ICU Healthcare Worker Visit Analysis

```
options(warn = -1)
suppressPackageStartupMessages(library(dplyr))
suppressPackageStartupMessages(library(ggplot2))
```

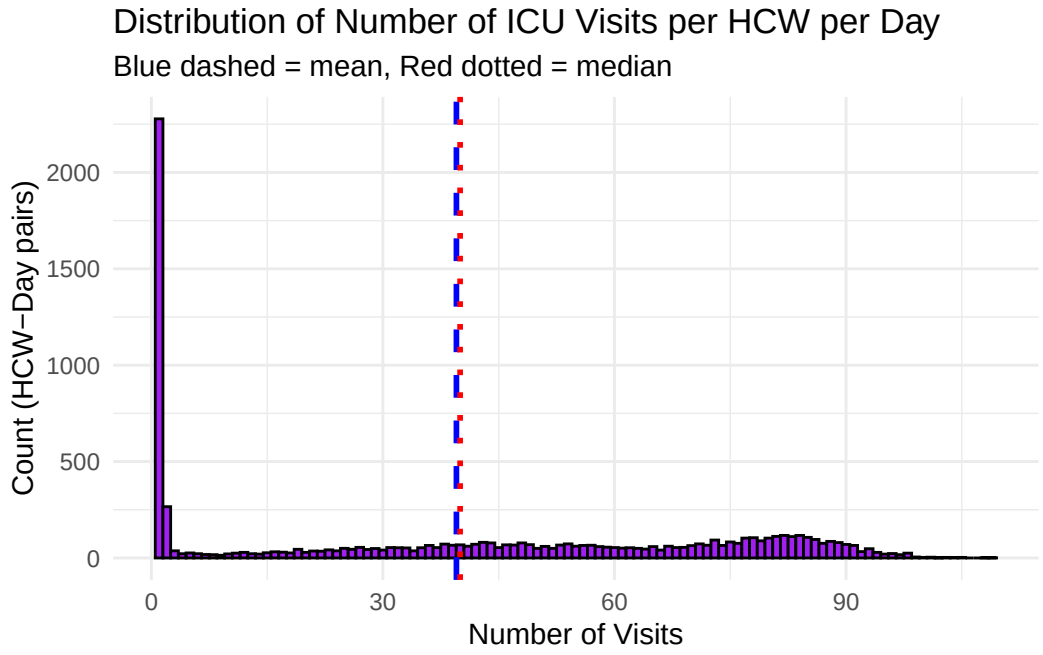
ICU Healthcare Worker Visit Analysis

This document provides analysis of the visit rates and behaviors of health care worker agents (HCWs) in the ICU. All results and visualizations related to HCW visits to ICU patients will be presented here.

```
library(dplyr)

df2 <- read.table("visit_data.txt", header = TRUE, sep = ",", stringsAsFactors = FALSE)
df2$visitDay <- floor(df2$visitTime)

# Filter for ICU visits only
df2_icu <- df2[df2$patientLocation == 'ICU', ]

# Remove first 90 visitTime values
df2_filtered <- df2_icu %>% arrange(visitTime) %>% slice(-(1:90))

# Histogram: for each hcwId, each day, distribution of number of visits
visits_per_day <- df2_filtered %>% group_by(hcwId, visitDay) %>% summarise(n_visits = n())
```

```
`summarise()` has grouped output by 'hcwId'. You can override using the
`.groups` argument.
```

```r
library(ggplot2)
ggplot(visits_per_day, aes(x = n_visits)) +
    geom_histogram(binwidth = 1, fill = "purple", color = "black") +
    geom_vline(aes(xintercept = mean(visits_per_day$n_visits)), color = "blue", linetype = "d

    geom_vline(aes(xintercept = median(visits_per_day$n_visits)), color = "red", linetype = "

    labs(title = "Distribution of Number of ICU Visits per HCW per Day",
             x = "Number of Visits",
             y = "Count (HCW-Day pairs)",
