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Minh Ngoc
[Date]

R Assignment Report

Minh Ngoc

2024-05-22

```
# == Task 1 ====

# Load data of Patient who has COVID-19 or Suspected COVID demographics ====

patient_info <- read.csv("data/patientsUG.csv")

head(patient_info)
```

```
##   Record_ID                            PATIENT_ID  BIRTHDATE DEATHDATE
AGE
## 1      3600 6aa2e953-ad8f-48cb-909b-30fb9522ebf8  3/17/1988
36.16667
## 2       532 9718334c-3289-4b1c-a017-72f3df283ab3  6/13/1951
72.92778
## 3      5907 de9f5575-ae1c-4df5-9ef1-92a845ed99c2   2/6/2006
18.28056
## 4      7462 c10ee469-6182-4228-ac26-21bcf2412337 10/28/1912 11/1/2016
111.55278
## 5     10390 42ff8e5c-9607-490f-a256-dd6bbbd6ac2a  6/24/1948 3/31/2020
75.89722
## 6      7818 e283d725-b355-4b86-98a5-b8274e643527   9/1/1992
31.71111
##   MARITAL  RACE GENDER        CITY         STATE         COUNTY  ZIP
## 1       M white      F    Rehoboth Massachusetts Bristol County   NA
## 2       M black      M      Boston Massachusetts Suffolk County 2113
## 3         white      M  Foxborough Massachusetts Norfolk County 2035
## 4       S black      F Springfield Massachusetts Hampden County 1020
## 5       M white      M   Braintree Massachusetts Norfolk County 2184
## 6       S black      M   Braintree Massachusetts Norfolk County 2184
```

```
conditions <- read.csv("data/conditionsUG.csv")

head(conditions)
```

```
##   Record_ID      START      STOP                            PATIENT_ID
## 1         1  2/15/2019  8/1/2019 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 2         2 10/30/2019 1/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 3         3   3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 4         4   3/1/2020  3/1/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 5         5   3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 6         6  2/12/2020 2/26/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
##                           ENCOUNTER_ID      CODE        DESCRIPTION
## 1 d5ee30a9-362f-429e-a87a-ee38d999b0a5  65363002       Otitis media
## 2 8bca6d8a-ab80-4cbf-8abb-46654235f227  65363002       Otitis media
```

```
## 3 681c380b-3c84-4c55-80a6-db3d9ea12fee 386661006    Fever (finding)
## 4 681c380b-3c84-4c55-80a6-db3d9ea12fee 840544004 Suspected COVID-19
## 5 681c380b-3c84-4c55-80a6-db3d9ea12fee 840539006           COVID-19
## 6 adedca64-700b-4fb9-82f1-9cbb658abb73  44465007    Sprain of ankle

# Filter the COVID-19 or Suspected COVID-19 conditions ====

condition_covid <- subset(conditions, (conditions$DESCRIPTION == "COVID-19")
                          | (conditions$DESCRIPTION == "Suspected COVID-19"))

head(condition_covid)

##    Record_ID     START      STOP                              PATIENT_ID
## 4          4  3/1/2020  3/1/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 5          5  3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 11        11 3/13/2020 3/13/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 12        12 3/13/2020 4/14/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 23        23 3/11/2020 3/11/2020 ae9efba3-ddc4-43f9-a781-f72019388548
## 24        24 3/11/2020 4/15/2020 ae9efba3-ddc4-43f9-a781-f72019388548
##                            ENCOUNTER_ID      CODE        DESCRIPTION
## 4  681c380b-3c84-4c55-80a6-db3d9ea12fee 840544004 Suspected COVID-19
## 5  681c380b-3c84-4c55-80a6-db3d9ea12fee 840539006           COVID-19
## 11 1ea74a77-3ad3-4948-a9cc-3084462035d6 840544004 Suspected COVID-19
## 12 1ea74a77-3ad3-4948-a9cc-3084462035d6 840539006           COVID-19
## 23 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840544004 Suspected COVID-19
## 24 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840539006           COVID-19

# Join the two tables: Covid Condition and Patient ====

merged_data <- merge(condition_covid, patient_info,
                     by = "PATIENT_ID", all = TRUE)

head(merged_data)

##                              PATIENT_ID Record_ID.x     START      STOP
## 1 0000b247-1def-417a-a783-41c8682be022       87721 2/18/2020 2/18/2020
## 2 0000b247-1def-417a-a783-41c8682be022       87722 2/18/2020 3/25/2020
## 3 00049ee8-5953-4edd-a277-b9c1b1a7f16b       72610  3/8/2020  3/8/2020
## 4 00049ee8-5953-4edd-a277-b9c1b1a7f16b       72611  3/8/2020 3/24/2020
## 5 00079a57-24a8-430f-b4f8-a1cf34f90060       75792 2/25/2020 2/25/2020
## 6 00079a57-24a8-430f-b4f8-a1cf34f90060       75793 2/25/2020 3/10/2020
##                            ENCOUNTER_ID      CODE        DESCRIPTION
Record_ID.y
## 1 93c3da2d-9420-49fa-94e3-7140ab9aeba1 840544004 Suspected COVID-19
9493
## 2 93c3da2d-9420-49fa-94e3-7140ab9aeba1 840539006           COVID-19
9493
## 3 dab47020-5bd0-4ce6-ae5c-e4f1ebd04627 840544004 Suspected COVID-19
7885
## 4 dab47020-5bd0-4ce6-ae5c-e4f1ebd04627 840539006           COVID-19
```

```
7885
## 5 3a23144d-0dee-4dca-90ea-0ad14c1c6909 840544004 Suspected COVID-19
8215
## 6 3a23144d-0dee-4dca-90ea-0ad14c1c6909 840539006           COVID-19
8215
##    BIRTHDATE DEATHDATE      AGE MARITAL  RACE GENDER               CITY
## 1  12/3/2007           16.45556         white      F North Attleborough
## 2  12/3/2007           16.45556         white      F North Attleborough
## 3 11/20/1984           39.49167       M white      M            Wayland
## 4 11/20/1984           39.49167       M white      M            Wayland
## 5  3/25/1991           33.14444       M white      F   Great Barrington
## 6  3/25/1991           33.14444       M white      F   Great Barrington
##           STATE           COUNTY  ZIP
## 1 Massachusetts   Bristol County   NA
## 2 Massachusetts   Bristol County   NA
## 3 Massachusetts Middlesex County   NA
## 4 Massachusetts Middlesex County   NA
## 5 Massachusetts Berkshire County 1230
## 6 Massachusetts Berkshire County 1230

# === 1.1 Distribution of patients across counties ====

# To count the occurrences of each unique value in the “county” column
# from our dataset,
# we can use the count() function from the dplyr package.

library(dplyr)

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union

# Count the occurrences of each county
county_counts <- merged_data %>% count(COUNTY)

# Print the result
print(county_counts)

##               COUNTY    n
## 1  Barnstable County  529
## 2   Berkshire County  320
## 3     Bristol County 1330
## 4       Dukes County   61
## 5       Essex County 1768
```

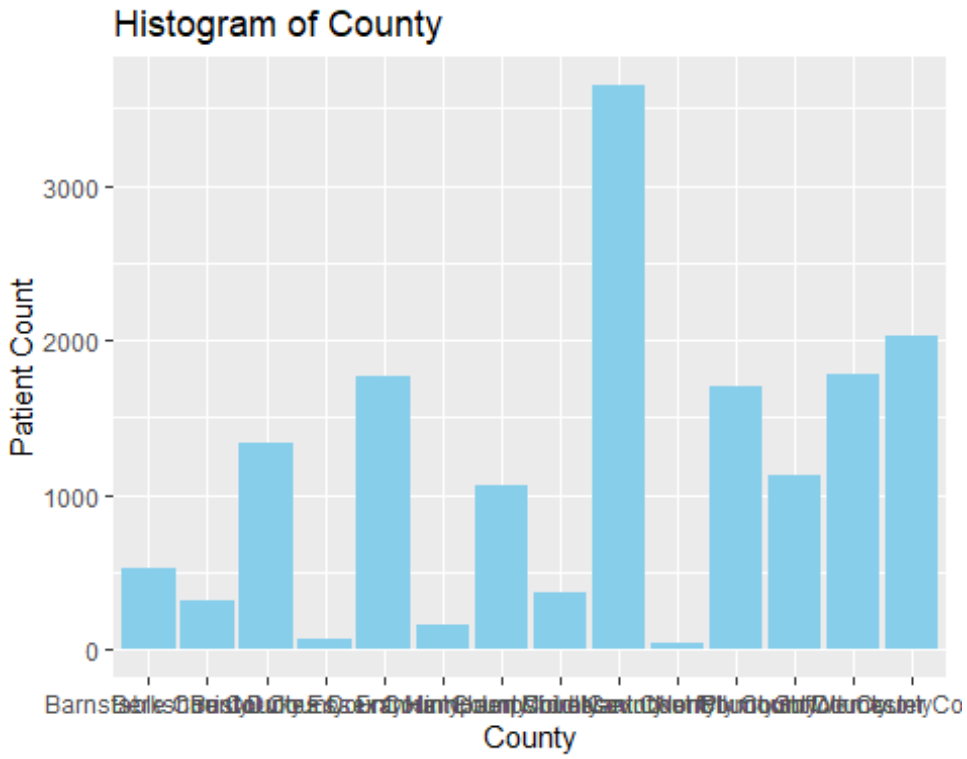
```
## 6    Franklin County  155
## 7     Hampden County 1056
## 8   Hampshire County  368
## 9   Middlesex County 3647
## 10  Nantucket County   40
## 11    Norfolk County 1704
## 12   Plymouth County 1129
## 13    Suffolk County 1775
## 14  Worcester County 2030
```

```
# See the data type
str(county_counts)
```

```
## 'data.frame':    14 obs. of  2 variables:
##  $ COUNTY: chr  "Barnstable County" "Berkshire County" "Bristol County"
"Dukes County" ...
