

Plasma

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```
library(tidyverse)
library(lubridate)
library(survival)

plasma_simple <- read_csv('./plasma_simple.csv')

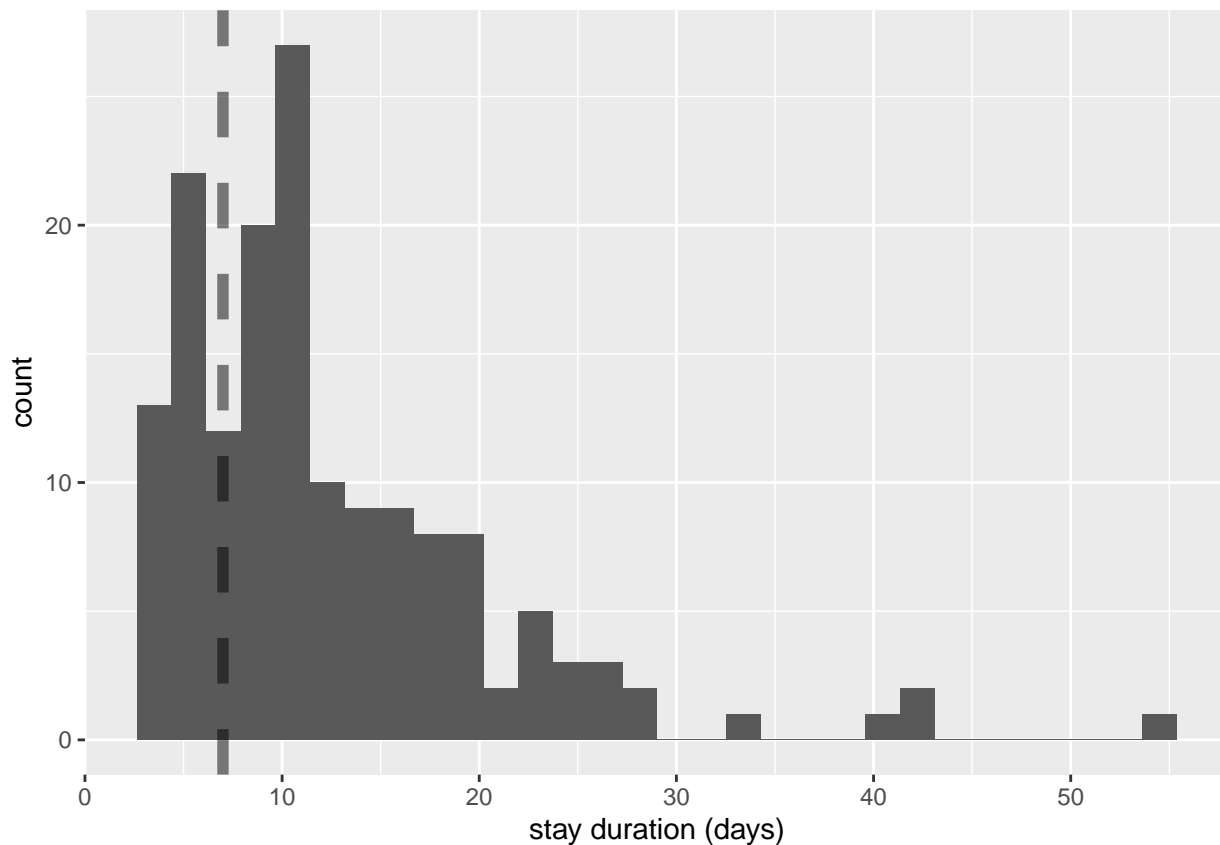
##
## -- Column specification -----
## cols(
##   .default = col_double(),
##   hospital = col_character(),
##   name = col_character(),
##   sex = col_character(),
##   vital_st = col_character(),
##   hta = col_character(),
##   dm = col_character(),
##   obesity = col_character(),
##   overweight = col_character()
## )
## i Use `spec()` for the full column specifications.
```

Hospital Stays:

- 49 patients had stays of 7 or less days.
- Stays lasted 12.4 days in average (sd 8.18).

```
plasma_simple %>%
  ggplot() +
  geom_histogram(aes(x = days_hospital)) +
  geom_vline(xintercept = 7, linetype = 2, size = 2, alpha = 0.5) +
  labs(x = 'stay duration (days)')

## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



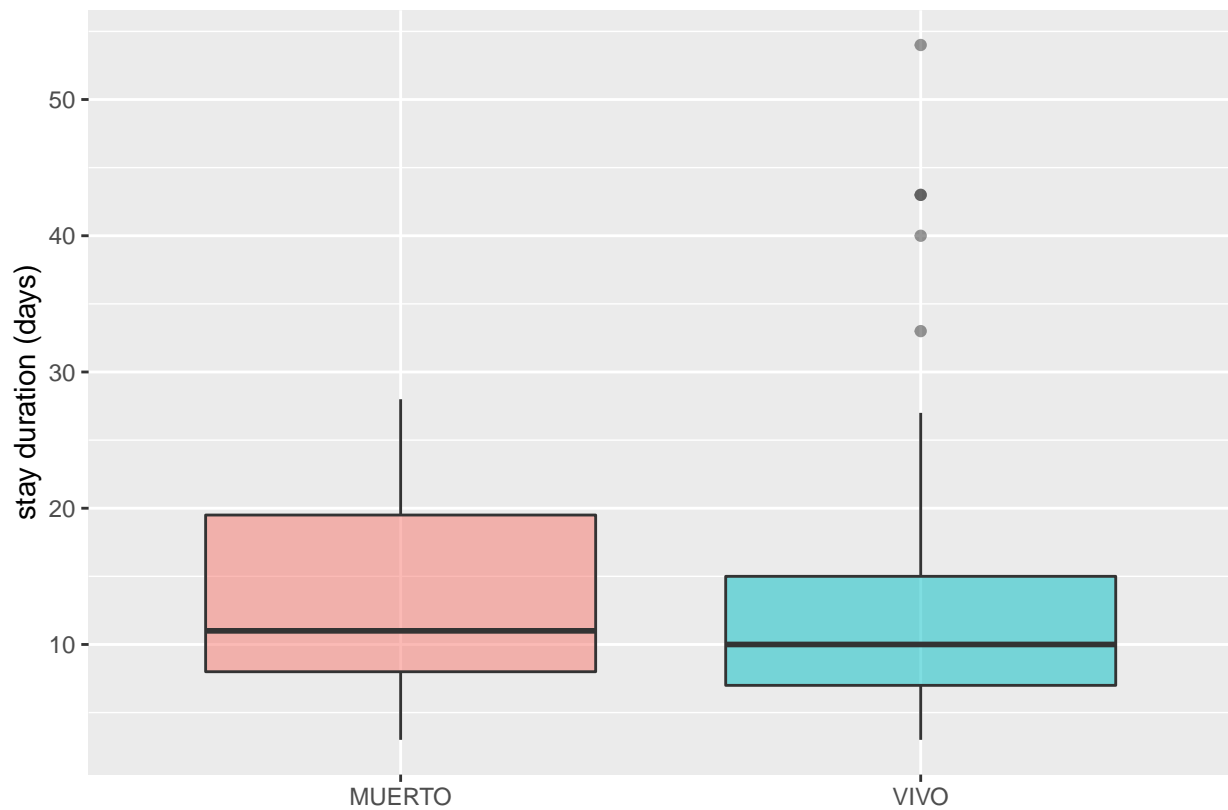
```
plasma_simple %>%
  filter(days_hospital <= 7) %>%
  count()
```

```
## # A tibble: 1 x 1
##       n
##   <int>
## 1     47
```

```
plasma_simple %>%
  summarise(mean(days_hospital), sd(days_hospital))
```

```
## # A tibble: 1 x 2
##   `mean(days_hospital)` `sd(days_hospital)`
##         <dbl>         <dbl>
## 1         12.4         8.19
```

```
plasma_simple %>%
  ggplot() +
  geom_boxplot(aes(x = vital_st, y = days_hospital, fill = vital_st), alpha = 0.5) +
  theme(legend.position = "None") +
  labs(x = '', y = 'stay duration (days)')
```