             subtitle = "Blue dashed = mean, Red dotted = median") +
    theme_minimal()
```




```r
# Text output for min, max, IQR
min_visits <- min(visits_per_day$n_visits)
max_visits <- max(visits_per_day$n_visits)
iqr_visits <- IQR(visits_per_day$n_visits)
cat("Min visits per HCW per day:", min_visits, "\n")
```

```
Min visits per HCW per day: 1
```

```r
cat("Max visits per HCW per day:", max_visits, "\n")
```

```
Max visits per HCW per day: 109
```

```r
cat("Interquartile range (IQR):", iqr_visits, "\n")
```

```
Interquartile range (IQR): 71
```

```r
nvisits <- nrow(df2_icu)

# Filter for nurse visits
df_nurse_visits <- df2_icu[df2_icu$hcwType == 'NURSE', ]
df_nurses <- distinct(df_nurse_visits, hcwType, hcwId)
nurse_count <- nrow(df_nurses)
# Filter for other HCW types
df_doctor_visits <- df2_icu[df2_icu$hcwType == 'DOCTOR', ]
df_doctors <- distinct(df_doctor_visits, hcwType, hcwId)
doctor_count <- nrow(df_doctors)
df_pt_visits     <- df2_icu[df2_icu$hcwType == 'PT', ]
df_pts <- distinct(df_pt_visits, hcwType, hcwId)
pt_count <- nrow(df_pts)

df_ot_visits     <- df2_icu[df2_icu$hcwType == 'OT', ]
df_ots <- distinct(df_ot_visits, hcwType, hcwId)
ot_count <- nrow(df_ots)

df_rt_visits     <- df2_icu[df2_icu$hcwType == 'RT', ]
df_rts <- distinct(df_rt_visits, hcwType, hcwId)
rt_count <- nrow(df_rts)
```

Total patient visits by hcw type (ICU)

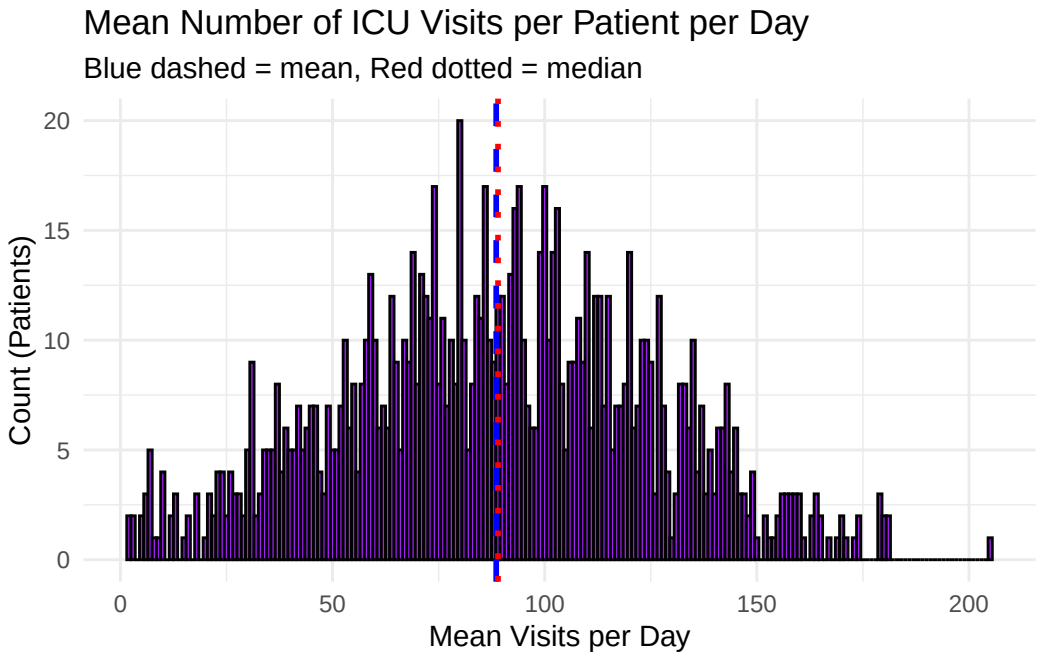
HCW Type	Total visits (365d)	mean/day
NURSE (10)	240399	65.8627397
DOCTOR (6)	70906	32.3771689
OT (12)	1277	0.2915525
PT (12)	988	0.2255708
RT (12)	598	0.1365297