##  $ n     : int  529 320 1330 61 1768 155 1056 368 3647 40 ...
```

```
# Load the necessary library
library(ggplot2)

# Create the histogram of County
ggplot(county_counts, aes(x = county_counts$COUNTY, y = county_counts$n)) +
  geom_bar(stat = "identity", fill = "skyblue") +
  labs(title = "Histogram of County", x = "County", y = "Patient Count")
```

```
## Warning: Use of `county_counts$COUNTY` is discouraged.
## ℹ Use `COUNTY` instead.

## Warning: Use of `county_counts$n` is discouraged.
## ℹ Use `n` instead.
```




```
# Bonus: Top 10 Counties that have the most COVID Patients ====

library(dplyr)

top_counties <- county_counts %>%
  arrange(desc(n)) %>%
  head(10)  # Select the top 10 conditions

# Print the top 10 counties that have the most Covid Patients
print(top_counties)
```

```
##               COUNTY    n
## 1   Middlesex County 3647
## 2   Worcester County 2030
## 3     Suffolk County 1775
## 4       Essex County 1768
## 5     Norfolk County 1704
## 6     Bristol County 1330
## 7    Plymouth County 1129
## 8     Hampden County 1056
## 9  Barnstable County  529
## 10  Hampshire County  368
```

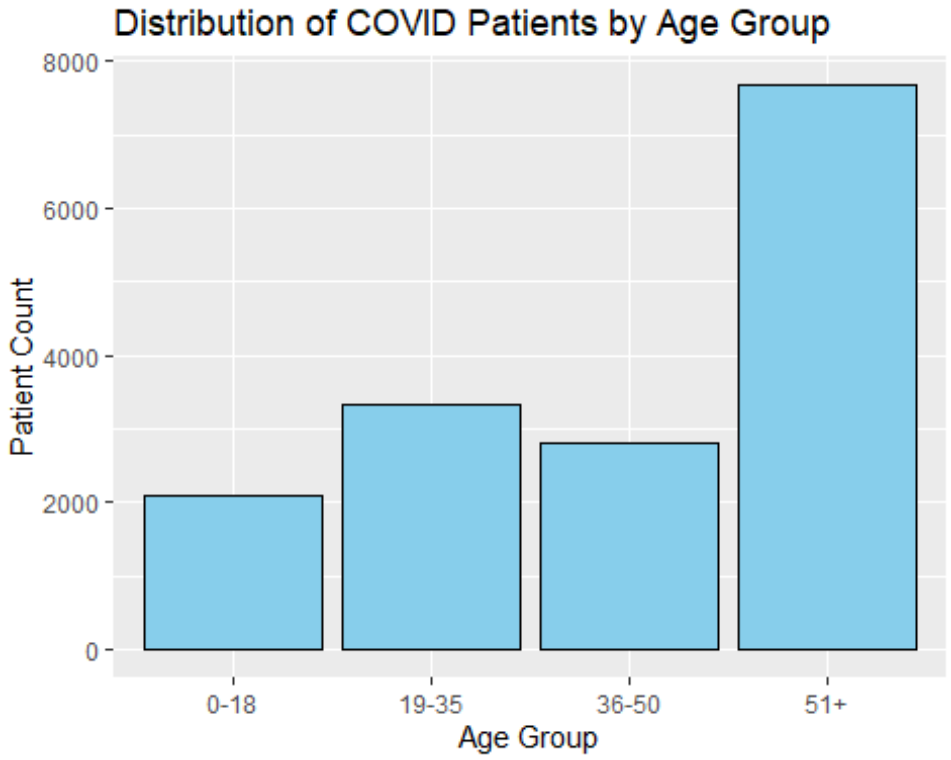
```
# =================

# 1.2. Distribution of Patients across Age Groups ====
```

```r
# Calculate the Age from Birthday column
# To quickly calculate in Excel,
# We use YEARFRAC(Birthday, TODAY()) function

head(merged_data)
```

```
##                              PATIENT_ID Record_ID.x     START      STOP
## 1 0000b247-1def-417a-a783-41c8682be022       87721 2/18/2020 2/18/2020
## 2 0000b247-1def-417a-a783-41c8682be022       87722 2/18/2020 3/25/2020
## 3 00049ee8-5953-4edd-a277-b9c1b1a7f16b       72610  3/8/2020  3/8/2020
## 4 00049ee8-5953-4edd-a277-b9c1b1a7f16b       72611  3/8/2020 3/24/2020
## 5 00079a57-24a8-430f-b4f8-a1cf34f90060       75792 2/25/2020 2/25/2020
## 6 00079a57-24a8-430f-b4f8-a1cf34f90060       75793 2/25/2020 3/10/2020
##                            ENCOUNTER_ID      CODE        DESCRIPTION
Record_ID.y
## 1 93c3da2d-9420-49fa-94e3-7140ab9aeba1 840544004 Suspected COVID-19
9493
## 2 93c3da2d-9420-49fa-94e3-7140ab9aeba1 840539006           COVID-19
9493
## 3 dab47020-5bd0-4ce6-ae5c-e4f1ebd04627 840544004 Suspected COVID-19
7885
## 4 dab47020-5bd0-4ce6-ae5c-e4f1ebd04627 840539006           COVID-19
7885
## 5 3a23144d-0dee-4dca-90ea-0ad14c1c6909 840544004 Suspected COVID-19
8215
## 6 3a23144d-0dee-4dca-90ea-0ad14c1c6909 840539006           COVID-19
8215
##    BIRTHDATE DEATHDATE      AGE MARITAL  RACE GENDER               CITY
## 1  12/3/2007           16.45556         white      F North Attleborough
## 2  12/3/2007           16.45556         white      F North Attleborough
## 3 11/20/1984           39.49167       M white      M            Wayland
## 4 11/20/1984           39.49167       M white      M            Wayland
## 5  3/25/1991           33.14444       M white      F   Great Barrington
## 6  3/25/1991           33.14444       M white      F   Great Barrington
##           STATE           COUNTY  ZIP
## 1 Massachusetts   Bristol County   NA
## 2 Massachusetts   Bristol County   NA
## 3 Massachusetts Middlesex County   NA
## 4 Massachusetts Middlesex County   NA
## 5 Massachusetts Berkshire County 1230
## 6 Massachusetts Berkshire County 1230
```

```r
# Label the Age Groups

merged_data$AGEGROUP <- cut(merged_data$AGE, breaks = c(0, 18, 35, 50, Inf),
                            labels = c("0-18", "19-35", "36-50", "51+"))

# See the number of patient by Age Group

summary(merged_data$AGEGROUP)
```

```
##  0-18 19-35 36-50   51+
##  2095  3329  2815  7673

library(ggplot2)

ggplot(merged_data, aes(x = AGEGROUP)) +
  geom_bar(fill = "skyblue", color = "black") +
  labs(title = "Distribution of COVID Patients by Age Group",
       x = "Age Group",
       y = "Patient Count")
```




```
# == Task 2 ====

# 2.1. Top 10 most common conditions (symptoms) related to the patients ====

head(conditions)

##   Record_ID      START      STOP                            PATIENT_ID
## 1         1  2/15/2019  8/1/2019 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 2         2 10/30/2019 1/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 3         3   3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 4         4   3/1/2020  3/1/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 5         5   3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 6         6  2/12/2020 2/26/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
##                            ENCOUNTER_ID      CODE        DESCRIPTION
## 1 d5ee30a9-362f-429e-a87a-ee38d999b0a5  65363002       Otitis media
## 2 8bca6d8a-ab80-4cbf-8abb-46654235f227  65363002       Otitis media
```

```
## 3 681c380b-3c84-4c55-80a6-db3d9ea12fee 386661006    Fever (finding)
## 4 681c380b-3c84-4c55-80a6-db3d9ea12fee 840544004 Suspected COVID-19
## 5 681c380b-3c84-4c55-80a6-db3d9ea12fee 840539006           COVID-19
## 6 adedca64-700b-4fb9-82f1-9cbb658abb73  44465007    Sprain of ankle
```

```
# Filtered conditions that related to COVID symptom

covid_symptoms <- subset(conditions, (conditions$DESCRIPTION == "COVID-19")
                         | (conditions$DESCRIPTION == "Suspected COVID-19")
                         | (conditions$DESCRIPTION == "Fever (finding)")
                         | (conditions$DESCRIPTION == "Cough (finding)")
                         | (conditions$DESCRIPTION == "Streptococcal sore
throat (disorder)")
                         | (conditions$DESCRIPTION == "Headache (finding)")
                         | (conditions$DESCRIPTION == "Fatigue (finding)")
                         | (conditions$DESCRIPTION == "Nausea (finding)")
                         | (conditions$DESCRIPTION == "Vomiting symptom
(finding)")
                         | (conditions$DESCRIPTION == "Loss of taste
(finding)"))

head(covid_symptoms)
```

```
##    Record_ID     START      STOP                            PATIENT_ID
## 3          3  3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 4          4  3/1/2020  3/1/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 5          5  3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 7          7 3/13/2020 4/14/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 10        10 3/13/2020 4/14/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 11        11 3/13/2020 3/13/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
##                             ENCOUNTER_ID      CODE        DESCRIPTION
## 3  681c380b-3c84-4c55-80a6-db3d9ea12fee 386661006    Fever (finding)
## 4  681c380b-3c84-4c55-80a6-db3d9ea12fee 840544004 Suspected COVID-19
## 5  681c380b-3c84-4c55-80a6-db3d9ea12fee 840539006           COVID-19
## 7  1ea74a77-3ad3-4948-a9cc-3084462035d6  49727002    Cough (finding)
## 10 1ea74a77-3ad3-4948-a9cc-3084462035d6 386661006    Fever (finding)
## 11 1ea74a77-3ad3-4948-a9cc-3084462035d6 840544004 Suspected COVID-19
```

```
library(dplyr)

condition_counts <- covid_symptoms %>% count(DESCRIPTION)

head(condition_counts)
```

```
##               DESCRIPTION    n
## 1               COVID-19 6648
## 2         Cough (finding) 4674
## 3       Fatigue (finding) 2644
## 4         Fever (finding) 6088
```

```
## 5      Headache (finding)  991
## 6 Loss of taste (finding) 3571

top_conditions <- condition_counts %>%
  arrange(desc(n)) %>%
  head(10)  # Select the top 10 conditions

# Print the top conditions
print(top_conditions)

##                            DESCRIPTION    n
## 1                   Suspected COVID-19 6863
## 2                             COVID-19 6648
## 3                Fever (finding) 6088
## 4                Cough (finding) 4674
## 5           Loss of taste (finding) 3571
## 6                 Fatigue (finding) 2644
## 7                Headache (finding)  991
## 8                  Nausea (finding)  375
## 9           Vomiting symptom (finding)  375
## 10 Streptococcal sore throat (disorder)  129

# ===
# 2.2. Top 10 conditions for genders: ====
# The Difference between Male & Female
#
# 2.2.1. Top 10 conditions for Male ====

head(patient_info)

