v4 : hospital == 1, -vomito, -desc_resp

José Elvano Moraes

4/14/2021

$SRAG^{causal\ modeling}$ & $COVID-19_{simulations}$

Dataset = https://dados.gov.br/dataset/bd-srag-2021

Banco de Dados de Síndrome Respiratória Aguda Grave - **incluindo dados da COVID-19**

Vigilância de Síndrome Respiratória Aguda Grave (SRAG) O Ministério da Saúde (MS), por meio da Secretaria de Vigilância em Saúde (SVS), desenvolve a vigilância da Síndrome Respiratória Aguda Grave (SRAG) no Brasil, desde a pandemia de Influenza A(H1N1)pdm09 em 2009. A partir disso, esta vigilância foi implantada na rede de Influenza e outros vírus respiratórios, que anteriormente atuava apenas com a vigilância sentinela de Síndrome Gripal (SG).

Recentemente (2020), a vigilância da COVID-19, a infecção humana causada pelo novo Coronavírus, foi incorporada na rede de vigilância da Influenza e outros vírus respiratórios.

Esta página tem como finalidade disponibilizar o legado dos bancos de dados (BD) epidemiológicos de SRAG, da rede de vigilância da Influenza e outros vírus respiratórios, desde o início da sua implantação (2009) até os dias atuais (2021), com a incorporação da vigilância da COVID-19. Atualmente, o sistema oficial para o registro dos casos e óbitos de SRAG é o Sistema de Informação da Vigilância Epidemiológica da Gripe (SIVEP-Gripe).

No Guia de Vigilância Epidemiológica Emergência de Saúde Pública de Importância Nacional pela Doença pelo Coronavírus 2019 estão disponíveis informações sobre definições de casos, critérios de confirmação e encerramento dos casos, dentre outros.

Ressaltamos que os dados da vigilância de SRAG no Brasil disponibilizados nesta página, estão sujeitos a alterações decorrentes da investigação pelas equipes de vigilância epidemiológica que desenvolvem o serviço nas três esferas de gestão.

As bases de dados de SRAG disponibilizadas neste portal passam por tratamento que envolve a anonimização, em cumprimento a legislação.

Os dados de 2021 são disponibilizados semanalmente, às quartas-feiras, podendo, excepcionalmente, a atualização ocorrer em outro dia

Para mais informações, acessar:

Gripe/Influenza - https://saude.gov.br/saude-de-a-z/gripe

COVID-19 - https://coronavirus.saude.gov.br/

Guia Nacional de Vigilância da COVID-19 - https://portalarquivos.saude.gov.br/images/af_gvs_coronavirus_6ago20_ajustes-finais-2.pdf

---

Nota

Este documento é ainda tão somente experimentação e análise exploratória em fase absolutamente incipiente. Por isso a falta de estrutura, gráficos não explicativos, *typos*, etc

Inferência da estrutura da Rede Causal usando o Algoritmo mmhc

---

```
suppressPackageStartupMessages(expr = library(tidyverse))
suppressPackageStartupMessages(expr = library(bnlearn))
suppressPackageStartupMessages(expr = library(bnstruct))
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suppressPackageStartupMessages(expr = library(Rgraphviz))
suppressPackageStartupMessages(expr = library(Rmpfr))
```

Dados completos

```
## [1] "data.frame"
```

```
## Rows: 451,339
## Columns: 17
## $ X1         <dbl> 1, 2, 3, 4, 5, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 20,~
## $ FEBRE      <fct> 2, 1, 1, 1, 2, 2, 1, 2, 2, 1, 1, NA, 1, 9, 1, 1, 2, 2, 1, 2~
## $ TOSSE      <fct> 1, 1, 1, 1, 2, 1, 1, 2, 2, 2, NA, 1, 1, 9, 1, 1, 2, 2, 1, 1~
## $ GARGANTA   <fct> 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, NA, NA, NA, 9, NA, 2, 2, 2, N~
## $ DISPNEIA   <fct> 1, 1, 2, 2, 1, 1, 1, 1, 2, 2, NA, NA, 1, 9, NA, 2, 1, 2, 1,~
## $ SATURACAO  <fct> 1, 2, 2, 1, 1, 1, 1, 1, 2, 2, NA, 1, 1, 9, NA, 2, 1, 1, 1, ~
## $ DIARREIA   <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 1, 1, NA, 9, NA, 2, 2, 1, NA,~
## $ OUTRO_SIN  <fct> 2, 2, 2, 1, NA, 2, 1, 2, NA, 2, 1, NA, NA, 9, NA, 2, 1, 1, ~
## $ HOSPITAL   <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ EVOLUCAO   <fct> NA, 1, 1, 1, NA, 1, 1, 2, 1, 1, 1, 1, 2, 9, NA, NA, 1, 1, N~
## $ RENAL      <fct> 2, 1, NA, 2, NA, 2, 2, 2, NA, NA, 1, NA, NA, NA, NA, 2, 2, ~
## $ DIABETES   <fct> 2, 1, NA, 1, NA, 1, 2, 2, NA, NA, 1, NA, NA, NA, NA, 2, 2, ~
## $ OBESIDADE  <fct> 2, 2, NA, 2, NA, 2, 2, 2, NA, NA, NA, NA, NA, NA, NA, 2, 2,~
## $ PERD_OLFT  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, NA, 1, NA, 2, NA, 2, 2, 2, NA~
## $ PERD_PALA  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, NA, 1, NA, 9, NA, 2, 2, 2, NA~
## $ VACINA     <fct> 1, 9, 2, 2, NA, 9, 2, 9, 2, 2, NA, 9, 9, NA, 9, 2, 9, 9, 2,~
## $ CLASSI_FIN <fct> NA, 5, 4, 4, 4, 5, 4, 5, 4, 4, 5, 5, 5, 5, NA, 4, 4, 5, NA,~
```

Omitindo Campos sem dados

```
dados_clinicos_no_na <- na.omit(dados_clinicos)
class(dados_clinicos_no_na)
```

```
## [1] "data.frame"
```

```
glimpse(dados_clinicos_no_na)
```

```
## Rows: 91,458
## Columns: 17
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```