Histogram: Mean Number of Visits per Patient per Day (ICU)

```
# Calculate mean number of visits per patientId per day
visits_per_patient_day <- df2_filtered %>% group_by(patientId, visitDay) %>% summarise(n_visi
```

```
`summarise()` has grouped output by 'patientId'. You can override using the
`.groups` argument.
```

```
mean_visits <- visits_per_patient_day %>% group_by(patientId) %>% summarise(mean_visits = mea
ggplot(mean_visits, aes(x = mean_visits)) +
    geom_histogram(binwidth = 1, fill = "purple", color = "black") +
    geom_vline(xintercept = mean(mean_visits$mean_visits), color = "blue", linetype = "dashed
    geom_vline(xintercept = median(mean_visits$mean_visits), color = "red", linetype = "dotte
  labs(title = "Mean Number of ICU Visits per Patient per Day",
       x = "Mean Visits per Day",
       y = "Count (Patients)",
       subtitle = "Blue dashed = mean, Red dotted = median") +
  theme_minimal()
```




```
min_mean_visits <- min(mean_visits$mean_visits)
max_mean_visits <- max(mean_visits$mean_visits)
```

```r
mean_mean_visits <- mean(mean_visits$mean_visits)
median_mean_visits <- median(mean_visits$mean_visits)
cat("Min  visits per patient per day:", min_mean_visits, "\n")
```

```
Min  visits per patient per day: 2
```

```r
cat("Max  visits per patient per day:", max_mean_visits, "\n")
```

```
Max  visits per patient per day: 205.5
```

```r
cat("Mean visits per patient per day:", mean_mean_visits, "\n")
```

```
Mean visits per patient per day: 88.57229
```

```r
cat("Median visits per patient per day:", median_mean_visits, "\n")
```

```
Median visits per patient per day: 89
```

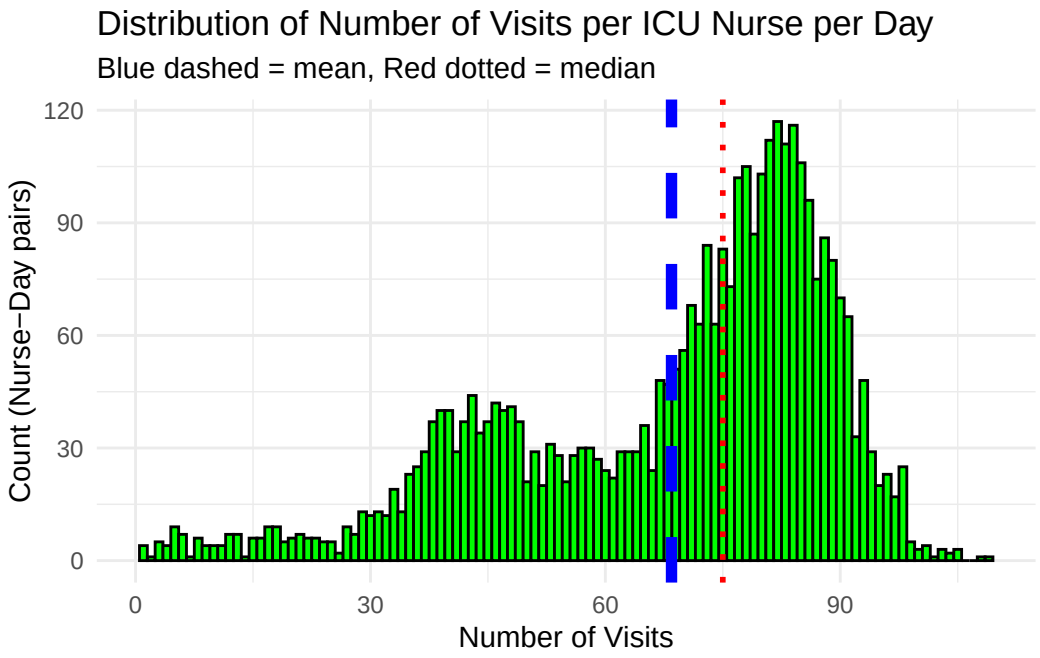
Visits per HCW per Day by Type (ICU)