##   Record_ID                            PATIENT_ID  BIRTHDATE DEATHDATE
AGE
## 1      3600 6aa2e953-ad8f-48cb-909b-30fb9522ebf8  3/17/1988
36.16667
## 2       532 9718334c-3289-4b1c-a017-72f3df283ab3  6/13/1951
72.92778
## 3      5907 de9f5575-ae1c-4df5-9ef1-92a845ed99c2   2/6/2006
18.28056
## 4      7462 c10ee469-6182-4228-ac26-21bcf2412337 10/28/1912 11/1/2016
111.55278
## 5     10390 42ff8e5c-9607-490f-a256-dd6bbbd6ac2a  6/24/1948 3/31/2020
75.89722
## 6      7818 e283d725-b355-4b86-98a5-b8274e643527   9/1/1992
31.71111
##   MARITAL  RACE GENDER        CITY         STATE         COUNTY  ZIP
## 1       M white      F    Rehoboth Massachusetts Bristol County   NA
## 2       M black      M      Boston Massachusetts Suffolk County 2113
## 3         white      M  Foxborough Massachusetts Norfolk County 2035
## 4       S black      F Springfield Massachusetts Hampden County 1020
## 5       M white      M   Braintree Massachusetts Norfolk County 2184
## 6       S black      M   Braintree Massachusetts Norfolk County 2184
```

```r
male <- subset(patient_info, patient_info$GENDER == "M")

head(male)
```

```
##   Record_ID                            PATIENT_ID  BIRTHDATE DEATHDATE
AGE
## 2       532 9718334c-3289-4b1c-a017-72f3df283ab3  6/13/1951
72.92778
## 3      5907 de9f5575-ae1c-4df5-9ef1-92a845ed99c2   2/6/2006
18.28056
## 5     10390 42ff8e5c-9607-490f-a256-dd6bbbd6ac2a  6/24/1948 3/31/2020
75.89722
## 6      7818 e283d725-b355-4b86-98a5-b8274e643527   9/1/1992
31.71111
## 7      8381 696eec8a-73f1-4aa3-a730-9609c4b6657a 10/30/2009
14.54722
## 9     12062 e586d6a9-2450-4931-9b36-91f5306acd31 10/27/1935 3/11/2020
88.55556
##   MARITAL  RACE GENDER        CITY         STATE           COUNTY  ZIP
## 2       M black      M      Boston Massachusetts   Suffolk County 2113
## 3         white      M  Foxborough Massachusetts   Norfolk County 2035
## 5       M white      M   Braintree Massachusetts   Norfolk County 2184
## 6       S black      M   Braintree Massachusetts   Norfolk County 2184
## 7         asian      M    Westwood Massachusetts   Norfolk County   NA
## 9       M white      M Northbridge Massachusetts Worcester County   NA
```

```r
library(dplyr)

male_condition <- inner_join(covid_symptoms, male,
                     by = "PATIENT_ID")

head(male_condition)
```

```
##   Record_ID.x     START      STOP                              PATIENT_ID
## 1           3  3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 2           4  3/1/2020  3/1/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 3           5  3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 4          16 3/11/2020 4/15/2020 ae9efba3-ddc4-43f9-a781-f72019388548
## 5          17 3/11/2020 4/15/2020 ae9efba3-ddc4-43f9-a781-f72019388548
## 6          18 3/11/2020 4/15/2020 ae9efba3-ddc4-43f9-a781-f72019388548
##                          ENCOUNTER_ID      CODE        DESCRIPTION
Record_ID.y
## 1 681c380b-3c84-4c55-80a6-db3d9ea12fee 386661006    Fever (finding)
1
## 2 681c380b-3c84-4c55-80a6-db3d9ea12fee 840544004 Suspected COVID-19
1
## 3 681c380b-3c84-4c55-80a6-db3d9ea12fee 840539006           COVID-19
1
## 4 eeab7c2d-71ba-4e04-af16-87a01dce7d54  25064002 Headache (finding)
3
```

```
## 5 eeab7c2d-71ba-4e04-af16-87a01dce7d54  49727002    Cough (finding)
3
## 6 eeab7c2d-71ba-4e04-af16-87a01dce7d54  84229001  Fatigue (finding)
3
##   BIRTHDATE DEATHDATE       AGE MARITAL  RACE GENDER        CITY
STATE
## 1 8/24/2017            6.730556         white      M Springfield
Massachusetts
## 2 8/24/2017            6.730556         white      M Springfield
Massachusetts
## 3 8/24/2017            6.730556         white      M Springfield
Massachusetts
## 4 6/30/1992           31.880556       S white      M    Chicopee
Massachusetts
## 5 6/30/1992           31.880556       S white      M    Chicopee
Massachusetts
## 6 6/30/1992           31.880556       S white      M    Chicopee
Massachusetts
##           COUNTY  ZIP
## 1 Hampden County 1106
## 2 Hampden County 1106
## 3 Hampden County 1106
## 4 Hampden County 1020
## 5 Hampden County 1020
## 6 Hampden County 1020

# Find the Top 10 conditions for Male

library(dplyr)

male_condition_counts <- male_condition %>% count(DESCRIPTION)

head(male_condition_counts)

##               DESCRIPTION    n
## 1               COVID-19 3161
## 2         Cough (finding) 2202
## 3       Fatigue (finding) 1271
## 4         Fever (finding) 2886
## 5      Headache (finding)  473
## 6 Loss of taste (finding) 1725

# Sort TOP 10 condition descending

male_top_conditions <- male_condition_counts %>%
  arrange(desc(n)) %>%
  head(10)  # Select the top 10 conditions

# Print the top 10 conditions for Male
print(male_top_conditions)
```

```
##                            DESCRIPTION    n
## 1                    Suspected COVID-19 3265
## 2                              COVID-19 3161
## 3                         Fever (finding) 2886
## 4                         Cough (finding) 2202
## 5                 Loss of taste (finding) 1725
## 6                        Fatigue (finding) 1271
## 7                      Headache (finding)  473
## 8                        Nausea (finding)  173
## 9              Vomiting symptom (finding)  173
## 10 Streptococcal sore throat (disorder)   68

# =====
# 2.2.2. Top 10 conditions for Female ====
# =====

head(patient_info)

##   Record_ID                            PATIENT_ID  BIRTHDATE DEATHDATE
AGE
## 1      3600 6aa2e953-ad8f-48cb-909b-30fb9522ebf8  3/17/1988
36.16667
## 2       532 9718334c-3289-4b1c-a017-72f3df283ab3  6/13/1951
72.92778
## 3      5907 de9f5575-ae1c-4df5-9ef1-92a845ed99c2   2/6/2006
18.28056
## 4      7462 c10ee469-6182-4228-ac26-21bcf2412337 10/28/1912 11/1/2016
111.55278
## 5     10390 42ff8e5c-9607-490f-a256-dd6bbbd6ac2a  6/24/1948 3/31/2020
75.89722
## 6      7818 e283d725-b355-4b86-98a5-b8274e643527   9/1/1992
31.71111
##   MARITAL  RACE GENDER        CITY         STATE         COUNTY  ZIP
## 1       M white      F    Rehoboth Massachusetts Bristol County   NA
## 2       M black      M      Boston Massachusetts Suffolk County 2113
## 3         white      M  Foxborough Massachusetts Norfolk County 2035
## 4       S black      F Springfield Massachusetts Hampden County 1020
## 5       M white      M   Braintree Massachusetts Norfolk County 2184
## 6       S black      M   Braintree Massachusetts Norfolk County 2184

female <- subset(patient_info, patient_info$GENDER == "F")

head(female)

##    Record_ID                            PATIENT_ID  BIRTHDATE DEATHDATE
## 1       3600 6aa2e953-ad8f-48cb-909b-30fb9522ebf8  3/17/1988
## 4       7462 c10ee469-6182-4228-ac26-21bcf2412337 10/28/1912 11/1/2016
## 8       6826 c3cad3d8-cbfa-42f3-8901-50bf814f2449  7/20/1922
## 11      6075 6b26b6e2-a7ff-4353-8b0d-48c712d4a31e 12/28/1926 2/23/1990
## 12      2356 febba7e3-0689-4b82-a0c6-f93b992e6415 12/31/1998
## 13     10598 97b6bb1a-78cd-48bb-9e03-39867c5c368e  9/12/2005
```

```
##          AGE MARITAL  RACE GENDER        CITY         STATE         COUNTY
ZIP
## 1   36.16667       M white      F    Rehoboth Massachusetts Bristol County
NA
## 4  111.55278       S black      F Springfield Massachusetts Hampden County
1020
## 8  101.82500       M white      F      Boston Massachusetts Suffolk County
2128
## 11  97.38611       M white      F  Foxborough Massachusetts Norfolk County
NA
## 12  25.38056         white      F      Ludlow Massachusetts Hampden County
NA
## 13  18.68056         white      F     Norwood Massachusetts Norfolk County
NA
```

```
library(dplyr)

female_condition <- inner_join(covid_symptoms, female,
                       by = "PATIENT_ID")

head(female_condition)
```

```