```
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## $ TOSSE      <fct> 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 1, 1, 2, 2,~
## $ GARGANTA   <fct> 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ DISPNEIA   <fct> 1, 2, 1, 1, 1, 1, 2, 2, 2, 1, 1, 1, 2, 2, 2, 2, 1, 2, 1, 2,~
## $ SATURACAO  <fct> 2, 1, 1, 1, 1, 1, 1, 2, 2, 1, 1, 2, 1, 1, 2, 2, 1, 2, 1, 1,~
## $ DIARREIA   <fct> 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 1, 2, 2,~
## $ OUTRO_SIN  <fct> 2, 1, 2, 1, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 1, 2, 2, 1, 1, 2,~
## $ HOSPITAL   <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ EVOLUCAO   <fct> 1, 1, 1, 1, 2, 1, 1, 1, 1, 1, 3, 1, 1, 1, 2, 1, 1, 2, 2, 2,~
## $ RENAL      <fct> 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 1, 2, 2, 2, 2,~
## $ DIABETES   <fct> 1, 1, 1, 2, 2, 2, 1, 1, 2, 2, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ OBESIDADE  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ PERD_OLFT  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ PERD_PALA  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ VACINA     <fct> 9, 2, 9, 2, 9, 9, 9, 9, 9, 1, 2, 9, 2, 9, 9, 1, 1, 1, 2, 2,~
## $ CLASSI_FIN <fct> 5, 4, 5, 4, 5, 4, 5, 4, 5, 4, 4, 5, 4, 4, 5, 5, 4, 5, 4, 5,~
```

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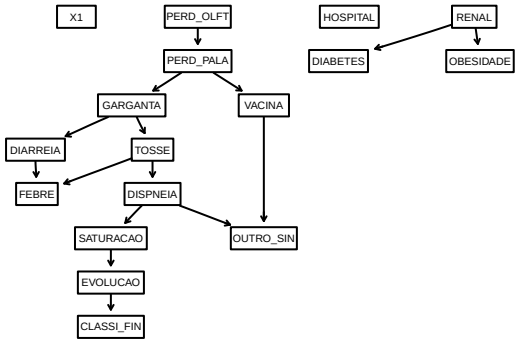
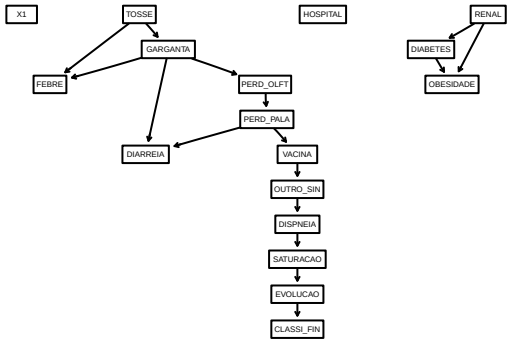
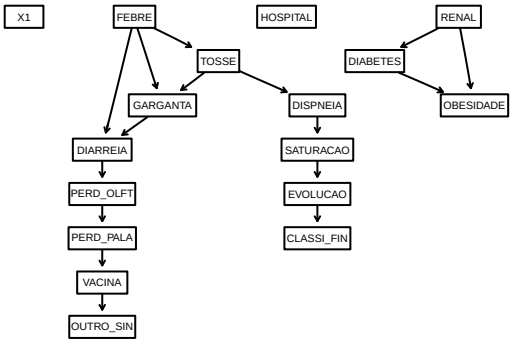


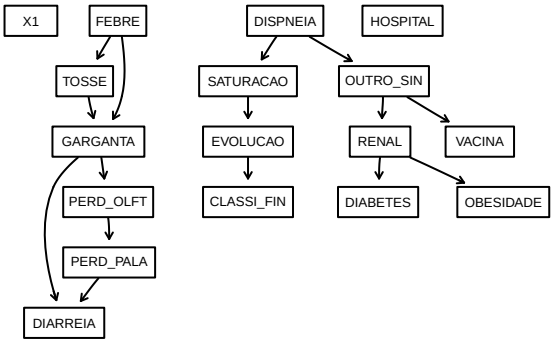
N = 10000 2



N = 10000 3



N = 10000 4



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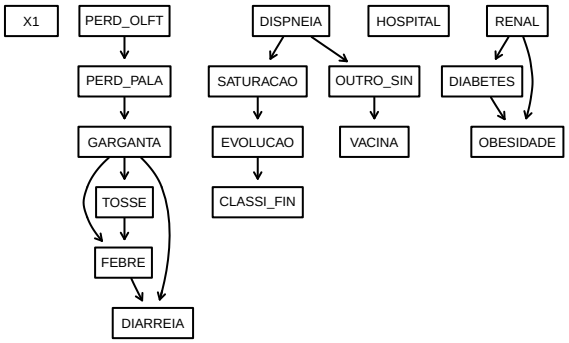

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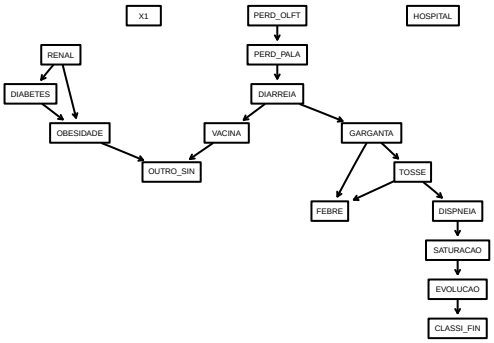