Distribution of Number of Visits per Nurse per Day (ICU)

```r
visits_per_nurse_day <- df_nurse_visits %>% group_by(hcwId, visitDay) %>% summarise(n_visits
```

```
`summarise()` has grouped output by 'hcwId'. You can override using the
`.groups` argument.
```

```r
ggplot(visits_per_nurse_day, aes(x = n_visits)) +
  geom_histogram(binwidth = 1, fill = "green", color = "black") +
  geom_vline(aes(xintercept = mean(visits_per_nurse_day$n_visits)), color = "blue", linetype
  geom_vline(aes(xintercept = median(visits_per_nurse_day$n_visits)), color = "red", linetyp
  labs(title = "Distribution of Number of Visits per ICU Nurse per Day",
       x = "Number of Visits",
       y = "Count (Nurse-Day pairs)",
       subtitle = "Blue dashed = mean, Red dotted = median") +
  theme_minimal()
```




```
min_nurse_visits <- min(visits_per_nurse_day$n_visits)
max_nurse_visits <- max(visits_per_nurse_day$n_visits)
mean_nurse_visits <- mean(visits_per_nurse_day$n_visits)
median_nurse_visits <- median(visits_per_nurse_day$n_visits)
```

Min visits per ICU nurse per day: 1 **Max visits per ICU nurse per day:** 109 **Mean visits per ICU nurse per day:** 68.4507403 **Median visits per ICU nurse per day:** 75

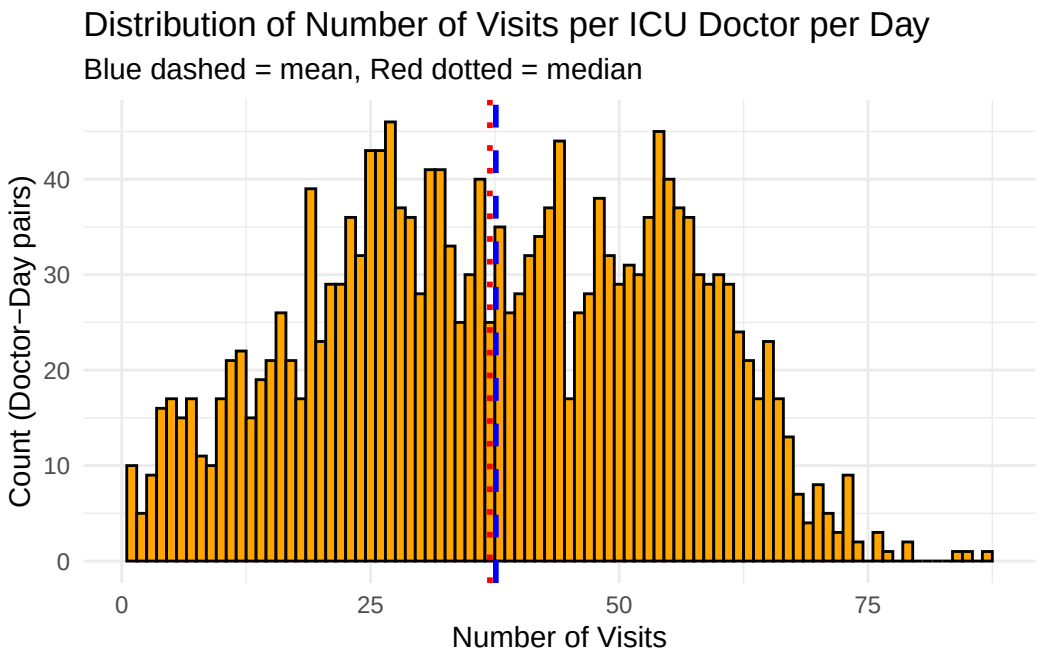
Distribution of Number of Visits per Doctor per Day (ICU)

```
visits_per_doctor_day <- df_doctor_visits %>% group_by(hcwId, visitDay) %>% summarise(n_visi
```

```
`summarise()` has grouped output by 'hcwId'. You can override using the
`.groups` argument.
```

```
ggplot(visits_per_doctor_day, aes(x = n_visits)) +
    geom_histogram(binwidth = 1, fill = "orange", color = "black") +
    geom_vline(aes(xintercept = mean(visits_per_doctor_day$n_visits)), color = "blue", linety
    geom_vline(aes(xintercept = median(visits_per_doctor_day$n_visits)), color = "red", linet
```

```
    labs(title = "Distribution of Number of Visits per ICU Doctor per Day",
             x = "Number of Visits",
             y = "Count (Doctor-Day pairs)",
             subtitle = "Blue dashed = mean, Red dotted = median") +
    theme_minimal()
```




```
min_doctor_visits <- min(visits_per_doctor_day$n_visits)
max_doctor_visits <- max(visits_per_doctor_day$n_visits)
mean_doctor_visits <- mean(visits_per_doctor_day$n_visits)
median_doctor_visits <- median(visits_per_doctor_day$n_visits)
```