##   Record_ID.x     START      STOP                              PATIENT_ID
## 1           7 3/13/2020 4/14/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 2          10 3/13/2020 4/14/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 3          11 3/13/2020 3/13/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 4          12 3/13/2020 4/14/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 5          13 4/28/2020  5/8/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 6          25  3/1/2020  4/7/2020 199c586f-af16-4091-9998-ee4cfc02ee7a
##                             ENCOUNTER_ID      CODE
## 1 1ea74a77-3ad3-4948-a9cc-3084462035d6  49727002
## 2 1ea74a77-3ad3-4948-a9cc-3084462035d6 386661006
## 3 1ea74a77-3ad3-4948-a9cc-3084462035d6 840544004
## 4 1ea74a77-3ad3-4948-a9cc-3084462035d6 840539006
## 5 e03b96de-5604-4989-a2d5-03a63e041eab  43878008
## 6 8333efdf-f7bf-43bb-b73f-2b663d14c1ad  49727002
##                              DESCRIPTION Record_ID.y BIRTHDATE DEATHDATE
## 1                       Cough (finding)           2  8/1/2016
## 2                       Fever (finding)           2  8/1/2016
## 3                     Suspected COVID-19          2  8/1/2016
## 4                              COVID-19           2  8/1/2016
## 5 Streptococcal sore throat (disorder)           2  8/1/2016
## 6                       Cough (finding)           4  1/9/2004
##         AGE MARITAL  RACE GENDER     CITY         STATE          COUNTY
ZIP
## 1  7.794444         white      F  Walpole Massachusetts  Norfolk County
2081
## 2  7.794444         white      F  Walpole Massachusetts  Norfolk County
2081
## 3  7.794444         white      F  Walpole Massachusetts  Norfolk County
```

```
2081
## 4  7.794444         white      F  Walpole Massachusetts  Norfolk County
2081
## 5  7.794444         white      F  Walpole Massachusetts  Norfolk County
2081
## 6 20.355556         white      F Pembroke Massachusetts Plymouth County
NA
```

```r
# Find the Top 10 conditions for Female

library(dplyr)

female_condition_counts <- female_condition %>% count(DESCRIPTION)

head(female_condition_counts)
```

```
##               DESCRIPTION    n
## 1               COVID-19 3487
## 2         Cough (finding) 2472
## 3       Fatigue (finding) 1373
## 4         Fever (finding) 3202
## 5      Headache (finding)  518
## 6 Loss of taste (finding) 1846
```

```r
# Sort TOP 10 condition descending

female_top_conditions <- female_condition_counts %>%
  arrange(desc(n)) %>%
  head(10)  # Select the top 10 conditions

# Print the top 10 conditions for Male
print(female_top_conditions)
```

```
##                            DESCRIPTION    n
## 1                   Suspected COVID-19 3598
## 2                             COVID-19 3487
## 3                        Fever (finding) 3202
## 4                        Cough (finding) 2472
## 5               Loss of taste (finding) 1846
## 6                      Fatigue (finding) 1373
## 7                     Headache (finding)  518
## 8                       Nausea (finding)  202
## 9            Vomiting symptom (finding)  202
## 10 Streptococcal sore throat (disorder)   61
```

```r
# Compare Male and Female Top 10 Conditions: ====
cat("Male Top 10 Conditions:", "\n")
```

```
## Male Top 10 Conditions:
```

```r
print(male_top_conditions)
```

```
##                            DESCRIPTION    n
## 1                    Suspected COVID-19 3265
## 2                              COVID-19 3161
## 3                         Fever (finding) 2886
## 4                         Cough (finding) 2202
## 5                 Loss of taste (finding) 1725
## 6                        Fatigue (finding) 1271
## 7                      Headache (finding)  473
## 8                        Nausea (finding)  173
## 9              Vomiting symptom (finding)  173
## 10 Streptococcal sore throat (disorder)   68
```

```
cat("Female Top 10 Conditions:", "\n")
```

```
## Female Top 10 Conditions:
```

```
print(female_top_conditions)
```

```
##                            DESCRIPTION    n
## 1                    Suspected COVID-19 3598
## 2                              COVID-19 3487
## 3                         Fever (finding) 3202
## 4                         Cough (finding) 2472
## 5                 Loss of taste (finding) 1846
## 6                        Fatigue (finding) 1373
## 7                      Headache (finding)  518
## 8                        Nausea (finding)  202
## 9              Vomiting symptom (finding)  202
## 10 Streptococcal sore throat (disorder)   61
```

```
cat("====================", "\n")
```

```
## ====================
```

```
cat("Key findings:", "\n")
```

```
## Key findings:
```

```
cat("====================", "\n")
```

```
## ====================
```

```
cat("There is a slightly difference in COVID symptoms
    between Male and Female", "\n")
```

```
## There is a slightly difference in COVID symptoms
##     between Male and Female
```

```
cat("Female has more COVID related patients than Male", "\n")
```

```
## Female has more COVID related patients than Male
```

```r
# == Task 3 ====

# Join 3 tables: Encounters, Conditions, and Patients
# To examine 2 factors of COVID Patients: Age Group and Gender

# 3.1. Join Conditions and Encounters ====

# Filter Covid conditions in dataset Conditions ====

# We already had this filtered dataset

head(condition_covid)
```

```
##    Record_ID     START      STOP                            PATIENT_ID
## 4          4  3/1/2020  3/1/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 5          5  3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 11        11 3/13/2020 3/13/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 12        12 3/13/2020 4/14/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 23        23 3/11/2020 3/11/2020 ae9efba3-ddc4-43f9-a781-f72019388548
## 24        24 3/11/2020 4/15/2020 ae9efba3-ddc4-43f9-a781-f72019388548
##                            ENCOUNTER_ID      CODE        DESCRIPTION
## 4  681c380b-3c84-4c55-80a6-db3d9ea12fee 840544004 Suspected COVID-19
## 5  681c380b-3c84-4c55-80a6-db3d9ea12fee 840539006           COVID-19
## 11 1ea74a77-3ad3-4948-a9cc-3084462035d6 840544004 Suspected COVID-19
## 12 1ea74a77-3ad3-4948-a9cc-3084462035d6 840539006           COVID-19
## 23 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840544004 Suspected COVID-19
## 24 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840539006           COVID-19
```

```r
# Filter Encounter Class in the dataset Encounters ====

# Read the dataset

encounter_info <- read.csv("data/encountersUG.csv")

head(encounter_info)
```

```
##   Record_ID                         ENCOUNTER_ID                START
## 1         1 d5ee30a9-362f-429e-a87a-ee38d999b0a5 2019-02-16T01:02:32Z
## 2         2 6a74fdef-2287-44bf-b9e7-18012376faca 2019-08-02T01:02:32Z
## 3         3 8bca6d8a-ab80-4cbf-8abb-46654235f227 2019-10-31T01:02:32Z
## 4         4 821e57ac-9304-46a9-9f9b-83daf60e9e43 2020-01-31T01:02:32Z
## 5         5 681c380b-3c84-4c55-80a6-db3d9ea12fee 2020-03-02T01:02:32Z
## 6         6 9aa748b8-3b44-4e34-b7a8-2e56f2ca3ca2 2019-07-08T08:02:25Z
##                   STOP                            PATIENT_ID ENCOUNTERCLASS
## 1 2019-02-16T01:17:32Z f0f3bc8d-ef38-49ce-a2bd-dfdda982b271     outpatient
## 2 2019-08-02T01:32:32Z f0f3bc8d-ef38-49ce-a2bd-dfdda982b271       wellness
## 3 2019-10-31T01:17:32Z f0f3bc8d-ef38-49ce-a2bd-dfdda982b271     outpatient
## 4 2020-01-31T01:17:32Z f0f3bc8d-ef38-49ce-a2bd-dfdda982b271       wellness
## 5 2020-03-02T01:58:32Z f0f3bc8d-ef38-49ce-a2bd-dfdda982b271     ambulatory
## 6 2019-07-08T08:17:25Z 067318a4-db8f-447f-8b6e-f2f61e9baaa5       wellness
```

```
##        CODE                        DESCRIPTION BASE_ENCOUNTER_COST
## 1 185345009             Encounter for symptom              129.16
## 2 410620009      Well child visit (procedure)              129.16
## 3 185345009             Encounter for symptom              129.16
## 4 410620009      Well child visit (procedure)              129.16
## 5 185345009 Encounter for symptom (procedure)              129.16
## 6 410620009      Well child visit (procedure)              129.16
##   TOTAL_CLAIM_COST PAYER_COVERAGE REASONCODE REASONDESCRIPTION
## 1           129.16          69.16   65363002      Otitis media
## 2           129.16         129.16         NA
## 3           129.16          69.16   65363002      Otitis media
## 4           129.16         129.16         NA
## 5           129.16          69.16         NA
## 6           129.16         129.16         NA

# Filter the dataset

encounter_filtered <- subset(encounter_info,