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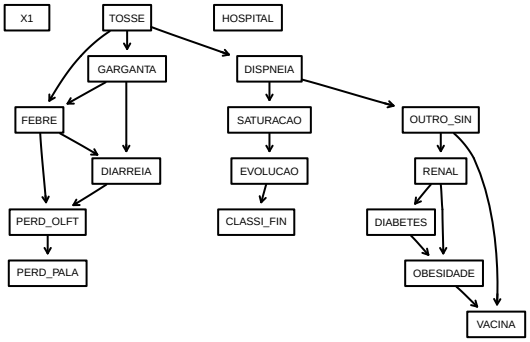

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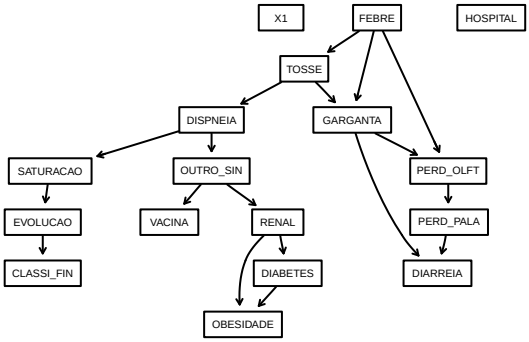

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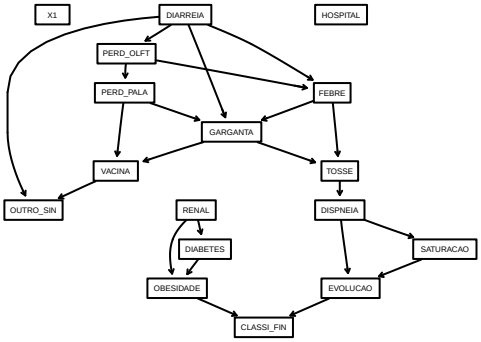

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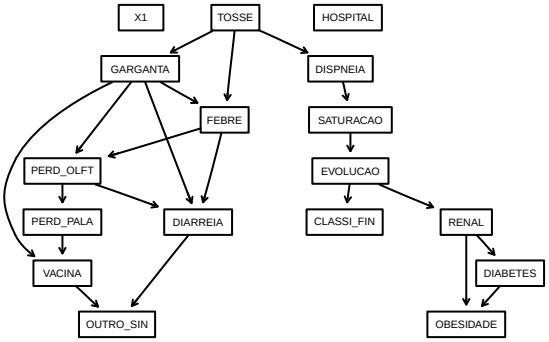

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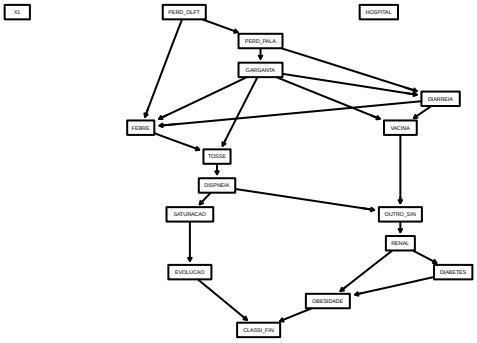

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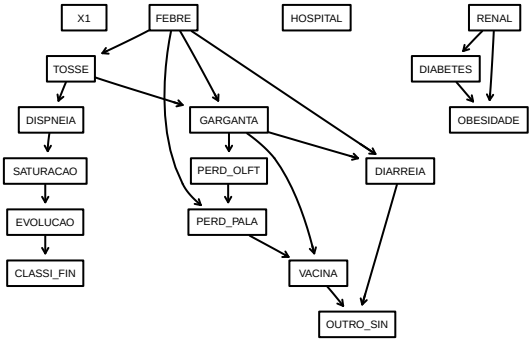

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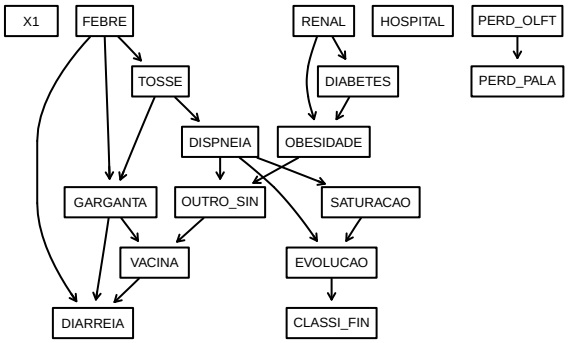

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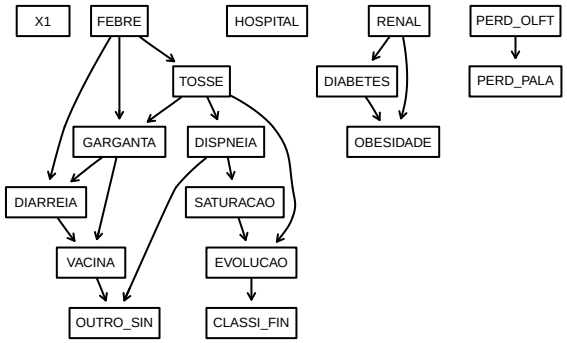

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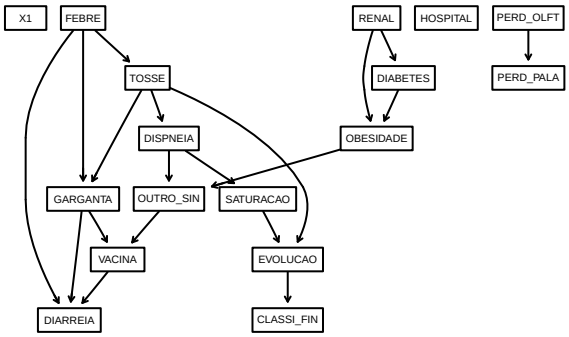

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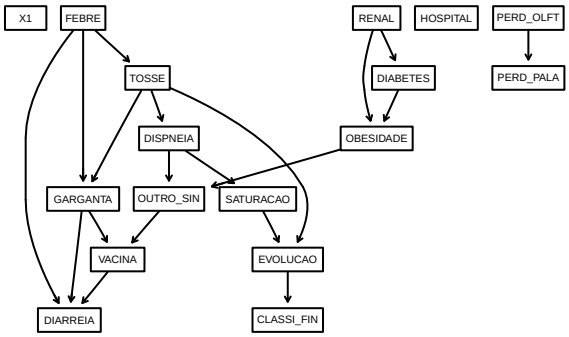

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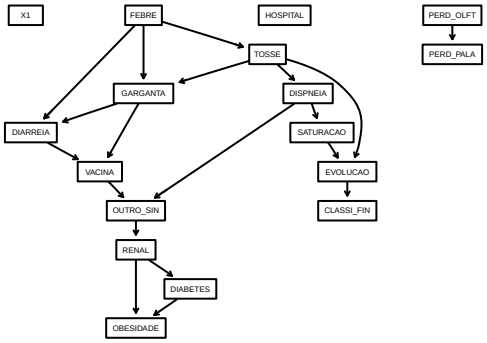

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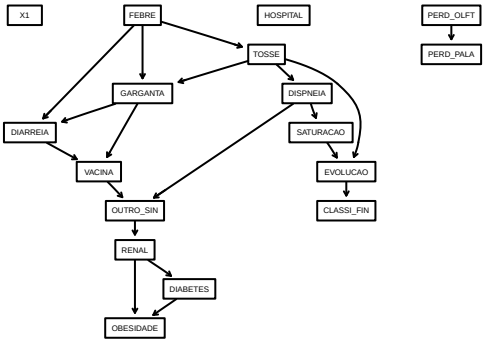

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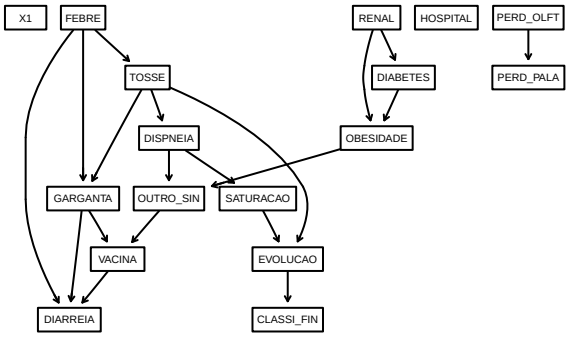

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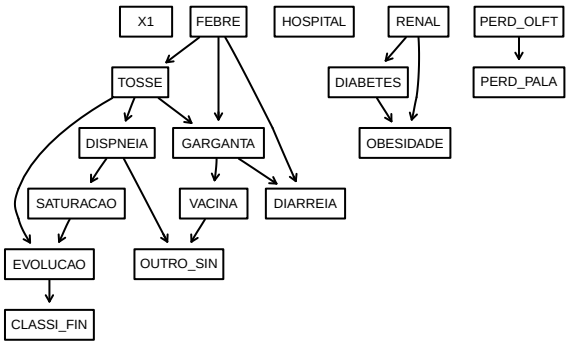

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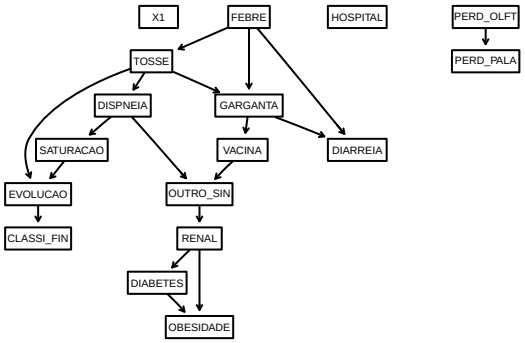

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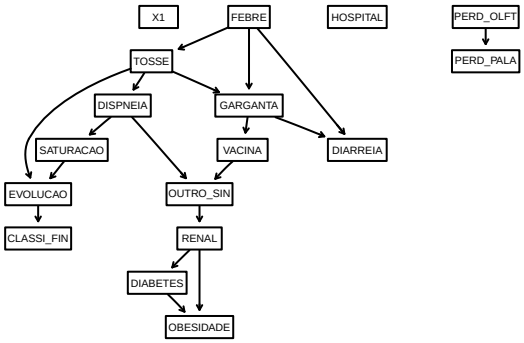

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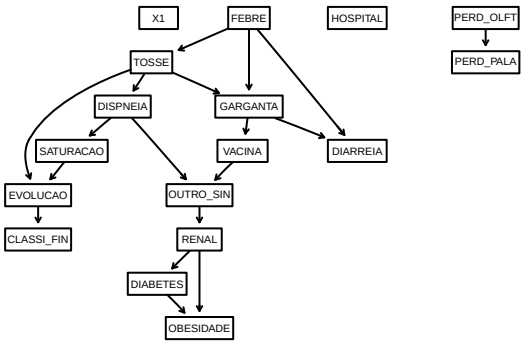

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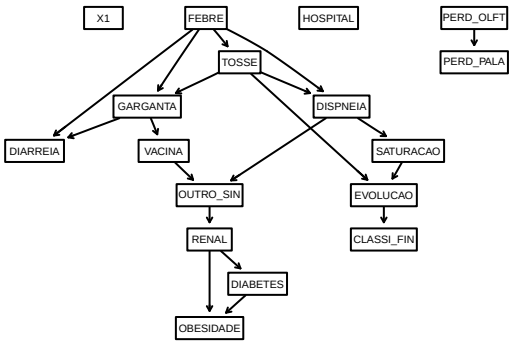