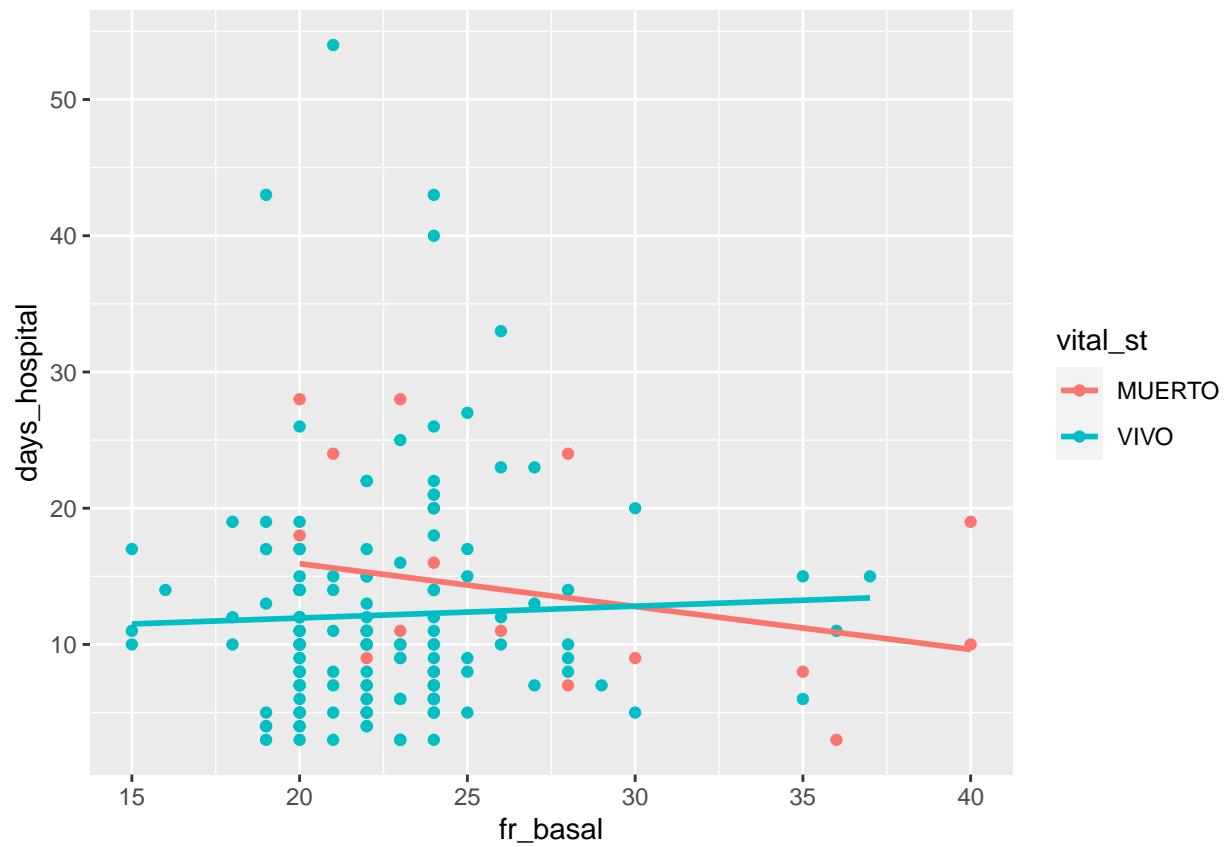


Predict hospital stay duration from saturation or respiratory frequency?

No.

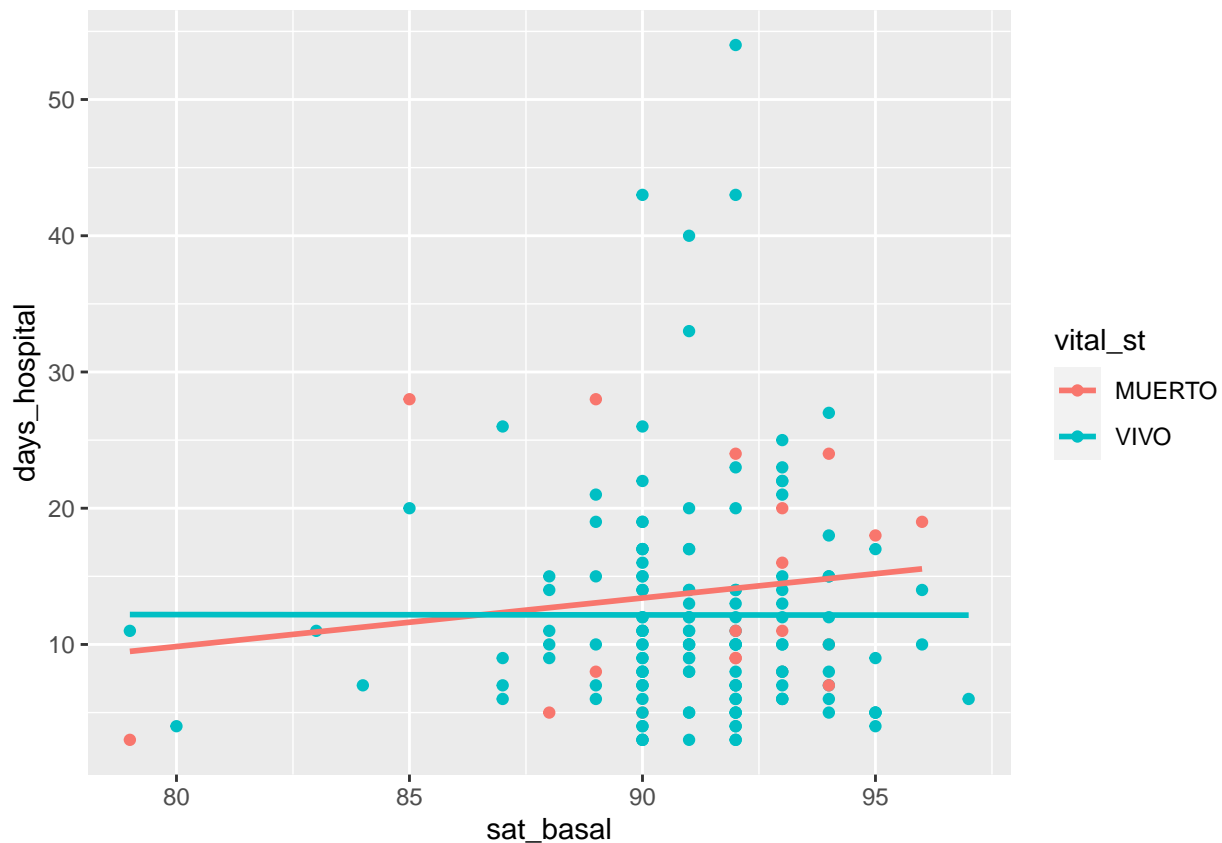
```
plasma_simple %>%  
  ggplot(aes(x = fr_basal, y = days_hospital, color = vital_st)) +  
  geom_point() +  
  geom_smooth(method = lm, se = FALSE)
```

```
## `geom_smooth()` using formula 'y ~ x'
```



```
plasma_simple %>%
  ggplot(aes(x = sat_basal, y = days_hospital, color = vital_st)) +
  geom_point() +
  geom_smooth(method = lm, se = FALSE)
```

```
## `geom_smooth()` using formula 'y ~ x'
```



First models:

- Differences were computed by (last measurement - basal).
- All models controll for age, sex, death or alive, hospital, number of days from: symptoms to hospitalization and symptoms to treatment.
- Treatment has a positive effect on saturation difference and respiratory frequency difference.

```
sat_mod <- lm(sat_diff ~ age + sex + group + vital_st + hospital +
  nd_sint_tto + nd_sint_ing, data = plasma_simple)
```

```
sat_mod %>%
  summary()
```

```
##
## Call:
## lm(formula = sat_diff ~ age + sex + group + vital_st + hospital +
##     nd_sint_tto + nd_sint_ing, data = plasma_simple)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -23.3454  -2.2764  -0.1697   1.5997  14.5166
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -4.113478    2.620488  -1.570   0.11870
## age          -0.073926    0.026989  -2.739   0.00695 **
```

```
## sexMASCULINO -0.219291 0.749964 -0.292 0.77041
## group 0.006302 0.702030 0.009 0.99285
## vital_stVIVO 5.967895 1.310061 4.555 1.12e-05 ***
## hospitalHPAS -0.217539 1.180252 -0.184 0.85403
## hospitalIESS 1.816690 1.100843 1.650 0.10110
## nd_sint_tto 0.106569 0.074420 1.432 0.15434
## nd_sint_ing 0.003670 0.015091 0.243 0.80822
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4.11 on 142 degrees of freedom
## (7 observations deleted due to missingness)
## Multiple R-squared: 0.2361, Adjusted R-squared: 0.1931
## F-statistic: 5.486 on 8 and 142 DF, p-value: 4.853e-06

fr_mod <- lm(fr_diff ~ age + sex + group + vital_st + hospital +
  nd_sint_tto + nd_sint_ing, data = plasma_simple)

fr_mod %>%
  summary()

##
## Call:
## lm(formula = fr_diff ~ age + sex + group + vital_st + hospital +
##     nd_sint_tto + nd_sint_ing, data = plasma_simple)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -16.6416  -2.2233   0.3685   2.1403  22.4224
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -1.097761    3.195110  -0.344  0.73167
## age           0.002846    0.032907   0.086  0.93121
## sexMASCULINO  0.251937    0.914417   0.276  0.78332
## group        -0.979610    0.855971  -1.144  0.25437
## vital_stVIVO -7.292668    1.597332  -4.566 1.07e-05 ***
## hospitalHPAS  1.986333    1.439058   1.380  0.16966
## hospitalIESS  2.985088    1.342236   2.224  0.02773 *
## nd_sint_tto   0.282053    0.090738   3.108  0.00227 **
## nd_sint_ing   0.018287    0.018400   0.994  0.32198
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.011 on 142 degrees of freedom
## (7 observations deleted due to missingness)
## Multiple R-squared: 0.2443, Adjusted R-squared: 0.2017
## F-statistic: 5.738 on 8 and 142 DF, p-value: 2.486e-06
```

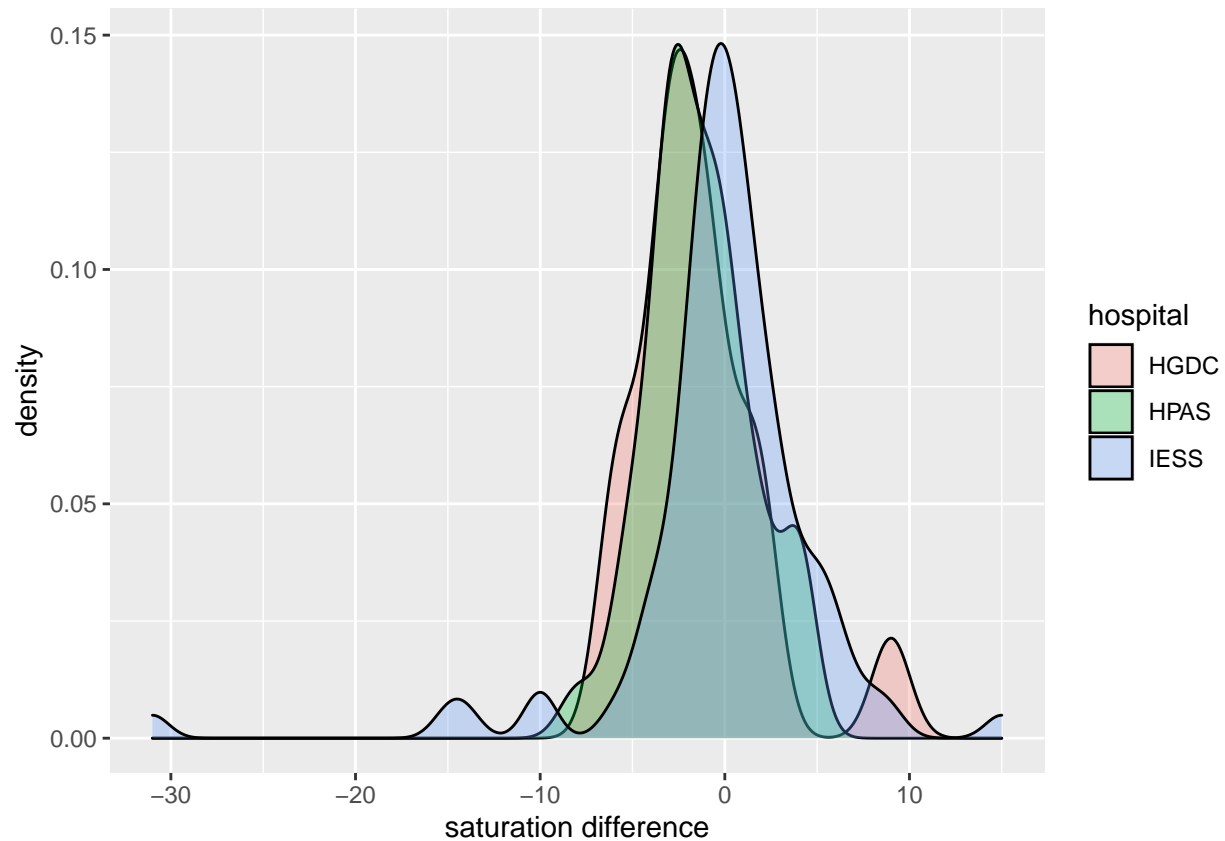
Distributions per Hospital

```
plasma_simple %>%
  ggplot() +
  geom_density(aes(sat_diff, fill = hospital), position = 'dodge', alpha = 0.3) +
```

```
labs(x = 'saturation difference')
```

```
## Warning: Removed 7 rows containing non-finite values (stat_density).
```