                             (encounter_info$ENCOUNTERCLASS == "ambulatory")
                             | (encounter_info$ENCOUNTERCLASS == "emergency")
                             | (encounter_info$ENCOUNTERCLASS == "inpatient")
                             | (encounter_info$ENCOUNTERCLASS == "urgent
care"))

# See the filtered dataset

head(encounter_filtered)

##    Record_ID                         ENCOUNTER_ID                 START
## 5          5 681c380b-3c84-4c55-80a6-db3d9ea12fee 2020-03-02T01:02:32Z
## 8          8 adedca64-700b-4fb9-82f1-9cbb658abb73 2020-02-12T08:02:25Z
## 9          9 1ea74a77-3ad3-4948-a9cc-3084462035d6 2020-03-13T08:02:25Z
## 10        10 e03b96de-5604-4989-a2d5-03a63e041eab 2020-04-28T08:02:25Z
## 12        12 11a2dfae-53d4-4d13-a74b-c540a525a1c4 2010-11-22T10:51:58Z
## 22        22 d875bd25-9aa8-464a-8021-a5a1a05a9599 2019-11-24T10:51:58Z
##                    STOP                            PATIENT_ID
ENCOUNTERCLASS
## 5  2020-03-02T01:58:32Z f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
ambulatory
## 8  2020-02-12T09:02:25Z 067318a4-db8f-447f-8b6e-f2f61e9baaa5
emergency
## 9  2020-03-13T08:52:25Z 067318a4-db8f-447f-8b6e-f2f61e9baaa5
ambulatory
## 10 2020-04-28T08:32:25Z 067318a4-db8f-447f-8b6e-f2f61e9baaa5
ambulatory
## 12 2010-11-22T11:06:58Z ae9efba3-ddc4-43f9-a781-f72019388548
ambulatory
## 22 2019-11-24T11:06:58Z ae9efba3-ddc4-43f9-a781-f72019388548
ambulatory
##         CODE                          DESCRIPTION BASE_ENCOUNTER_COST
```

```
## 5  185345009    Encounter for symptom (procedure)              129.16
## 8   50849002 Emergency room admission (procedure)              129.16
## 9  185345009    Encounter for symptom (procedure)              129.16
## 10 185345009                 Encounter for symptom             129.16
## 12 390906007     Hypertension follow-up encounter              129.16
## 22 185345009                 Encounter for symptom             129.16
##    TOTAL_CLAIM_COST PAYER_COVERAGE REASONCODE
## 5            129.16          69.16         NA
## 8            129.16          59.16         NA
## 9            129.16          59.16         NA
## 10           129.16          59.16   43878008
## 12           129.16          49.16         NA
## 22           129.16          49.16  444814009
##                       REASONDESCRIPTION
## 5
## 8
## 9
## 10 Streptococcal sore throat (disorder)
## 12
## 22           Viral sinusitis (disorder)
```

```
# Join the two datasets: conditions, encounters

library(dplyr)

merged_data_2 <- inner_join(condition_covid, encounter_filtered,
                            by = "ENCOUNTER_ID")

head(merged_data_2)
```

```
##   Record_ID.x   START.x    STOP.x                          PATIENT_ID.x
## 1           4  3/1/2020  3/1/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 2           5  3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 3          11 3/13/2020 3/13/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 4          12 3/13/2020 4/14/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 5          23 3/11/2020 3/11/2020 ae9efba3-ddc4-43f9-a781-f72019388548
## 6          24 3/11/2020 4/15/2020 ae9efba3-ddc4-43f9-a781-f72019388548
##                           ENCOUNTER_ID    CODE.x      DESCRIPTION.x
Record_ID.y
## 1 681c380b-3c84-4c55-80a6-db3d9ea12fee 840544004 Suspected COVID-19
5
## 2 681c380b-3c84-4c55-80a6-db3d9ea12fee 840539006           COVID-19
5
## 3 1ea74a77-3ad3-4948-a9cc-3084462035d6 840544004 Suspected COVID-19
9
## 4 1ea74a77-3ad3-4948-a9cc-3084462035d6 840539006           COVID-19
9
## 5 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840544004 Suspected COVID-19
23
## 6 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840539006           COVID-19
```

```
23
##                 START.y               STOP.y
## 1 2020-03-02T01:02:32Z 2020-03-02T01:58:32Z
## 2 2020-03-02T01:02:32Z 2020-03-02T01:58:32Z
## 3 2020-03-13T08:02:25Z 2020-03-13T08:52:25Z
## 4 2020-03-13T08:02:25Z 2020-03-13T08:52:25Z
## 5 2020-03-11T10:51:58Z 2020-03-11T11:42:58Z
## 6 2020-03-11T10:51:58Z 2020-03-11T11:42:58Z
##                           PATIENT_ID.y ENCOUNTERCLASS    CODE.y
## 1 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271     ambulatory 185345009
## 2 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271     ambulatory 185345009
## 3 067318a4-db8f-447f-8b6e-f2f61e9baaa5     ambulatory 185345009
## 4 067318a4-db8f-447f-8b6e-f2f61e9baaa5     ambulatory 185345009
## 5 ae9efba3-ddc4-43f9-a781-f72019388548     ambulatory 185345009
## 6 ae9efba3-ddc4-43f9-a781-f72019388548     ambulatory 185345009
##                       DESCRIPTION.y BASE_ENCOUNTER_COST TOTAL_CLAIM_COST
## 1 Encounter for symptom (procedure)              129.16           129.16
## 2 Encounter for symptom (procedure)              129.16           129.16
## 3 Encounter for symptom (procedure)              129.16           129.16
## 4 Encounter for symptom (procedure)              129.16           129.16
## 5 Encounter for symptom (procedure)              129.16           129.16
## 6 Encounter for symptom (procedure)              129.16           129.16
##   PAYER_COVERAGE REASONCODE REASONDESCRIPTION
## 1          69.16         NA
## 2          69.16         NA
## 3          59.16         NA
## 4          59.16         NA
## 5          49.16         NA
## 6          49.16         NA

# Prepare to join the 2 data frames: merged_data_2 and patients
# Join via "PATIENT_ID" column
# But in the merged_data_2 there are 2 Patient_id columns
# They are: Patient_id.x and Patient_id.y
# We need to:

# 1. Delete one column: Patient_id.y

merged_data_2$PATIENT_ID.y <- NULL

# See the dataset
head(merged_data_2)

##   Record_ID.x   START.x    STOP.x                        PATIENT_ID.x
## 1           4  3/1/2020  3/1/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 2           5  3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 3          11 3/13/2020 3/13/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 4          12 3/13/2020 4/14/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 5          23 3/11/2020 3/11/2020 ae9efba3-ddc4-43f9-a781-f72019388548
## 6          24 3/11/2020 4/15/2020 ae9efba3-ddc4-43f9-a781-f72019388548
```

```
##                            ENCOUNTER_ID    CODE.x      DESCRIPTION.x
Record_ID.y
## 1 681c380b-3c84-4c55-80a6-db3d9ea12fee 840544004 Suspected COVID-19
5
## 2 681c380b-3c84-4c55-80a6-db3d9ea12fee 840539006           COVID-19
5
## 3 1ea74a77-3ad3-4948-a9cc-3084462035d6 840544004 Suspected COVID-19
9
## 4 1ea74a77-3ad3-4948-a9cc-3084462035d6 840539006           COVID-19
9
## 5 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840544004 Suspected COVID-19
23
## 6 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840539006           COVID-19
23
##                 START.y               STOP.y ENCOUNTERCLASS    CODE.y
## 1 2020-03-02T01:02:32Z 2020-03-02T01:58:32Z     ambulatory 185345009
## 2 2020-03-02T01:02:32Z 2020-03-02T01:58:32Z     ambulatory 185345009
## 3 2020-03-13T08:02:25Z 2020-03-13T08:52:25Z     ambulatory 185345009
## 4 2020-03-13T08:02:25Z 2020-03-13T08:52:25Z     ambulatory 185345009
## 5 2020-03-11T10:51:58Z 2020-03-11T11:42:58Z     ambulatory 185345009
## 6 2020-03-11T10:51:58Z 2020-03-11T11:42:58Z     ambulatory 185345009
##                       DESCRIPTION.y BASE_ENCOUNTER_COST TOTAL_CLAIM_COST
## 1 Encounter for symptom (procedure)              129.16           129.16
## 2 Encounter for symptom (procedure)              129.16           129.16
## 3 Encounter for symptom (procedure)              129.16           129.16
## 4 Encounter for symptom (procedure)              129.16           129.16
## 5 Encounter for symptom (procedure)              129.16           129.16
## 6 Encounter for symptom (procedure)              129.16           129.16
##   PAYER_COVERAGE REASONCODE REASONDESCRIPTION
## 1          69.16         NA
## 2          69.16         NA
## 3          59.16         NA
## 4          59.16         NA
## 5          49.16         NA
## 6          49.16         NA
```