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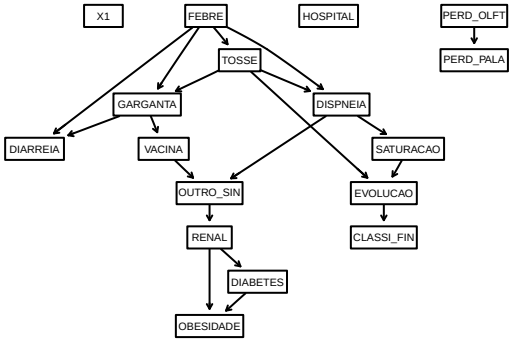

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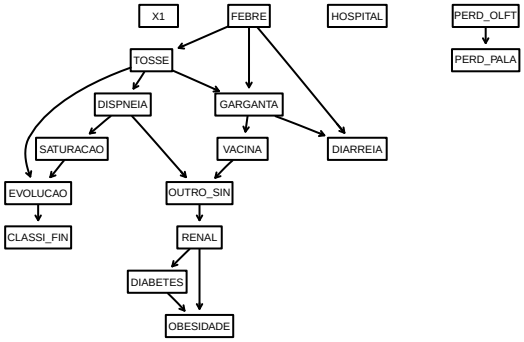

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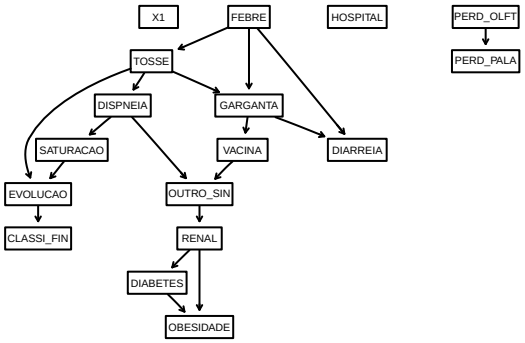

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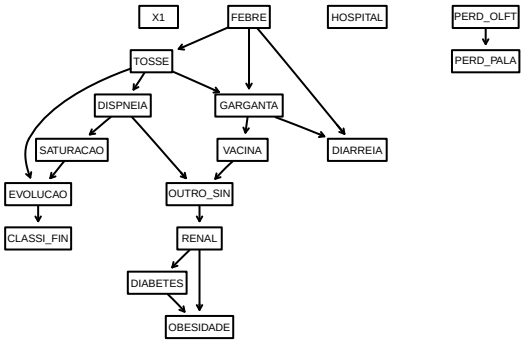
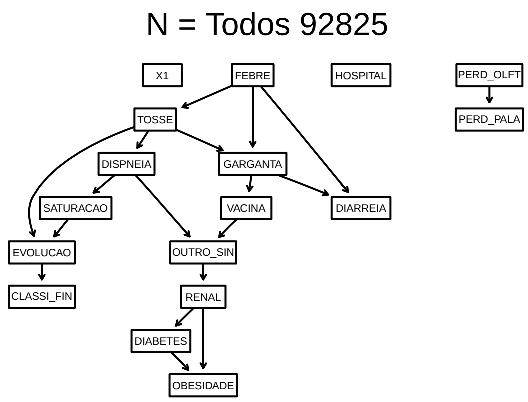
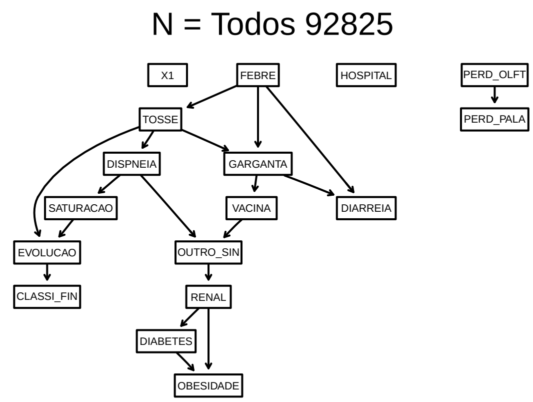



N = Todos 92825
X1
FEBRE
HOSPITAL
PERD_OLFT
TOSSE
PERD_PALA
DISPNEIA
GARGANTA
SATURACAO
VACINA
DIARREIA
EVOLUCAO
OUTRO_SIN
CLASSI_FIN
RENAL
DIABETES
OBESIDADE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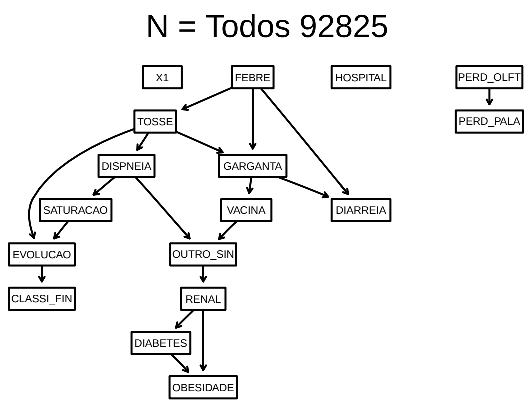
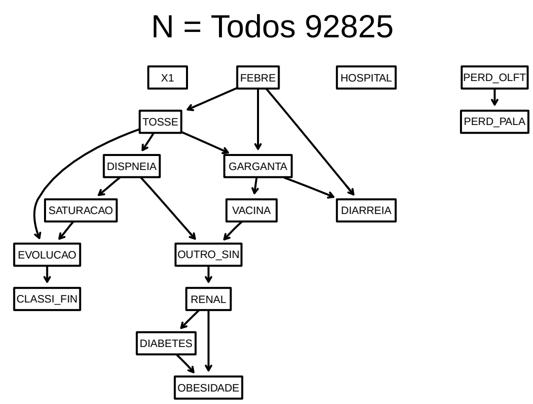
X1
FEBRE
HOSPITAL
PERD_OLFT
TOSSE
PERD_PALA
DISPNEIA
GARGANTA
SATURACAO
VACINA
DIARREIA
EVOLUCAO
OUTRO_SIN
CLASSI_FIN
RENAL
DIABETES
OBESIDADE

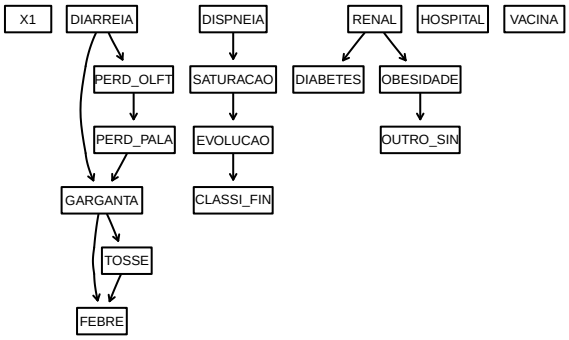

N = Todos 92825
X1
FEBRE
HOSPITAL
PERD_OLFT
TOSSE
PERD_PALA
DISPNEIA
GARGANTA
SATURACAO
VACINA
DIARREIA
EVOLUCAO
OUTRO_SIN
CLASSI_FIN
RENAL
DIABETES
OBESIDADE


N = Todos 92825
X1
FEBRE
HOSPITAL
PERD_OLFT
TOSSE
PERD_PALA
DISPNEIA
GARGANTA
SATURACAO
VACINA
DIARREIA
EVOLUCAO
OUTRO_SIN
CLASSI_FIN
RENAL
DIABETES
OBESIDADE

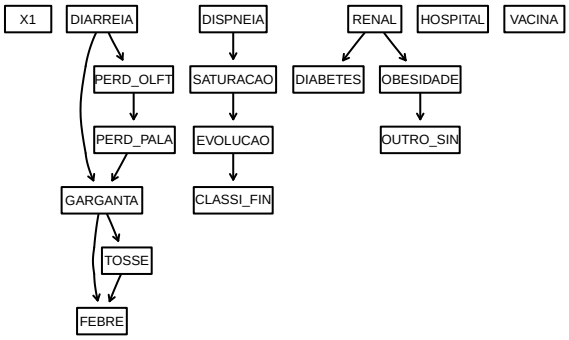
Vacinados *versus* não vacinados

Vacinados

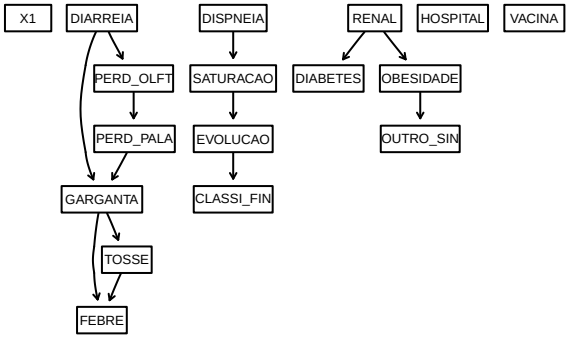
Vacinados, N = 15626, 1



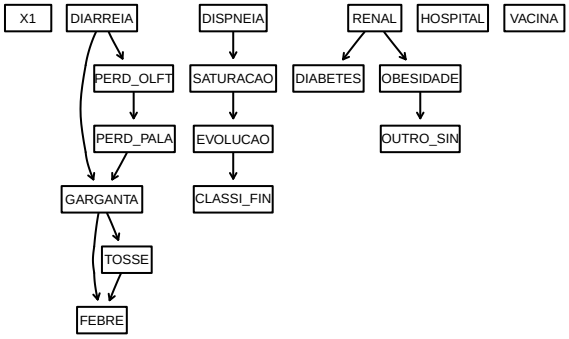
Vacinados, N = 15626, 2



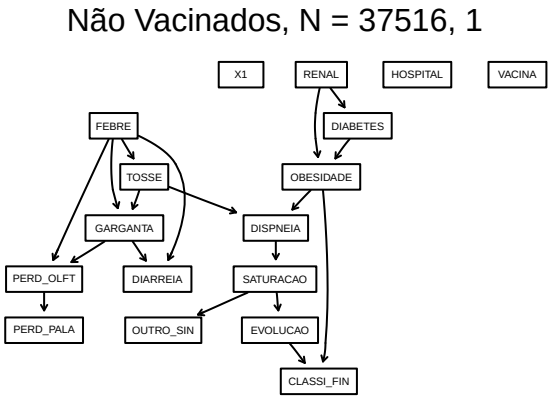
Vacinados, N = 15626, 3

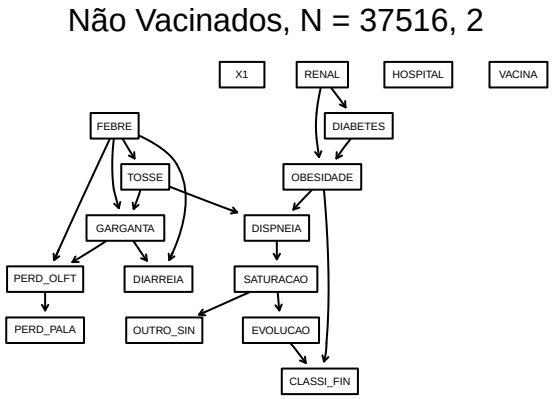


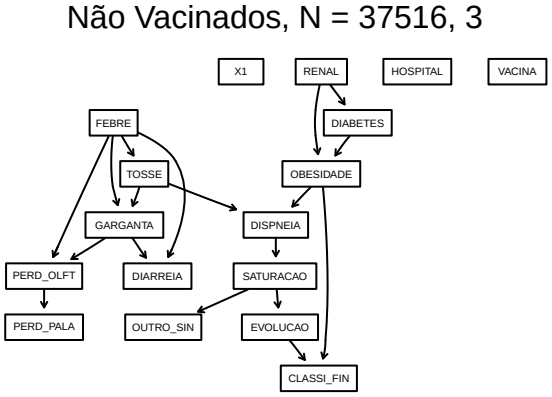
Vacinados, N = 15626, 4

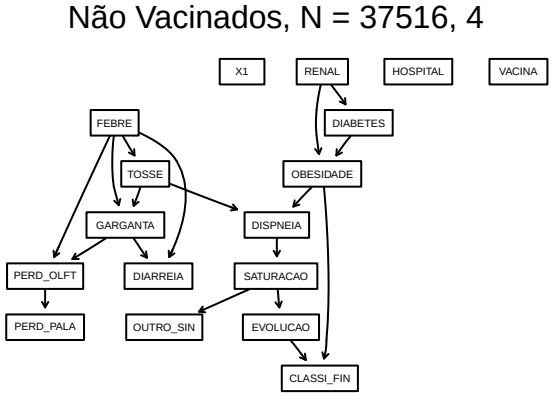


Não Vacinados









Agrupamento por Classificação final dos casos