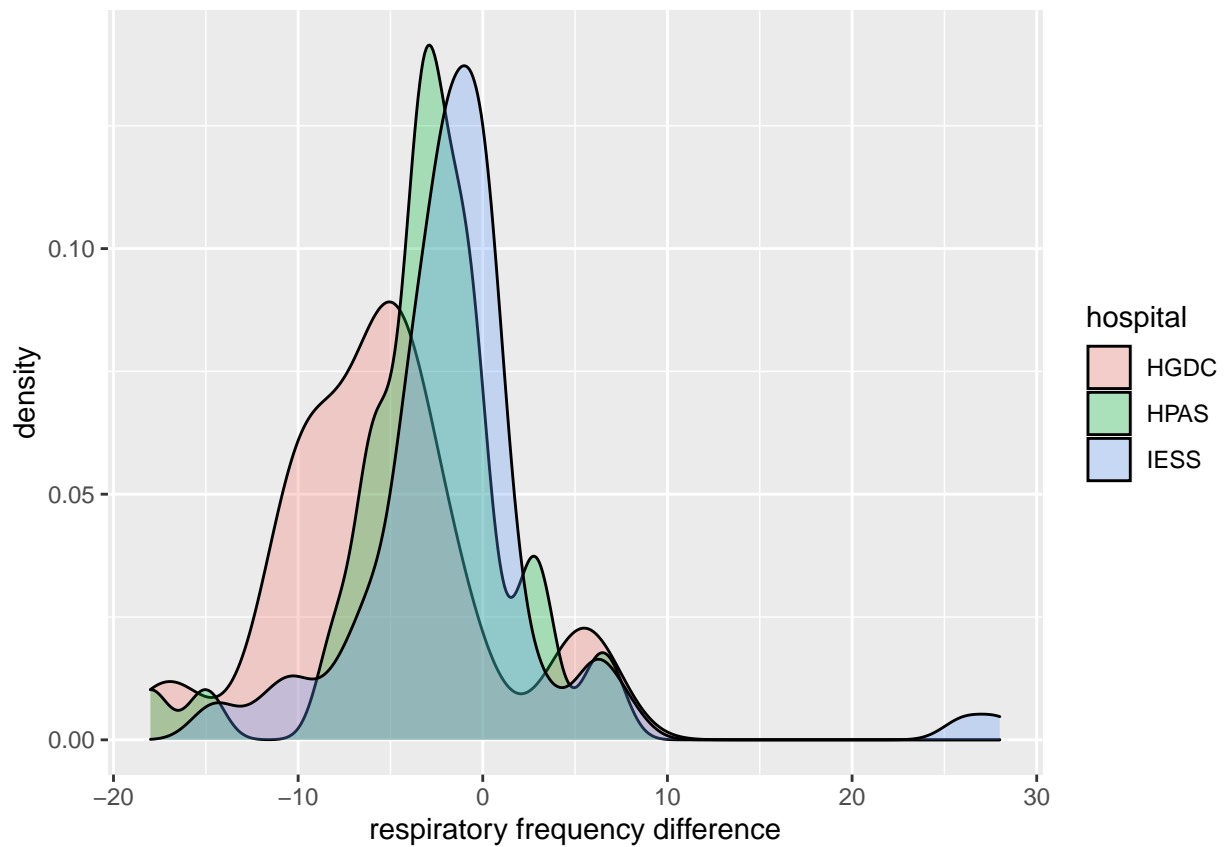
```
## Warning: Width not defined. Set with `position_dodge(width = ?)`
```



```
plasma_simple %>%  
  ggplot() +  
  geom_density(aes(fr_diff, fill = hospital), position = 'dodge', alpha = 0.3) +  
  labs(x = 'respiratory frequency difference')
```