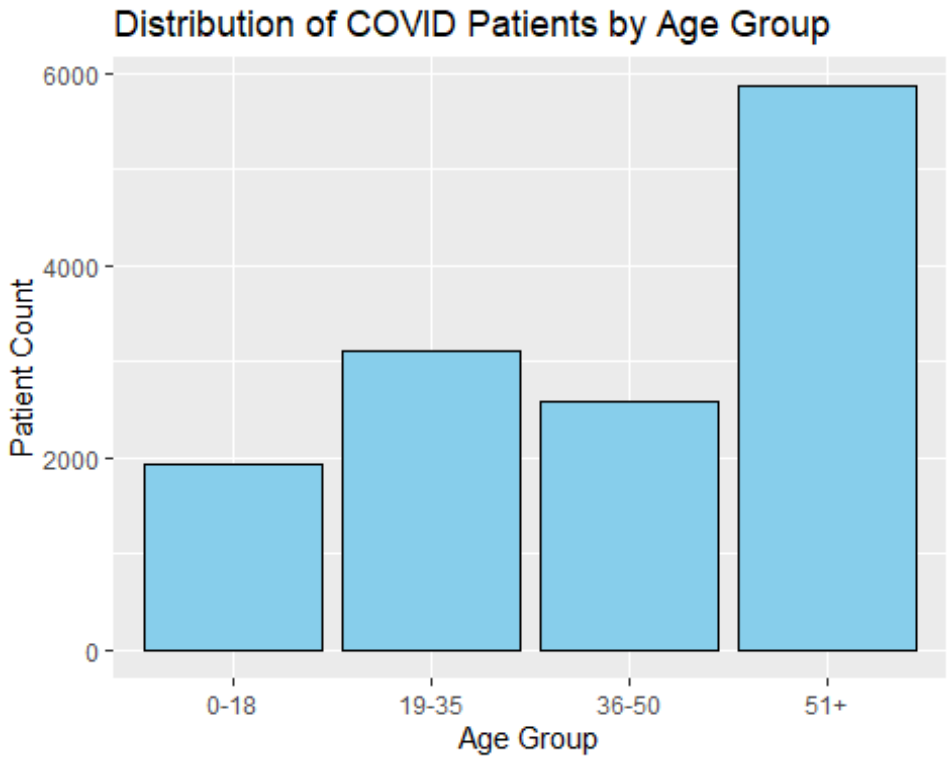
```r
# 2. Rename the column: Patient_id.x to Patient_id

colnames(merged_data_2)[colnames(merged_data_2) == "PATIENT_ID.x"] <-
"PATIENT_ID"

# See the dataset
head(merged_data_2)
```

```
##   Record_ID.x   START.x    STOP.x                            PATIENT_ID
## 1           4  3/1/2020  3/1/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 2           5  3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 3          11 3/13/2020 3/13/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 4          12 3/13/2020 4/14/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 5          23 3/11/2020 3/11/2020 ae9efba3-ddc4-43f9-a781-f72019388548
```

```
## 6          24 3/11/2020 4/15/2020 ae9efba3-ddc4-43f9-a781-f72019388548
##                            ENCOUNTER_ID    CODE.x      DESCRIPTION.x
Record_ID.y
## 1 681c380b-3c84-4c55-80a6-db3d9ea12fee 840544004 Suspected COVID-19
5
## 2 681c380b-3c84-4c55-80a6-db3d9ea12fee 840539006           COVID-19
5
## 3 1ea74a77-3ad3-4948-a9cc-3084462035d6 840544004 Suspected COVID-19
9
## 4 1ea74a77-3ad3-4948-a9cc-3084462035d6 840539006           COVID-19
9
## 5 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840544004 Suspected COVID-19
23
## 6 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840539006           COVID-19
23
##                 START.y               STOP.y ENCOUNTERCLASS    CODE.y
## 1 2020-03-02T01:02:32Z 2020-03-02T01:58:32Z     ambulatory 185345009
## 2 2020-03-02T01:02:32Z 2020-03-02T01:58:32Z     ambulatory 185345009
## 3 2020-03-13T08:02:25Z 2020-03-13T08:52:25Z     ambulatory 185345009
## 4 2020-03-13T08:02:25Z 2020-03-13T08:52:25Z     ambulatory 185345009
## 5 2020-03-11T10:51:58Z 2020-03-11T11:42:58Z     ambulatory 185345009
## 6 2020-03-11T10:51:58Z 2020-03-11T11:42:58Z     ambulatory 185345009
##                       DESCRIPTION.y BASE_ENCOUNTER_COST TOTAL_CLAIM_COST
## 1 Encounter for symptom (procedure)              129.16           129.16
## 2 Encounter for symptom (procedure)              129.16           129.16
## 3 Encounter for symptom (procedure)              129.16           129.16
## 4 Encounter for symptom (procedure)              129.16           129.16
## 5 Encounter for symptom (procedure)              129.16           129.16
## 6 Encounter for symptom (procedure)              129.16           129.16
##   PAYER_COVERAGE REASONCODE REASONDESCRIPTION
## 1          69.16         NA
## 2          69.16         NA
## 3          59.16         NA
## 4          59.16         NA
## 5          49.16         NA
## 6          49.16         NA

# 3. Join with dataset Patients via Patient_id column

patient <- inner_join(merged_data_2, patient_info,
                      by = "PATIENT_ID")

# See the result
head(patient)

##   Record_ID.x   START.x    STOP.x                           PATIENT_ID
## 1           4  3/1/2020  3/1/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 2           5  3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 3          11 3/13/2020 3/13/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 4          12 3/13/2020 4/14/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
```

```
## 5          23 3/11/2020 3/11/2020 ae9efba3-ddc4-43f9-a781-f72019388548
## 6          24 3/11/2020 4/15/2020 ae9efba3-ddc4-43f9-a781-f72019388548
##                           ENCOUNTER_ID    CODE.x      DESCRIPTION.x
Record_ID.y
## 1 681c380b-3c84-4c55-80a6-db3d9ea12fee 840544004 Suspected COVID-19
5
## 2 681c380b-3c84-4c55-80a6-db3d9ea12fee 840539006           COVID-19
5
## 3 1ea74a77-3ad3-4948-a9cc-3084462035d6 840544004 Suspected COVID-19
9
## 4 1ea74a77-3ad3-4948-a9cc-3084462035d6 840539006           COVID-19
9
## 5 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840544004 Suspected COVID-19
23
## 6 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840539006           COVID-19
23
##                START.y               STOP.y ENCOUNTERCLASS    CODE.y
## 1 2020-03-02T01:02:32Z 2020-03-02T01:58:32Z     ambulatory 185345009
## 2 2020-03-02T01:02:32Z 2020-03-02T01:58:32Z     ambulatory 185345009
## 3 2020-03-13T08:02:25Z 2020-03-13T08:52:25Z     ambulatory 185345009
## 4 2020-03-13T08:02:25Z 2020-03-13T08:52:25Z     ambulatory 185345009
## 5 2020-03-11T10:51:58Z 2020-03-11T11:42:58Z     ambulatory 185345009
## 6 2020-03-11T10:51:58Z 2020-03-11T11:42:58Z     ambulatory 185345009
##                        DESCRIPTION.y BASE_ENCOUNTER_COST TOTAL_CLAIM_COST
## 1 Encounter for symptom (procedure)              129.16           129.16
## 2 Encounter for symptom (procedure)              129.16           129.16
## 3 Encounter for symptom (procedure)              129.16           129.16
## 4 Encounter for symptom (procedure)              129.16           129.16
## 5 Encounter for symptom (procedure)              129.16           129.16
## 6 Encounter for symptom (procedure)              129.16           129.16
##   PAYER_COVERAGE REASONCODE REASONDESCRIPTION Record_ID BIRTHDATE
DEATHDATE
## 1          69.16         NA                           1 8/24/2017
## 2          69.16         NA                           1 8/24/2017
## 3          59.16         NA                           2  8/1/2016
## 4          59.16         NA                           2  8/1/2016
## 5          49.16         NA                           3 6/30/1992
## 6          49.16         NA                           3 6/30/1992
##         AGE MARITAL  RACE GENDER        CITY         STATE         COUNTY
ZIP
## 1  6.730556         white      M Springfield Massachusetts Hampden County
1106
## 2  6.730556         white      M Springfield Massachusetts Hampden County
1106
## 3  7.794444         white      F     Walpole Massachusetts Norfolk County
2081
## 4  7.794444         white      F     Walpole Massachusetts Norfolk County
2081
## 5 31.880556       S white      M    Chicopee Massachusetts Hampden County
1020
```

```
## 6 31.880556       S white      M    Chicopee Massachusetts Hampden County
1020

# To examine 2 factors: Age Group and Gender ====

# Top Age Group  that has Covid ====

patient$AGEGROUP <- cut(patient$AGE, breaks = c(0, 18, 35, 50, Inf),
                            labels = c("0-18", "19-35", "36-50", "51+"))

# See the number of patient by Age Group

summary(patient$AGEGROUP)

##  0-18 19-35 36-50   51+
##  1930  3106  2594  5863

# Plot the histogram for Age Group

library(ggplot2)

ggplot(patient, aes(x = AGEGROUP)) +
  geom_bar(fill = "skyblue", color = "black") +
  labs(title = "Distribution of COVID Patients by Age Group",
       x = "Age Group",
       y = "Patient Count")
```



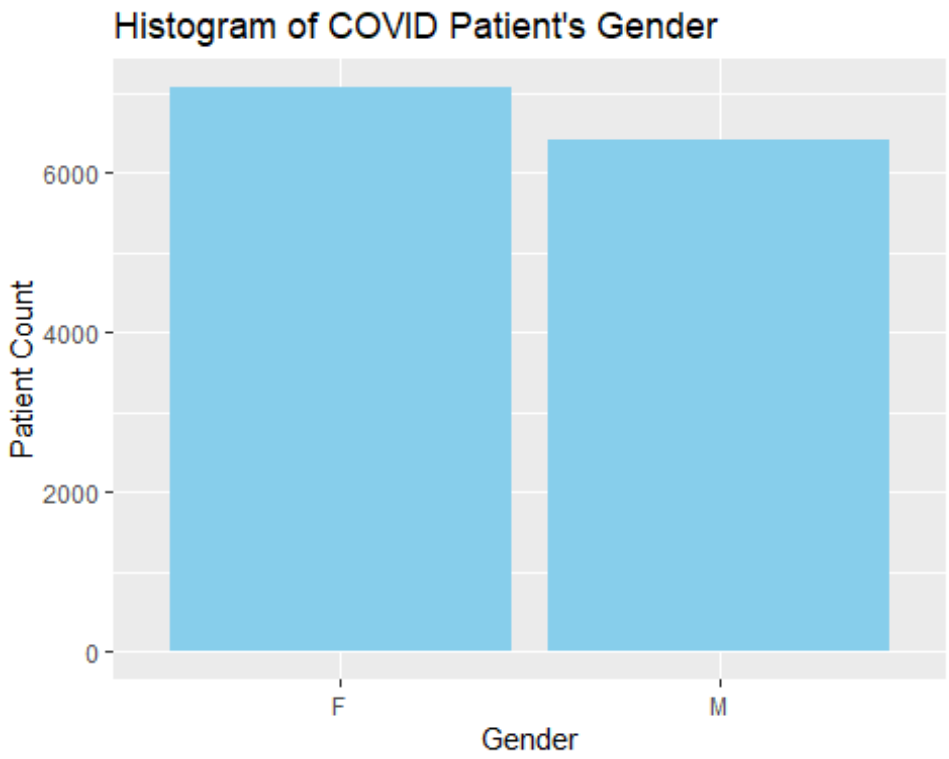
```r
# For the Gender: ====

library(dplyr)

# Count the occurrences of each Gender
gender_counts <- patient %>% count(GENDER)

# Print the result
print(gender_counts)
```

```
##   GENDER    n
## 1      F 7076
## 2      M 6417
```

```r
# See the data type
str(gender_counts)
```

```
## 'data.frame':    2 obs. of  2 variables:
##  $ GENDER: chr  "F" "M"
##  $ n     : int  7076 6417
```

```r
# Load the necessary library
library(ggplot2)

# Create the histogram of Gender
ggplot(gender_counts, aes(x = GENDER, y = n)) +
  geom_bar(stat = "identity", fill = "skyblue") +
  labs(title = "Histogram of COVID Patient's Gender",
       x = "Gender", y = "Patient Count")
```




```
cat("==================================", "\n")
```

```
## ==================================
```

```
cat("Key findings: ", "we explore that", "\n")
```

```
## Key findings:  we explore that
```

```
cat("For the Age Group:", "\n")
```

```
## For the Age Group:
```

```
summary(patient$AGEGROUP)
```

```
##  0-18 19-35 36-50   51+
##  1930  3106  2594  5863
```

```
cat("Most COVID Patients are in the Age Group from 51+ yrs old", "\n")
```

```
## Most COVID Patients are in the Age Group from 51+ yrs old
```

```