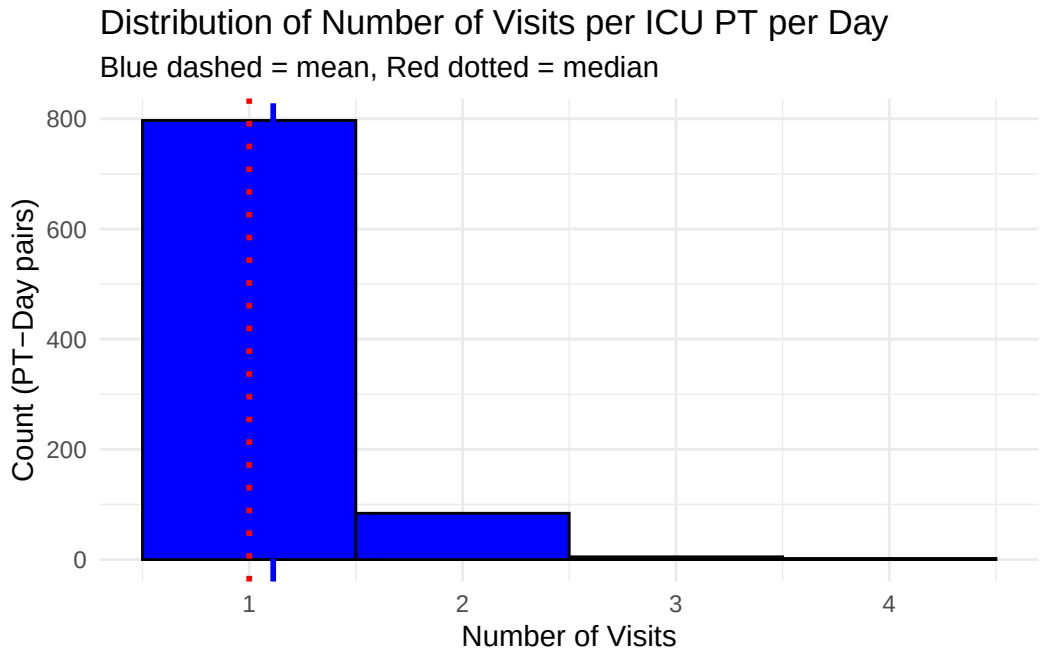
Min visits per ICU doctor per day: 1 **Max visits per ICU doctor per day:** 87 **Mean visits per ICU doctor per day:** 37.5959703 **Median visits per ICU doctor per day:** 37