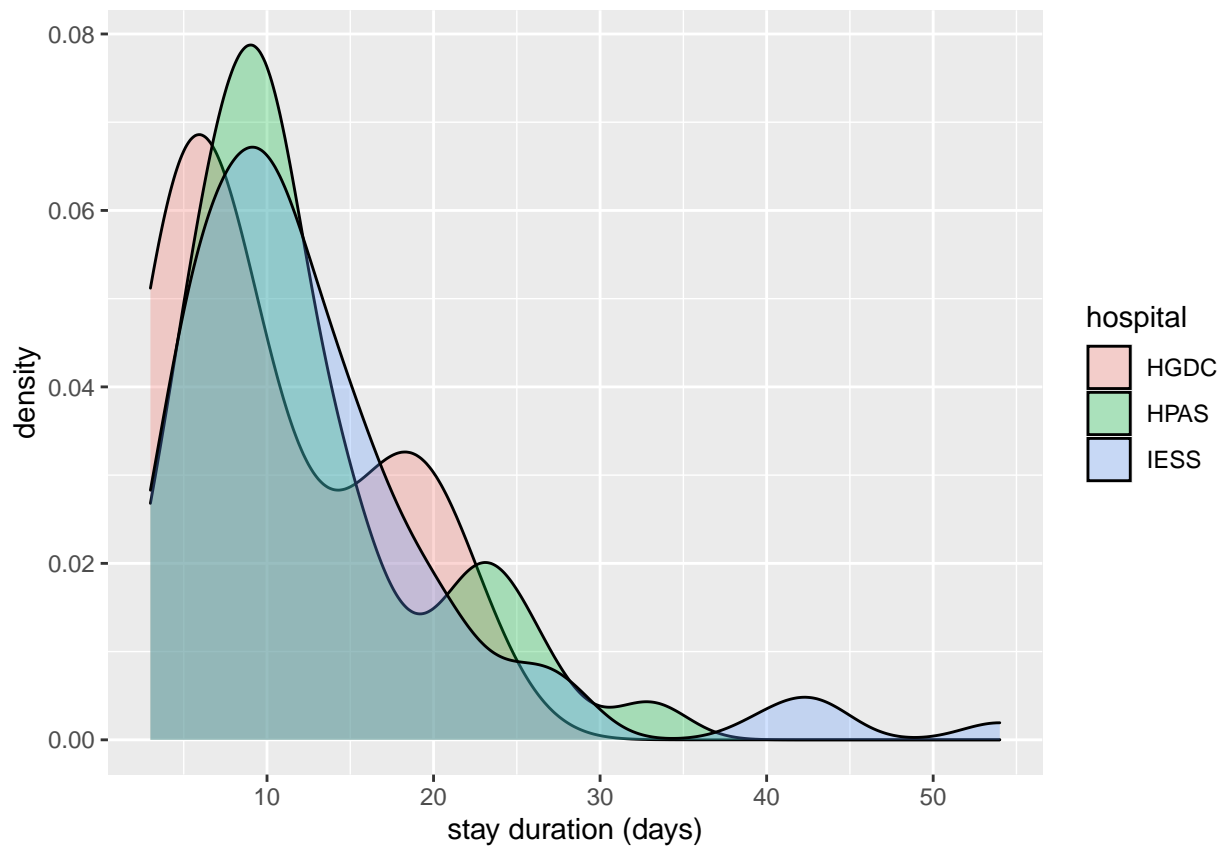
```
## Warning: Removed 7 rows containing non-finite values (stat_density).
```

```
## Warning: Width not defined. Set with `position_dodge(width = ?)`
```



```
plasma_simple %>%
  ggplot() +
  geom_density(aes(days_hospital, fill = hospital), position = 'dodge', alpha = 0.3) +
  labs(x = 'stay duration (days)')
```

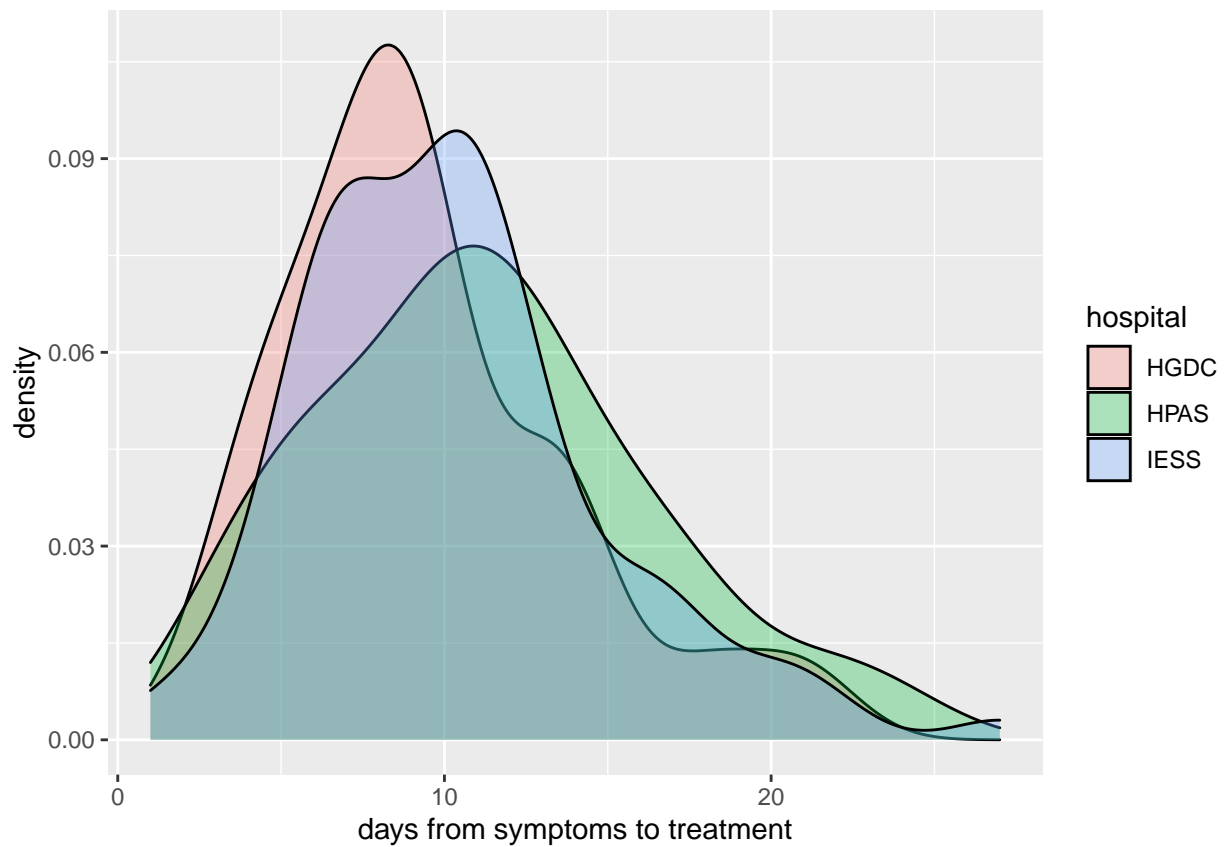
```
## Warning: Width not defined. Set with `position_dodge(width = ?)`
```