cat("Then followed by the Age Group from 19 to 35 yrs old", "\n")
```

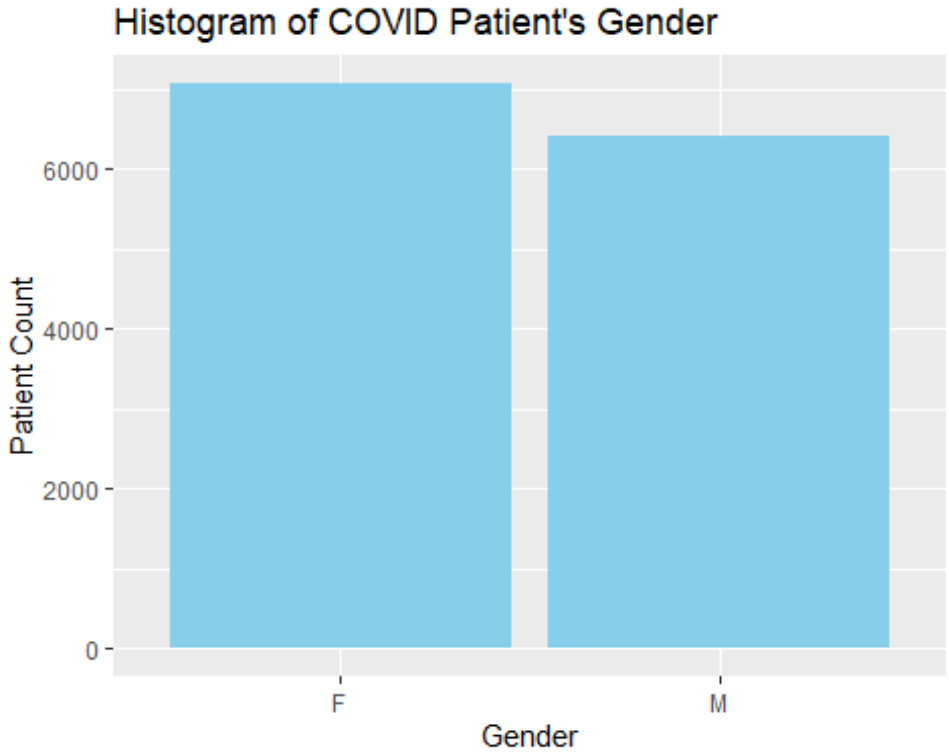
```
## Then followed by the Age Group from 19 to 35 yrs old
```

```
cat("==================================", "\n")
```

```
## ==================================
```

```
cat("For the Gender of COVID Patients:", "\n")
```

```
## For the Gender of COVID Patients:

cat("Look at the Histogram: ", "\n")

## Look at the Histogram:

ggplot(gender_counts, aes(x = GENDER, y = n)) +
  geom_bar(stat = "identity", fill = "skyblue") +
  labs(title = "Histogram of COVID Patient's Gender",
       x = "Gender", y = "Patient Count")
```




```
cat("We see that Female COVID Patients are more than Male COVID Patients",
    "\n")

## We see that Female COVID Patients are more than Male COVID Patients

# ======================
# Task 4 ======
# 4.1. Filter Patients who Died because of COVID

# We will filter the dataset Encounters which description
# is "Death Certificate"

# We already had the data frame enounter_info

# See the data frame
head(encounter_info)
```

```
##   Record_ID                          ENCOUNTER_ID                START
## 1         1 d5ee30a9-362f-429e-a87a-ee38d999b0a5 2019-02-16T01:02:32Z
## 2         2 6a74fdef-2287-44bf-b9e7-18012376faca 2019-08-02T01:02:32Z
## 3         3 8bca6d8a-ab80-4cbf-8abb-46654235f227 2019-10-31T01:02:32Z
## 4         4 821e57ac-9304-46a9-9f9b-83daf60e9e43 2020-01-31T01:02:32Z
## 5         5 681c380b-3c84-4c55-80a6-db3d9ea12fee 2020-03-02T01:02:32Z
## 6         6 9aa748b8-3b44-4e34-b7a8-2e56f2ca3ca2 2019-07-08T08:02:25Z
##                    STOP                              PATIENT_ID ENCOUNTERCLASS
## 1 2019-02-16T01:17:32Z f0f3bc8d-ef38-49ce-a2bd-dfdda982b271     outpatient
## 2 2019-08-02T01:32:32Z f0f3bc8d-ef38-49ce-a2bd-dfdda982b271       wellness
## 3 2019-10-31T01:17:32Z f0f3bc8d-ef38-49ce-a2bd-dfdda982b271     outpatient
## 4 2020-01-31T01:17:32Z f0f3bc8d-ef38-49ce-a2bd-dfdda982b271       wellness
## 5 2020-03-02T01:58:32Z f0f3bc8d-ef38-49ce-a2bd-dfdda982b271     ambulatory
## 6 2019-07-08T08:17:25Z 067318a4-db8f-447f-8b6e-f2f61e9baaa5       wellness
##        CODE                        DESCRIPTION BASE_ENCOUNTER_COST
## 1 185345009             Encounter for symptom              129.16
## 2 410620009      Well child visit (procedure)              129.16
## 3 185345009             Encounter for symptom              129.16
## 4 410620009      Well child visit (procedure)              129.16
## 5 185345009 Encounter for symptom (procedure)              129.16
## 6 410620009      Well child visit (procedure)              129.16
##   TOTAL_CLAIM_COST PAYER_COVERAGE REASONCODE REASONDESCRIPTION
## 1           129.16          69.16   65363002      Otitis media
## 2           129.16         129.16         NA
## 3           129.16          69.16   65363002      Otitis media
## 4           129.16         129.16         NA
## 5           129.16          69.16         NA
## 6           129.16         129.16         NA

# Filter the data
encounter_death <- subset(encounter_info,
                          encounter_info$DESCRIPTION == "Death
Certification")

# See the filtered data frame
head(encounter_death)

##      Record_ID                          ENCOUNTER_ID                START
## 86          94 a966109f-28b5-49ae-8700-02bcc2bb56d6 2016-05-14T13:29:26Z
## 521        693 66d1a1cd-9876-409a-a1cb-3f9836ac8249 2020-03-25T15:51:30Z
## 741        964 7fe393e9-35e3-4329-8c79-14d0a0f7ed7b 2010-04-23T17:07:19Z
## 947       1346 48d25632-6b54-444e-a9ba-553962f2fa04 1999-09-05T13:11:46Z
## 1032      1621 77021032-f641-4b84-9596-383aae341b45 2020-03-31T19:29:43Z
## 1171      1817 8df41367-f686-4681-9ee5-7e39613ea66b 2007-09-30T06:35:54Z
##                     STOP                              PATIENT_ID
ENCOUNTERCLASS
## 86   2016-05-14T13:44:26Z 58cac9ec-4baa-46c1-b919-0ed13572b51d
wellness
## 521  2020-03-25T16:06:30Z c70992c9-ff13-467b-9032-1901506edeef
wellness
```

```
## 741  2010-04-23T17:22:19Z cd7cdbef-ef08-48da-9302-19bf4b2dffa3
wellness
## 947  1999-09-05T13:26:46Z 419c213d-8d35-440c-bf47-a536f95df517
wellness
## 1032 2020-03-31T19:44:43Z edad31f3-5a08-4678-8d31-271a41a2aad5
wellness
## 1171 2007-09-30T06:50:54Z 944884c0-5358-479e-bdf5-c0dd87739ef7
wellness
##           CODE         DESCRIPTION BASE_ENCOUNTER_COST TOTAL_CLAIM_COST
## 86   308646001 Death Certification              129.16           129.16
## 521  308646001 Death Certification              129.16           129.16
## 741  308646001 Death Certification              129.16           129.16
## 947  308646001 Death Certification              129.16           129.16
## 1032 308646001 Death Certification              129.16           129.16
## 1171 308646001 Death Certification              129.16           129.16
##      PAYER_COVERAGE REASONCODE                       REASONDESCRIPTION
## 86                0  230690007                                  Stroke
## 521               0  840539006                               COVID-19
## 741               0  254837009 Malignant neoplasm of breast (disorder)
## 947               0   22298006                   Myocardial Infarction
## 1032              0  840539006                               COVID-19
## 1171              0  230690007                                  Stroke
```

```
# See the Covid condition
head(condition_covid)
```

```
##    Record_ID     START      STOP                              PATIENT_ID
## 4          4  3/1/2020  3/1/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 5          5  3/1/2020 3/30/2020 f0f3bc8d-ef38-49ce-a2bd-dfdda982b271
## 11        11 3/13/2020 3/13/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 12        12 3/13/2020 4/14/2020 067318a4-db8f-447f-8b6e-f2f61e9baaa5
## 23        23 3/11/2020 3/11/2020 ae9efba3-ddc4-43f9-a781-f72019388548
## 24        24 3/11/2020 4/15/2020 ae9efba3-ddc4-43f9-a781-f72019388548
##                            ENCOUNTER_ID      CODE        DESCRIPTION
## 4  681c380b-3c84-4c55-80a6-db3d9ea12fee 840544004 Suspected COVID-19
## 5  681c380b-3c84-4c55-80a6-db3d9ea12fee 840539006           COVID-19
## 11 1ea74a77-3ad3-4948-a9cc-3084462035d6 840544004 Suspected COVID-19
## 12 1ea74a77-3ad3-4948-a9cc-3084462035d6 840539006           COVID-19
## 23 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840544004 Suspected COVID-19
## 24 eeab7c2d-71ba-4e04-af16-87a01dce7d54 840539006           COVID-19
```

```
# Join the 2 data frames: encounter_recover and condition_covid

merged_data_3 <- merge(encounter_death, condition_covid,
                           by = "ENCOUNTER_ID", all = TRUE)

head(merged_data_3)
```

```
##                            ENCOUNTER_ID Record_ID.x              START.x
## 1 00048220-08df-43fa-97a0-045db65d789f          NA                 <NA>
## 2 00048220-08df-43fa-97a0-045db65d789f          NA                 <NA>
```

```
## 3 00171db0-2f5b-449e-947b-862440182c68          NA                  <NA>
## 4 00171db0-2f5b-449e-947b-862440182c68          NA                  <NA>
## 5 001a4cda-4939-49cc-9627-38fa6485a85a       95360 1977-09-14T03:37:33Z
## 6 001e5792-8b36-4291-99d8-23404c9226f0          NA                  <NA>
##                 STOP.x                           PATIENT_ID.x ENCOUNTERCLASS
## 1                 <NA>                                   <NA>           <NA>
## 2                 <NA>                                   <NA>           <NA>
## 3                 <NA>                                   <NA>           <NA>
## 4                 <NA>                                   <NA>           <NA>
## 5 1977-09-14T03:52:33Z c8110c1e-34fd-4c56-88ce-4b3dc0320fdc       wellness
## 6                 <NA>                                   <NA>           <NA>
##      CODE.x       DESCRIPTION.x BASE_ENCOUNTER_COST TOTAL_CLAIM_COST
## 1        NA                <NA>                  NA               NA
## 2        NA                <NA>                  NA               NA
## 3        NA                <NA>                  NA               NA
## 4        NA                <NA>                  NA               NA
## 5 308646001 Death Certification              129.16           129.16
## 6        NA                <NA>                  NA               NA
##   PAYER_COVERAGE REASONCODE                      REASONDESCRIPTION
Record_ID.y