```
# 1 - SRAG porinfluenza
# 2 - SRAG por outro virus respiratorio
# 3 - SRAG por outro agente etiologico,qual:
# 4 - SRAG nao especificado
# 5 - SRAG por COVID-19
```

```
srag.covid <- dados_clinicos_no_na %>% filter (CLASSI_FIN == 5)
srag.nao.covid <- dados_clinicos_no_na %>% filter (CLASSI_FIN != 5)

# Dados COVID Positivos
glimpse(srag.covid)
```

```
## Rows: 73,272
## Columns: 17
## $ X1         <dbl> 2, 7, 9, 21, 26, 29, 34, 36, 39, 42, 45, 49, 56, 58, 64, 69~
## $ FEBRE      <fct> 1, 2, 2, 2, 2, 1, 2, 1, 1, 1, 1, 2, 1, 2, 1, 2, 2, 1, 1, 1,~
## $ TOSSE      <fct> 1, 1, 2, 2, 2, 2, 2, 2, 1, 2, 1, 1, 2, 1, 1, 2, 2, 1, 2, 2,~
## $ GARGANTA   <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 1, 2, 2, 2, 1, 2,~
## $ DISPNEIA   <fct> 1, 1, 1, 2, 2, 1, 2, 2, 2, 2, 1, 1, 1, 1, 2, 1, 2, 1, 2, 1,~
## $ SATURACAO  <fct> 2, 1, 1, 1, 2, 2, 2, 2, 2, 1, 2, 2, 1, 1, 1, 1, 2, 2, 2, 2,~
## $ DIARREIA   <fct> 2, 2, 2, 1, 2, 2, 2, 2, 1, 2, 2, 2, 2, 1, 1, 2, 2, 1, 1, 2,~
```

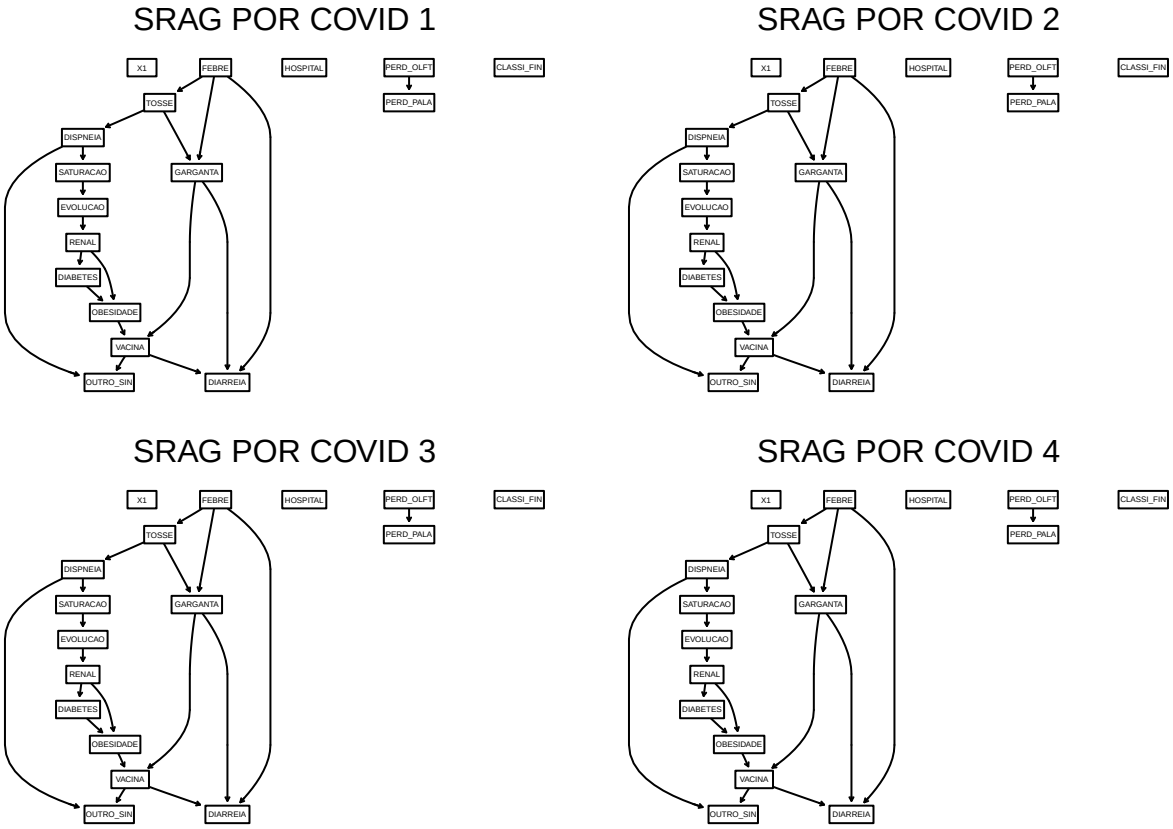
```
## $ OUTRO_SIN  <fct> 2, 2, 2, 1, 1, 2, 1, 2, 1, 2, 2, 2, 1, 2, 1, 1, 1, 2, 1, 2,~
## $ HOSPITAL   <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ EVOLUCAO   <fct> 1, 1, 2, 1, 1, 1, 2, 1, 2, 2, 1, 2, 1, 2, 2, 2, 1, 1, 1, 2,~
## $ RENAL      <fct> 1, 2, 2, 2, 2, 1, 2, 1, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ DIABETES   <fct> 1, 1, 2, 1, 2, 1, 2, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 1, 2, 2,~
## $ OBESIDADE  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 1, 2, 2,~
## $ PERD_OLFT  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2,~
## $ PERD_PALA  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ VACINA     <fct> 9, 9, 9, 9, 9, 9, 9, 1, 1, 2, 2, 1, 2, 2, 9, 9, 2, 1, 9, 2,~
## $ CLASSI_FIN <fct> 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,~
```