Treatment per Hospital

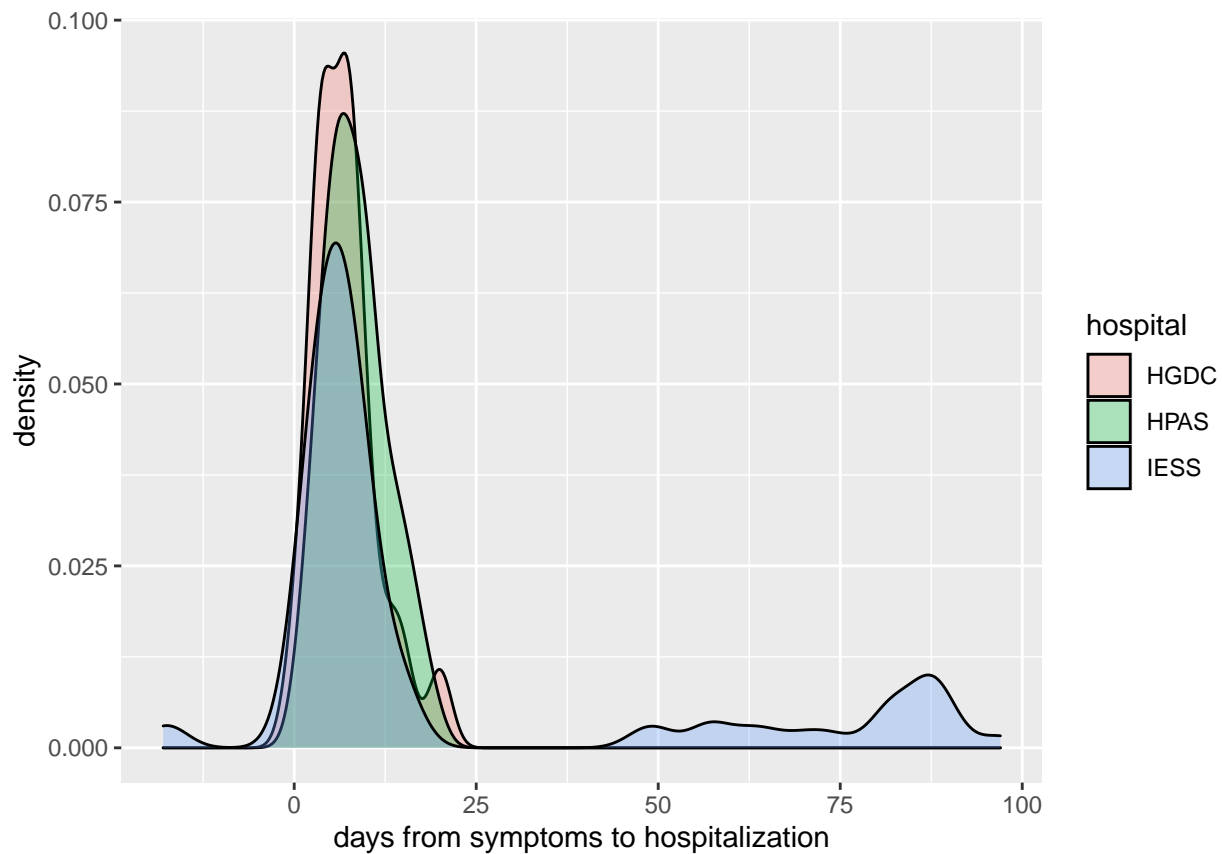
```
plasma_simple %>%
  ggplot() +
  geom_density(aes(nd_sint_tto, fill = hospital), position = 'dodge', alpha = 0.3) +
  labs(x = 'days from symptoms to treatment')
```

```
## Warning: Width not defined. Set with `position_dodge(width = ?)`
```



```
plasma_simple %>%
  ggplot() +
  geom_density(aes(nd_sint_ing, fill = hospital), position = 'dodge', alpha = 0.3) +
  labs(x = 'days from symptoms to hospitalization')
```

```
## Warning: Width not defined. Set with `position_dodge(width = ?)`
```



Missing data.

```
plasma_simple %>%
  filter(is.na(sat_final)) %>%
  count()
```

```
## # A tibble: 1 x 1
##       n
##   <int>
## 1     7
```

missing data:

```
plasma_simple %>%
  group_by(hospital) %>%
  mutate(n_hosp = n()) %>%
  filter(is.na(sat_final)) %>%
  group_by(hospital, group) %>%
  summarise(n_na = n(), n_hosp = max(n_hosp)) %>%
  mutate(percent = 100*(n_na / n_hosp)) %>%
  select(hospital, group, percent) %>%
  pivot_wider(names_from = group, values_from = percent)
```