Distribution of Number of Visits per PT per Day (ICU)

```
visits_per_pt_day <- df_pt_visits %>% group_by(hcwId, visitDay) %>% summarise(n_visits = n()
```

```
`summarise()` has grouped output by 'hcwId'. You can override using the
`.groups` argument.
```

```r
ggplot(visits_per_pt_day, aes(x = n_visits)) +
    geom_histogram(binwidth = 1, fill = "blue", color = "black") +
    geom_vline(aes(xintercept = mean(visits_per_pt_day$n_visits)), color = "blue", linetype =
    geom_vline(aes(xintercept = median(visits_per_pt_day$n_visits)), color = "red", linetype
    labs(title = "Distribution of Number of Visits per ICU PT per Day",
             x = "Number of Visits",
             y = "Count (PT-Day pairs)",
             subtitle = "Blue dashed = mean, Red dotted = median") +
    theme_minimal()
```




```r
min_pt_visits <- min(visits_per_pt_day$n_visits)
max_pt_visits <- max(visits_per_pt_day$n_visits)
mean_pt_visits <- mean(visits_per_pt_day$n_visits)
median_pt_visits <- median(visits_per_pt_day$n_visits)
```

Min visits per ICU PT per day: 1 **Max visits per ICU PT per day:** 4 **Mean visits per ICU PT per day:** 1.1126126 **Median visits per ICU PT per day:** 1

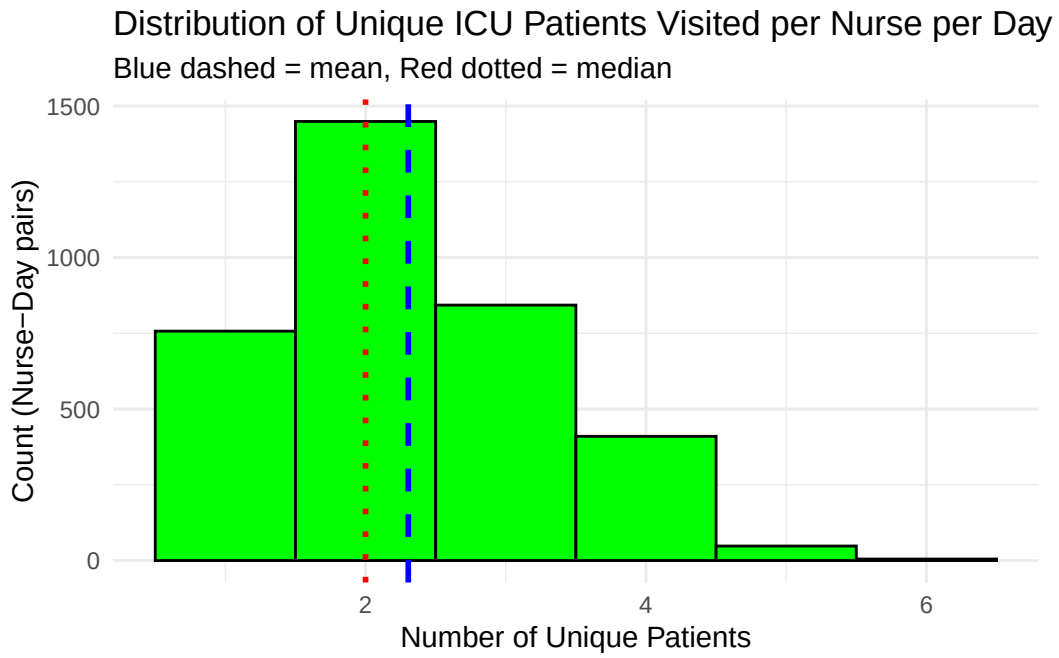
Distribution of Number of Unique Patients Visited per Day by HCW Type (ICU)

Nurses (ICU)

```
unique_patients_per_nurse_day <- df_nurse_visits %>% group_by(hcwId, visitDay) %>% summarise
```

```
`summarise()` has grouped output by 'hcwId'. You can override using the
`.groups` argument.
```

```
ggplot(unique_patients_per_nurse_day, aes(x = n_unique_patients)) +
    geom_histogram(binwidth = 1, fill = "green", color = "black") +
    geom_vline(aes(xintercept = mean(n_unique_patients)), color = "blue", linetype = "dashed"
    geom_vline(aes(xintercept = median(n_unique_patients)), color = "red", linetype = "dotte
    labs(title = "Distribution of Unique ICU Patients Visited per Nurse per Day",
             x = "Number of Unique Patients",
             y = "Count (Nurse-Day pairs)",
             subtitle = "Blue dashed = mean, Red dotted = median") +
    theme_minimal()
```



```r
min_nurse_patients <- min(unique_patients_per_nurse_day$n_unique_patients)
max_nurse_patients <- max(unique_patients_per_nurse_day$n_unique_patients)
mean_nurse_patients <- mean(unique_patients_per_nurse_day$n_unique_patients)
median_nurse_patients <- median(unique_patients_per_nurse_day$n_unique_patients)
```

