication.

```
rankallhospitals <- function(Complication, num=1) {
  #if don't provide the value of "num" in the function to overwrite it, 1 is the default
  RankHospital <- comps %>%
    filter(measure_id == Complication) %>%
    select(hospital, state, higher, score, measure_id) %>%
    arrange(higher,score)

  RankHospital[1:num,]
}
```

To test the function, I checked the top 10 hospitals in the country with the complication “Serious blood clots after surgery”. In addition to that, I also tested the function by omitting the number of hospitals in the function, with the complication “A wound that splits open after surgery on the abdomen or pelvis”.

```
rankallhospitals("PSI_12_POSTOP_PULMEMB_DVT",10)
```

```
## # A tibble: 10 x 5
##           hospital state higher score
##           <chr> <chr>   <dbl> <dbl>
## 1 ST DAVID'S MEDICAL CENTER TX      3.23  1.39
## 2 INDIANA UNIVERSITY HEALTH BLOOMINGTON HOSPITAL IN      3.84  1.39
## 3 MOSAIC LIFE CARE AT ST JOSEPH MO      3.91  1.82
## 4 ROPER HOSPITAL SC      4.11  2.25
## 5 PROVIDENCE SACRED HEART MEDICAL CENTER WA      4.12  2.56
## 6 LAKE HEALTH OH      4.13  1.40
## 7 EAST TEXAS MEDICAL CENTER TX      4.14  2.26
## 8 BON SECOURS MEMORIAL REGIONAL MEDICAL CENTER VA      4.17  1.81
## 9 SAINT FRANCIS MEDICAL CENTER MO      4.18  1.99
## 10 BAPTIST HEALTH MEDICAL CENTER NORTH LITTLE ROCK AR      4.20  1.72
## # ... with 1 more variables: measure_id <chr>
```



```
rankallhospitals("PSI_14_POSTOP_DEHIS")
```

```
## # A tibble: 1 x 5
##       hospital state higher score      measure_id
##       <chr> <chr>   <dbl> <dbl>         <chr>
## 1 CLEVELAND CLINIC   OH    2.67  1.18 PSI_14_POSTOP_DEHIS
```

System Information

```
sessionInfo()
```

```
## R version 3.4.1 (2017-06-30)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 16299)
##
## Matrix products: default
##
## locale:
## [1] LC_COLLATE=English_United States.1252
## [2] LC_CTYPE=English_United States.1252
## [3] LC_MONETARY=English_United States.1252
## [4] LC_NUMERIC=C
## [5] LC_TIME=English_United States.1252
##
## attached base packages:
## [1] stats      graphics  grDevices  utils      datasets  methods   base
##
## other attached packages:
## [1] bindrcpp_0.2 readr_1.1.1 dplyr_0.7.4
##
## loaded via a namespace (and not attached):
## [1] Rcpp_0.12.12    digest_0.6.12   rprojroot_1.2   assertthat_0.2.0
## [5] R6_2.2.2        backports_1.1.0 magrittr_1.5     evaluate_0.10.1
## [9] highr_0.6       rlang_0.1.2     stringi_1.1.5   rmarkdown_1.8
## [13] tools_3.4.1     stringr_1.2.0   glue_1.1.1      hms_0.3
## [17] yaml_2.1.14     compiler_3.4.1  pkgconfig_2.0.1 htmltools_0.3.6
## [21] bindr_0.1       knitr_1.17      tibble_1.3.4
```