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

```
## # A tibble: 2 x 3
## # Groups:   hospital [2]
##   hospital `0` `1`
```

```
##    <chr>      <dbl> <dbl>
## 1 HGDC       8.70  13.0
## 2 HPAS       4.65   NA
```

Hospitalization Days and Probability of Survival

```
glm(days_hospital ~ age + sex + group + vital_st + hospital +
     nd_sint_tto + nd_sint_ing, data=plasma_simple,
     family = poisson(link='log')) %>%
  summary()
```

```
##
## Call:
## glm(formula = days_hospital ~ age + sex + group + vital_st +
##      hospital + nd_sint_tto + nd_sint_ing, family = poisson(link = "log"),
##      data = plasma_simple)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -3.5011  -1.5109  -0.5000   0.7748   8.5560
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)  1.690795   0.161527  10.468 < 2e-16 ***
## age          0.008894   0.001849   4.810 1.51e-06 ***
## sexMASCULINO -0.057516   0.051802  -1.110  0.2669
## group        -0.077812   0.047261  -1.646  0.0997 .
## vital_stVIVO -0.110625   0.070596  -1.567  0.1171
## hospitalHPAS  0.150331   0.079593   1.889  0.0589 .
## hospitalIESS  0.302426   0.072200   4.189 2.81e-05 ***
## nd_sint_tto   0.034565   0.004703   7.350 1.99e-13 ***
## nd_sint_ing   -0.007332   0.001214  -6.042 1.53e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##      Null deviance: 711.58  on 157  degrees of freedom
## Residual deviance: 588.23  on 149  degrees of freedom
## AIC: 1268.4
##
## Number of Fisher Scoring iterations: 5
```

```
coxph(Surv(days_hospital, status) ~ age + sex + group + hospital +
      nd_sint_tto + nd_sint_ing + hta + obesity + dm,
      data=plasma_simple) %>%
  summary()
```

```
## Call:
## coxph(formula = Surv(days_hospital, status) ~ age + sex + group +
##      hospital + nd_sint_tto + nd_sint_ing + hta + obesity + dm,
##      data = plasma_simple)
##
##      n= 127, number of events= 15
##      (31 observations deleted due to missingness)
```

```
##
##               coef exp(coef) se(coef)      z Pr(>|z|)
## age           0.11154   1.11800  0.03746  2.977  0.00291 **
## sexMASCULINO  2.94985  19.10306  1.21499  2.428  0.01519 *
## group         0.61220   1.84449  0.67647  0.905  0.36547
## hospitalHPAS -1.42113   0.24144  0.87274 -1.628  0.10345
## hospitalIESS -2.45772   0.08563  1.07514 -2.286  0.02226 *
## nd_sint_tto  -0.11253   0.89357  0.06816 -1.651  0.09873 .
## nd_sint_ing   0.04525   1.04628  0.01702  2.658  0.00786 **
## htaSI         -0.61279   0.54184  0.88428 -0.693  0.48832
## obesitySI     -0.14497   0.86505  0.94739 -0.153  0.87838
## dmSI          0.49126   1.63438  0.81802  0.601  0.54814
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##               exp(coef) exp(-coef) lower .95 upper .95
## age              1.11800    0.89445    1.03885    1.2032
## sexMASCULINO     19.10306    0.05235    1.76563   206.6833
## group            1.84449    0.54216    0.48985    6.9453
## hospitalHPAS     0.24144    4.14182    0.04364    1.3356
## hospitalIESS     0.08563   11.67815    0.01041    0.7043
## nd_sint_tto      0.89357    1.11911    0.78183    1.0213
## nd_sint_ing      1.04628    0.95576    1.01195    1.0818
## htaSI            0.54184    1.84557    0.09576    3.0660
## obesitySI        0.86505    1.15601    0.13509    5.5394
## dmSI            1.63438    0.61185    0.32889    8.1218
##
## Concordance= 0.893 (se = 0.033 )
## Likelihood ratio test= 27.81 on 10 df,  p=0.002
## Wald test              = 17.76 on 10 df,  p=0.06
## Score (logrank) test = 25.27 on 10 df,  p=0.005
coxph(Surv(days_hospital, status) ~ group,
      data=plasma_simple) %>%
  summary()

## Call:
## coxph(formula = Surv(days_hospital, status) ~ group, data = plasma_simple)
##
## n= 158, number of events= 19
##
##               coef exp(coef) se(coef)      z Pr(>|z|)
## group 0.003121  1.003126  0.477064  0.007  0.995
##
##               exp(coef) exp(-coef) lower .95 upper .95
## group      1.003      0.9969    0.3938    2.555
##
## Concordance= 0.57 (se = 0.07 )
## Likelihood ratio test= 0 on 1 df,  p=1
## Wald test              = 0 on 1 df,  p=1
## Score (logrank) test = 0 on 1 df,  p=1
survfit(Surv(days_hospital, status) ~ group, data=plasma_simple) %>%
  broom::tidy() %>%
  ggplot(aes(time, estimate, color = strata)) +
```

```
geom_line() +  
geom_ribbon(aes(ymin=conf.low, ymax=conf.high), alpha=0.2)
```