Min unique ICU patients per Nurse per day: 1 **Max unique ICU patients per Nurse per day:** 6 **Mean unique ICU patients per Nurse per day:** 2.3046697 **Median unique ICU patients per Nurse per day:** 2

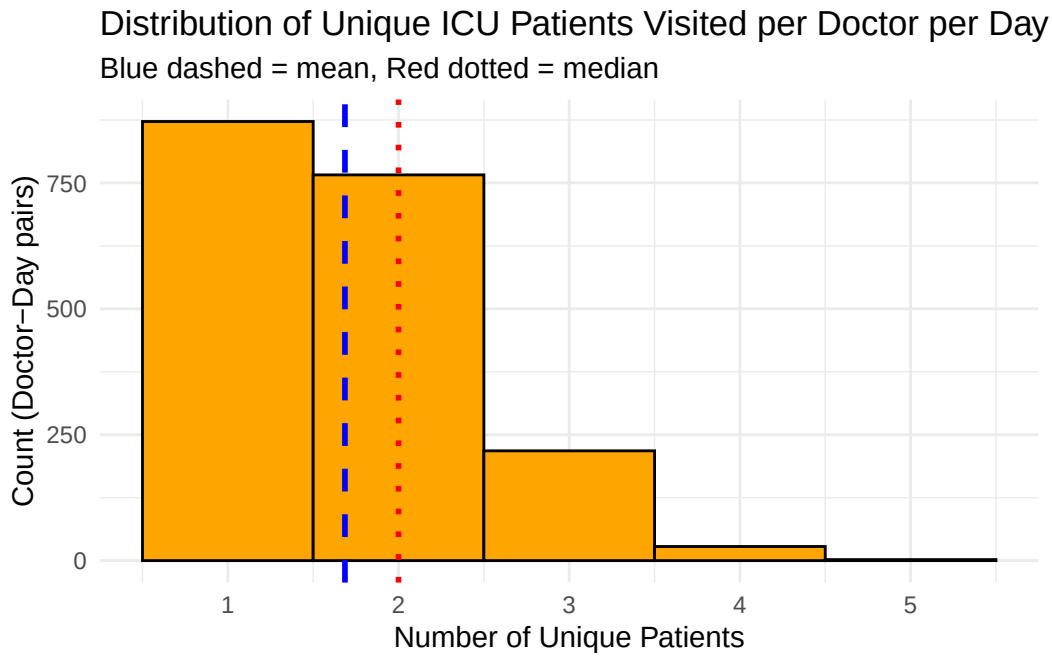
Unique Patients visited per day (ICU)

Doctors

```r
unique_patients_per_doctor_day <- df_doctor_visits %>% group_by(hcwId, visitDay) %>% summaris
```

```
`summarise()` has grouped output by 'hcwId'. You can override using the
`.groups` argument.
```

```r
ggplot(unique_patients_per_doctor_day, aes(x = n_unique_patients)) +
    geom_histogram(binwidth = 1, fill = "orange", color = "black") +
    geom_vline(aes(xintercept = mean(n_unique_patients)), color = "blue", linetype = "dashed"
    geom_vline(aes(xintercept = median(n_unique_patients)), color = "red", linetype = "dotte
    labs(title = "Distribution of Unique ICU Patients Visited per Doctor per Day",
             x = "Number of Unique Patients",
             y = "Count (Doctor-Day pairs)",
             subtitle = "Blue dashed = mean, Red dotted = median") +
    theme_minimal()
```




```
min_doctor_patients <- min(unique_patients_per_doctor_day$n_unique_patients)
max_doctor_patients <- max(unique_patients_per_doctor_day$n_unique_patients)
mean_doctor_patients <- mean(unique_patients_per_doctor_day$n_unique_patients)
median_doctor_patients <- median(unique_patients_per_doctor_day$n_unique_patients)
```