```
#
#
# Dados Covid Negativos
glimpse(srag.nao.covid)
```

```
## Rows: 18,186
## Columns: 17
## $ X1         <dbl> 4, 8, 20, 25, 27, 28, 31, 32, 38, 40, 51, 59, 70, 72, 83, 1~
## $ FEBRE      <fct> 1, 1, 2, 2, 2, 2, 1, 2, 1, 2, 9, 2, 1, 2, 2, 2, 1, 1, 2, 2,~
## $ TOSSE      <fct> 1, 1, 2, 2, 2, 2, 2, 1, 1, 2, 9, 1, 1, 1, 2, 2, 1, 1, 2, 1,~
## $ GARGANTA   <fct> 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ DISPNEIA   <fct> 2, 1, 1, 2, 1, 1, 2, 2, 1, 1, 1, 2, 1, 2, 2, 1, 1, 1, 2, 2,~
## $ SATURACAO  <fct> 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 1, 2, 1, 2, 2,~
## $ DIARREIA   <fct> 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 9, 2, 2, 1, 1, 2, 2, 2, 2, 2,~
## $ OUTRO_SIN  <fct> 1, 1, 1, 1, 2, 2, 2, 2, 2, 1, 9, 2, 2, 2, 2, 2, 1, 2, 2, 2,~
## $ HOSPITAL   <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ EVOLUCAO   <fct> 1, 1, 1, 1, 1, 3, 1, 1, 1, 2, 3, 1, 2, 1, 2, 2, 1, 1, 3, 2,~
## $ RENAL      <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 1, 2,~
## $ DIABETES   <fct> 1, 2, 2, 1, 2, 1, 2, 2, 2, 2, 1, 2, 2, 1, 2, 9, 2, 2, 2, 2,~
## $ OBESIDADE  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2,~
## $ PERD_OLFT  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 9, 2,~
## $ PERD_PALA  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 9, 2,~
## $ VACINA     <fct> 2, 2, 9, 9, 1, 2, 2, 9, 1, 2, 2, 2, 9, 9, 9, 2, 1, 1, 9, 9,~
## $ CLASSI_FIN <fct> 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,~
```

SRAG por COVID

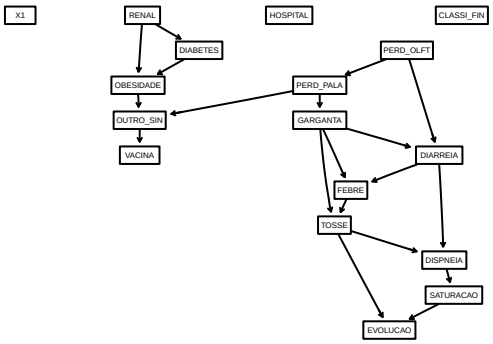
```
#
bn.covid.1 <- mmhc(sample_frac(tbl = srag.covid, size = .9, replace = FALSE))
bn.covid.2 <- mmhc(sample_frac(tbl = srag.covid, size = .9, replace = FALSE))
bn.covid.3 <- mmhc(sample_frac(tbl = srag.covid, size = .9, replace = FALSE))
bn.covid.4 <- mmhc(sample_frac(tbl = srag.covid, size = .9, replace = FALSE))
par(mfrow=c(2,2))
graphviz.plot(bn.covid.1, main="SRAG POR COVID 1", shape="rectangle")
graphviz.plot(bn.covid.2, main="SRAG POR COVID 2", shape="rectangle")
graphviz.plot(bn.covid.3, main="SRAG POR COVID 3", shape="rectangle")
graphviz.plot(bn.covid.4, main="SRAG POR COVID 4", shape="rectangle")
```



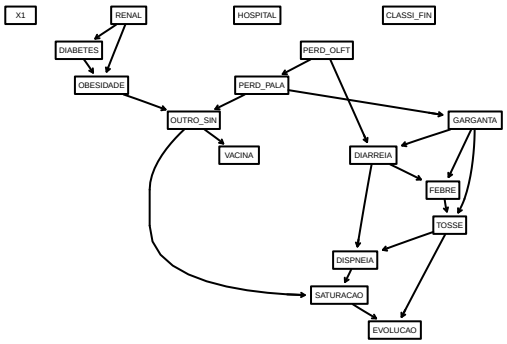
SRAG por causas não COVID

```
#
bn.nao.covid.1 <- mmhc(sample_frac(tbl = srag.nao.covid, size = .9, replace = FALSE))
bn.nao.covid.2 <- mmhc(sample_frac(tbl = srag.nao.covid, size = .9, replace = FALSE))
bn.nao.covid.3 <- mmhc(sample_frac(tbl = srag.nao.covid, size = .9, replace = FALSE))
bn.nao.covid.4 <- mmhc(sample_frac(tbl = srag.nao.covid, size = .9, replace = FALSE))
par(mfrow=c(2,2))
graphviz.plot(bn.nao.covid.1, main="SRAG NÃO COVID 1", shape="rectangle")
graphviz.plot(bn.nao.covid.2, main="SRAG NÃO COVID 2", shape="rectangle")
graphviz.plot(bn.nao.covid.3, main="SRAG NÃO COVID 3", shape="rectangle")
graphviz.plot(bn.nao.covid.4, main="SRAG NÃO COVID 4", shape="rectangle")
```

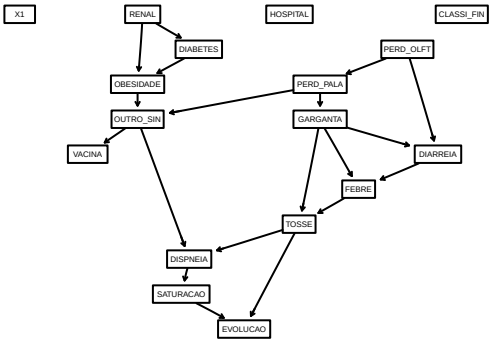
SRAG NÃO COVID 1



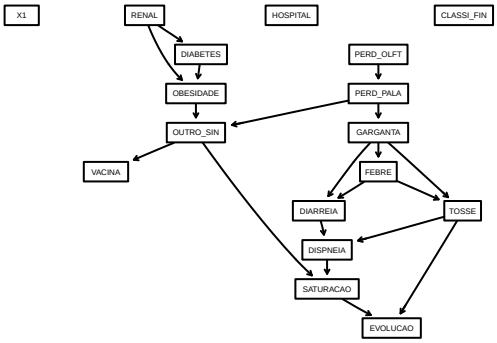
SRAG NÃO COVID 2



SRAG NÃO COVID 3



SRAG NÃO COVID 4



COVID *versus* não COVID - vacinados *versus* não-vacinados