## 1             NA         NA                                   <NA>
11260
## 2             NA         NA                                   <NA>
11261
## 3             NA         NA                                   <NA>
1058
## 4             NA         NA                                   <NA>
1059
## 5              0   94260004 Secondary malignant neoplasm of colon
NA
## 6             NA         NA                                   <NA>
24321
##    START.y    STOP.y                          PATIENT_ID.y    CODE.y
## 1 3/6/2020  3/6/2020 5b564764-d10b-4984-b3a6-e6c2fe56ae36 840544004
## 2 3/6/2020 3/22/2020 5b564764-d10b-4984-b3a6-e6c2fe56ae36 840539006
## 3 3/3/2020  3/4/2020 059b0e22-b52b-408d-b8b5-cdeb6ad9ce76 840544004
## 4 3/4/2020  4/4/2020 059b0e22-b52b-408d-b8b5-cdeb6ad9ce76 840539006
## 5     <NA>      <NA>                                <NA>        NA
## 6 3/3/2020  3/3/2020 bfec39f5-d29f-4b0c-b4f7-314142563ba4 840544004
##        DESCRIPTION.y
## 1 Suspected COVID-19
## 2           COVID-19
## 3 Suspected COVID-19
## 4           COVID-19
## 5               <NA>
## 6 Suspected COVID-19

# Join with Patients data frame
# We need to have one Patient_id in the merged_data_3
# We need to:
```

```r
# 1. Delete the column Patient_id.x

merged_data_3$PATIENT_ID.x <- NULL

# See the dataset
head(merged_data_3)
```

```
##                            ENCOUNTER_ID Record_ID.x              START.x
## 1 00048220-08df-43fa-97a0-045db65d789f          NA                 <NA>
## 2 00048220-08df-43fa-97a0-045db65d789f          NA                 <NA>
## 3 00171db0-2f5b-449e-947b-862440182c68          NA                 <NA>
## 4 00171db0-2f5b-449e-947b-862440182c68          NA                 <NA>
## 5 001a4cda-4939-49cc-9627-38fa6485a85a       95360 1977-09-14T03:37:33Z
## 6 001e5792-8b36-4291-99d8-23404c9226f0          NA                 <NA>
##                  STOP.x ENCOUNTERCLASS    CODE.x       DESCRIPTION.x
## 1                  <NA>           <NA>        NA                <NA>
## 2                  <NA>           <NA>        NA                <NA>
## 3                  <NA>           <NA>        NA                <NA>
## 4                  <NA>           <NA>        NA                <NA>
## 5 1977-09-14T03:52:33Z       wellness 308646001 Death Certification
## 6                  <NA>           <NA>        NA                <NA>
##   BASE_ENCOUNTER_COST TOTAL_CLAIM_COST PAYER_COVERAGE REASONCODE
## 1                  NA                NA             NA         NA
## 2                  NA                NA             NA         NA
## 3                  NA                NA             NA         NA
## 4                  NA                NA             NA         NA
## 5              129.16            129.16              0   94260004
## 6                  NA                NA             NA         NA
##                      REASONDESCRIPTION Record_ID.y  START.y    STOP.y
## 1                                 <NA>       11260 3/6/2020  3/6/2020
## 2                                 <NA>       11261 3/6/2020 3/22/2020
## 3                                 <NA>        1058 3/3/2020  3/4/2020
## 4                                 <NA>        1059 3/4/2020  4/4/2020
## 5 Secondary malignant neoplasm of colon          NA     <NA>       <NA>
## 6                                 <NA>       24321 3/3/2020  3/3/2020
##                           PATIENT_ID.y    CODE.y      DESCRIPTION.y
## 1 5b564764-d10b-4984-b3a6-e6c2fe56ae36 840544004 Suspected COVID-19
## 2 5b564764-d10b-4984-b3a6-e6c2fe56ae36 840539006           COVID-19
## 3 059b0e22-b52b-408d-b8b5-cdeb6ad9ce76 840544004 Suspected COVID-19
## 4 059b0e22-b52b-408d-b8b5-cdeb6ad9ce76 840539006           COVID-19
## 5                                 <NA>        NA               <NA>
## 6 bfec39f5-d29f-4b0c-b4f7-314142563ba4 840544004 Suspected COVID-19
```

```r
# 2. Rename the column: Patient_id.y to Patient_id

colnames(merged_data_3)[colnames(merged_data_3) == "PATIENT_ID.y"] <-
"PATIENT_ID"

head(merged_data_3)
```

```
##                            ENCOUNTER_ID Record_ID.x               START.x
## 1 00048220-08df-43fa-97a0-045db65d789f          NA                  <NA>
## 2 00048220-08df-43fa-97a0-045db65d789f          NA                  <NA>
## 3 00171db0-2f5b-449e-947b-862440182c68          NA                  <NA>
## 4 00171db0-2f5b-449e-947b-862440182c68          NA                  <NA>
## 5 001a4cda-4939-49cc-9627-38fa6485a85a       95360 1977-09-14T03:37:33Z
## 6 001e5792-8b36-4291-99d8-23404c9226f0          NA                  <NA>
##                  STOP.x ENCOUNTERCLASS    CODE.x       DESCRIPTION.x
## 1                  <NA>           <NA>        NA                <NA>
## 2                  <NA>           <NA>        NA                <NA>
## 3                  <NA>           <NA>        NA                <NA>
## 4                  <NA>           <NA>        NA                <NA>
## 5 1977-09-14T03:52:33Z       wellness 308646001 Death Certification
## 6                  <NA>           <NA>        NA                <NA>
##   BASE_ENCOUNTER_COST TOTAL_CLAIM_COST PAYER_COVERAGE REASONCODE
## 1                  NA                NA             NA         NA
## 2                  NA                NA             NA         NA
## 3                  NA                NA             NA         NA
## 4                  NA                NA             NA         NA
## 5              129.16            129.16              0   94260004
## 6                  NA                NA             NA         NA
##                      REASONDESCRIPTION Record_ID.y  START.y    STOP.y
## 1                                 <NA>       11260 3/6/2020  3/6/2020
## 2                                 <NA>       11261 3/6/2020 3/22/2020
## 3                                 <NA>        1058 3/3/2020  3/4/2020
## 4                                 <NA>        1059 3/4/2020  4/4/2020
## 5 Secondary malignant neoplasm of colon          NA     <NA>      <NA>
## 6                                 <NA>       24321 3/3/2020  3/3/2020
##                             PATIENT_ID    CODE.y      DESCRIPTION.y
## 1 5b564764-d10b-4984-b3a6-e6c2fe56ae36 840544004 Suspected COVID-19
## 2 5b564764-d10b-4984-b3a6-e6c2fe56ae36 840539006           COVID-19
## 3 059b0e22-b52b-408d-b8b5-cdeb6ad9ce76 840544004 Suspected COVID-19
## 4 059b0e22-b52b-408d-b8b5-cdeb6ad9ce76 840539006           COVID-19
## 5                                 <NA>        NA               <NA>
## 6 bfec39f5-d29f-4b0c-b4f7-314142563ba4 840544004 Suspected COVID-19
```

```
# Count the death patients,
# use 'dplyr' package to call the count() function

library(dplyr)

# See the number of dead people that had Death Certificate
death_counts <- merged_data_3 %>% count(DESCRIPTION.x)

print(death_counts)
```

```
##         DESCRIPTION.x     n
## 1 Death Certification  1291
## 2                <NA> 13511
```

```r
# See the number of Covid Patients:
covid_counts <- merged_data_3 %>% count(DESCRIPTION.y)

print(covid_counts)
```

```
##        DESCRIPTION.y    n
## 1           COVID-19 6648
## 2 Suspected COVID-19 6863
## 3               <NA> 1291
```

```r
# We see that dead patients are not died because of COVID

cat("Key Finding:", "\n")
```

```
## Key Finding:
```

```r
cat("Base on this below:", "\n")
```

```
## Base on this below:
```

```r
print(covid_counts)
```

```
##        DESCRIPTION.y    n
## 1           COVID-19 6648
## 2 Suspected COVID-19 6863
## 3               <NA> 1291
```

```r
cat("We see that dead patients ARE NOT died because of COVID", "\n")
```

```
## We see that dead patients ARE NOT died because of COVID
```

```r
# In the 2 datasets: Encounters and Conditions
# There is no info about "Recover" for COVID Patients
# So we cannot analyze more

# ==== END =====
```