Min unique ICU patients per Doctor per day: 1 **Max unique ICU patients per Doctor per day:** 5 **Mean unique ICU patients per Doctor per day:** 1.6861082 **Median unique ICU patients per Doctor per day:** 2

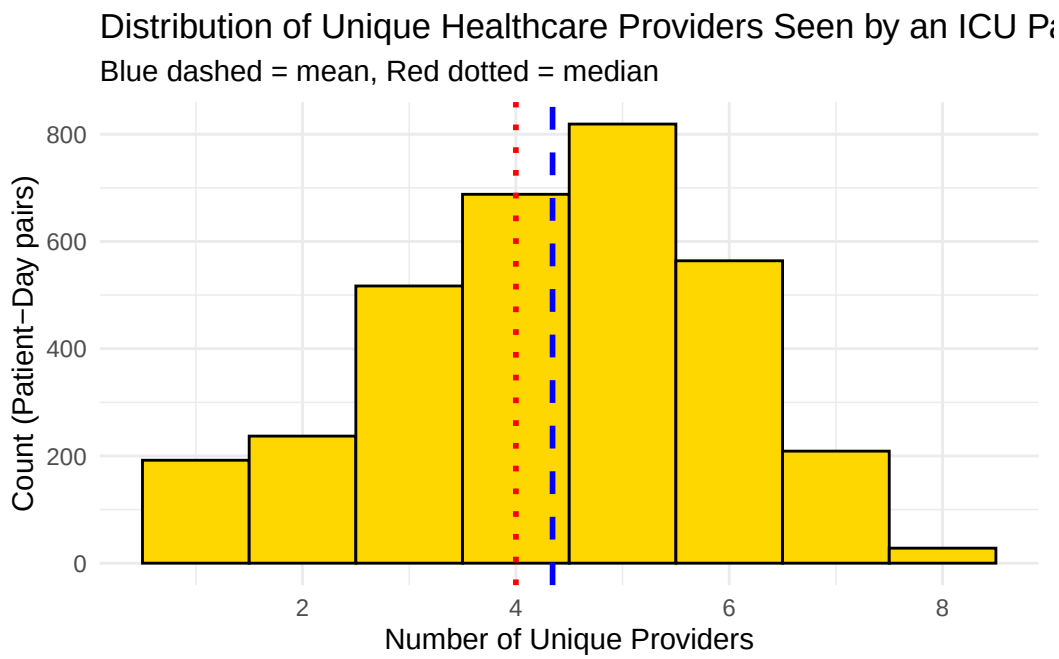
Distribution of Number of Unique Healthcare Providers Seen by a Patient per Day (ICU)

```
unique_providers_per_patient_day <- df2_filtered %>% group_by(patientId, visitDay) %>% summa
```

```
`summarise()` has grouped output by 'patientId'. You can override using the
`.groups` argument.
```

```
ggplot(unique_providers_per_patient_day, aes(x = n_unique_providers)) +
    geom_histogram(binwidth = 1, fill = "gold", color = "black") +
    geom_vline(aes(xintercept = mean(n_unique_providers)), color = "blue", linetype = "dashe
```

```
    geom_vline(aes(xintercept = median(n_unique_providers)), color = "red", linetype = "dotte
    labs(title = "Distribution of Unique Healthcare Providers Seen by an ICU Patient per Day"
             x = "Number of Unique Providers",
             y = "Count (Patient-Day pairs)",
             subtitle = "Blue dashed = mean, Red dotted = median") +
    theme_minimal()
```




```
min_patient_providers <- min(unique_providers_per_patient_day$n_unique_providers)
max_patient_providers <- max(unique_providers_per_patient_day$n_unique_providers)
mean_patient_providers <- mean(unique_providers_per_patient_day$n_unique_providers)
median_patient_providers <- median(unique_providers_per_patient_day$n_unique_providers)
```

Min unique providers per ICU patient per day: 1 **Max unique providers per ICU patient per day:** 8 **Mean unique providers per ICU patient per day:** 4.3438844 **Median unique providers per ICU patient per day:** 4