```
srag.covid.vac <- dados_clinicos_no_na %>% filter (CLASSI_FIN == 5 & VACINA == 1)
srag.covid.nao.vac <- dados_clinicos_no_na_NO_vacina %>% filter (CLASSI_FIN == 5  & VACINA == 2)
#
srag.nao.covid.vac <- dados_clinicos_no_na %>% filter (CLASSI_FIN != 5 & VACINA == 1)
srag.nao.covid.nao.vac <- dados_clinicos_no_na_NO_vacina %>% filter (CLASSI_FIN != 5 & VACINA == 2)
#
# Dados COVID & VACINADOS
glimpse(srag.covid.vac)
```

```
## Rows: 12,444
## Columns: 17
## $ X1         <dbl> 36, 39, 49, 76, 91, 105, 116, 118, 133, 141, 157, 160, 204,~
## $ FEBRE      <fct> 1, 1, 2, 1, 2, 2, 1, 2, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 2, 1,~
## $ TOSSE      <fct> 2, 1, 1, 1, 1, 1, 1, 2, 2, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1,~
## $ GARGANTA   <fct> 2, 2, 1, 1, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 1, 1, 2, 2, 2, 2,~
## $ DISPNEIA   <fct> 2, 2, 1, 1, 2, 2, 1, 2, 1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1,~
## $ SATURACAO  <fct> 2, 2, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 2, 1, 1, 1, 2, 1, 1, 1,~
## $ DIARREIA   <fct> 2, 1, 2, 1, 2, 2, 2, 1, 2, 2, 2, 2, 1, 2, 1, 2, 1, 2, 2, 1,~
## $ OUTRO_SIN  <fct> 2, 1, 2, 2, 1, 2, 2, 2, 1, 9, 2, 2, 2, 2, 2, 2, 2, 1, 2, 1,~
## $ HOSPITAL   <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ EVOLUCAO   <fct> 1, 2, 2, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 2, 2, 1, 1, 1, 1, 1,~
## $ RENAL      <fct> 1, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ DIABETES   <fct> 2, 2, 1, 1, 2, 1, 1, 2, 1, 2, 1, 1, 2, 2, 1, 1, 2, 1, 2, 2,~
```

```
## $ OBESIDADE  <fct> 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ PERD_OLFT  <fct> 2, 2, 2, 1, 2, 2, 9, 2, 2, 9, 1, 2, 2, 2, 1, 2, 2, 2, 2, 2,~
## $ PERD_PALA  <fct> 2, 2, 2, 2, 2, 2, 9, 2, 2, 9, 1, 2, 2, 2, 1, 2, 2, 2, 2, 2,~
## $ VACINA     <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ CLASSI_FIN <fct> 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,~
```

```
#
glimpse(srag.covid.nao.vac)
```

```
## Rows: 29,667
## Columns: 17
## $ X1         <dbl> 42, 45, 56, 58, 71, 80, 86, 104, 122, 148, 182, 222, 252, 2~
## $ FEBRE      <fct> 1, 1, 1, 2, 2, 1, 2, 1, 1, 2, 2, 2, 2, 1, 1, 2, 1, 2, 1, 2,~
## $ TOSSE      <fct> 2, 1, 2, 1, 2, 2, 1, 1, 2, 2, 2, 1, 1, 2, 2, 2, 1, 1, 1, 1,~
## $ GARGANTA   <fct> 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2,~
## $ DISPNEIA   <fct> 2, 1, 1, 1, 2, 1, 1, 2, 2, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1,~
## $ SATURACAO  <fct> 1, 2, 1, 1, 2, 2, 1, 2, 2, 1, 1, 1, 1, 1, 1, 1, 1, 2, 1, 2,~
## $ DIARREIA   <fct> 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2,~
## $ OUTRO_SIN  <fct> 2, 2, 1, 2, 1, 2, 2, 2, 1, 2, 1, 9, 1, 2, 2, 2, 1, 2, 2, 2,~
## $ HOSPITAL   <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ EVOLUCAO   <fct> 2, 1, 1, 2, 1, 2, 1, 1, 9, 1, 2, 1, 2, 1, 1, 2, 2, 1, 2, 2,~
## $ RENAL      <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 1, 2, 2, 2, 1,~
## $ DIABETES   <fct> 2, 2, 1, 1, 1, 2, 2, 1, 2, 1, 1, 9, 2, 2, 2, 1, 2, 1, 2, 2,~
## $ OBESIDADE  <fct> 2, 2, 2, 1, 2, 2, 2, 2, 2, 1, 2, 9, 2, 2, 1, 2, 2, 2, 2, 2,~
## $ PERD_OLFT  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 1, 2, 2, 2, 1, 2,~
## $ PERD_PALA  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 1, 2, 2, 2, 1, 2,~
## $ VACINA     <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ CLASSI_FIN <fct> 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,~
```

```
#
#
# Dados NAO COVID & NAO VACINADOS
glimpse(srag.nao.covid.vac)
```

```
## Rows: 2,937
## Columns: 17
## $ X1         <dbl> 27, 38, 115, 121, 139, 153, 231, 382, 878, 1024, 1896, 1900~
## $ FEBRE      <fct> 2, 1, 1, 1, 2, 1, 2, 2, 1, 2, 2, 1, 1, 1, 1, 2, 2, 2, 2, 1,~
## $ TOSSE      <fct> 2, 1, 1, 1, 2, 1, 2, 1, 1, 2, 1, 2, 2, 1, 1, 2, 1, 1, 1, 2,~
## $ GARGANTA   <fct> 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ DISPNEIA   <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ SATURACAO  <fct> 1, 1, 2, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 2, 2, 1, 1, 1, 2,~
## $ DIARREIA   <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2,~
## $ OUTRO_SIN  <fct> 2, 2, 1, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 1, 2, 2, 2, 2, 1,~
## $ HOSPITAL   <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ EVOLUCAO   <fct> 1, 1, 1, 1, 1, 1, 1, 3, 2, 1, 1, 1, 1, 3, 1, 1, 1, 1, 2, 1,~
## $ RENAL      <fct> 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ DIABETES   <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 1, 2, 2, 1, 2,~
## $ OBESIDADE  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 1, 2,~
## $ PERD_OLFT  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ PERD_PALA  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ VACINA     <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ CLASSI_FIN <fct> 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,~
```

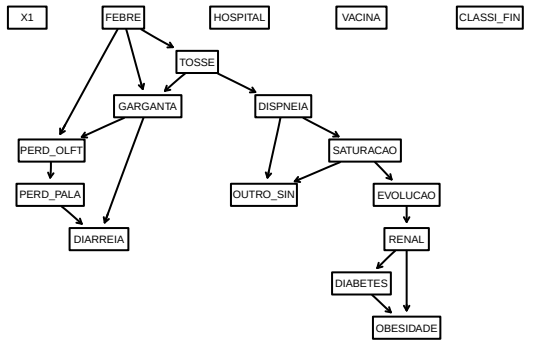
```
#
glimpse(srag.nao.covid.nao.vac)
```

```
## Rows: 7,264
## Columns: 17
## $ X1         <dbl> 4, 8, 28, 31, 40, 51, 59, 109, 134, 136, 155, 235, 240, 246~
## $ FEBRE      <fct> 1, 1, 2, 1, 2, 9, 2, 2, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ TOSSE      <fct> 1, 1, 2, 2, 2, 9, 1, 2, 2, 2, 2, 2, 1, 2, 1, 1, 2, 2, 1, 2,~
## $ GARGANTA   <fct> 2, 1, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ DISPNEIA   <fct> 2, 1, 1, 2, 1, 1, 2, 1, 2, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ SATURACAO  <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 1, 1, 1, 2, 2, 2, 1, 1, 2,~
## $ DIARREIA   <fct> 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2,~
## $ OUTRO_SIN  <fct> 1, 1, 2, 2, 1, 9, 2, 2, 1, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2,~
## $ HOSPITAL   <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ EVOLUCAO   <fct> 1, 1, 3, 1, 2, 3, 1, 2, 1, 1, 2, 1, 2, 2, 1, 1, 9, 1, 1, 1,~
## $ RENAL      <fct> 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2,~
## $ DIABETES   <fct> 1, 2, 1, 2, 2, 1, 2, 9, 2, 2, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2,~
## $ OBESIDADE  <fct> 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ PERD_OLFT  <fct> 2, 2, 2, 2, 2, 9, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2,~
## $ PERD_PALA  <fct> 2, 2, 2, 2, 2, 9, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2,~
## $ VACINA     <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ CLASSI_FIN <fct> 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 2, 4, 4, 4, 4,~
```

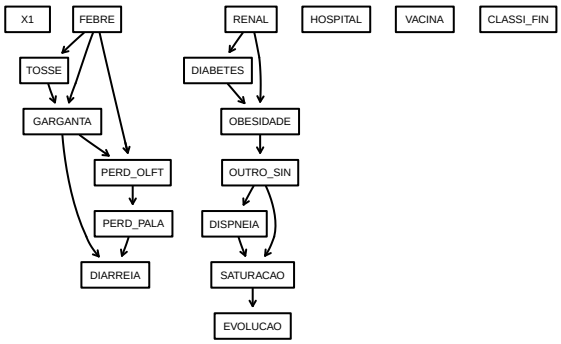
COVID não vacinados

```
#
bn.covid.nao.vac.1 <- mmhc(sample_frac(tbl = srag.covid.nao.vac, size = .9, replace = FALSE))
bn.covid.nao.vac.2 <- mmhc(sample_frac(tbl = srag.covid.nao.vac, size = .9, replace = FALSE))
bn.covid.nao.vac.3 <- mmhc(sample_frac(tbl = srag.covid.nao.vac, size = .9, replace = FALSE))
bn.covid.nao.vac.4 <- mmhc(sample_frac(tbl = srag.covid.nao.vac, size = .9, replace = FALSE))
par(mfrow=c(2,2))
graphviz.plot(bn.covid.nao.vac.1, main="COVID NÃO VACINADOS 1. N = 30013", shape="rectangle")
graphviz.plot(bn.covid.nao.vac.2, main="COVID NÃO VACINADOS 2. N = 30013", shape="rectangle")
graphviz.plot(bn.covid.nao.vac.3, main="COVID NÃO VACINADOS 3. N = 30013", shape="rectangle")
graphviz.plot(bn.covid.nao.vac.4, main="COVID NÃO VACINADOS 4. N = 30013", shape="rectangle")
```

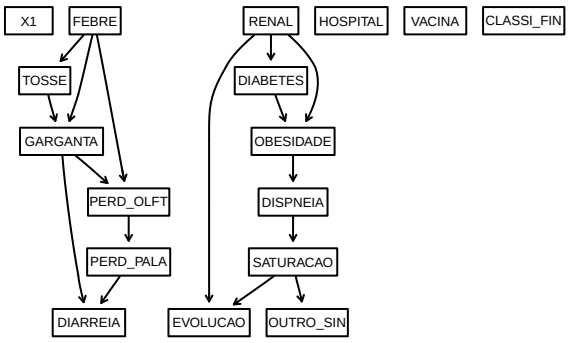
COVID NÃO VACINADOS 1. N = 30013



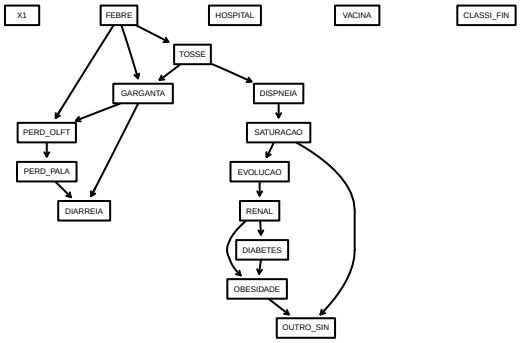
COVID NÃO VACINADOS 2. N = 30013



COVID NÃO VACINADOS 3. N = 30013

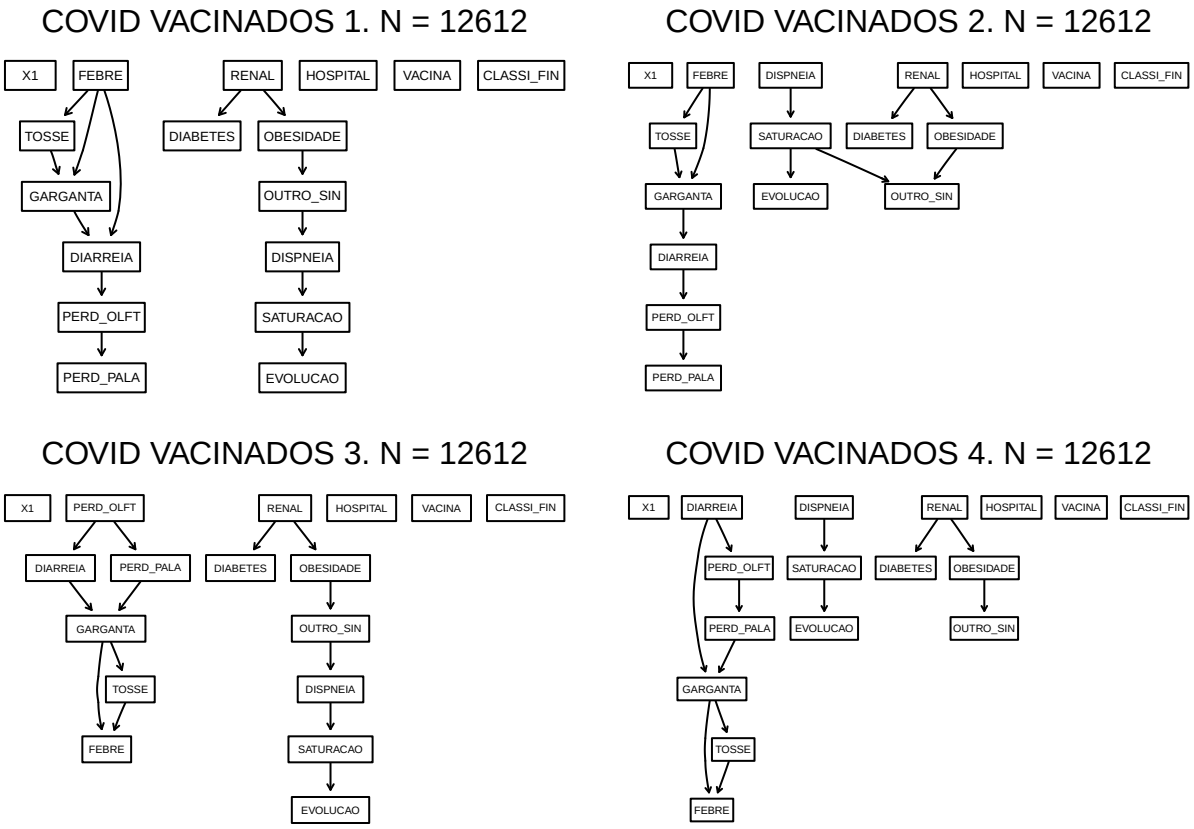


COVID NÃO VACINADOS 4. N = 30013



COVID vacinados

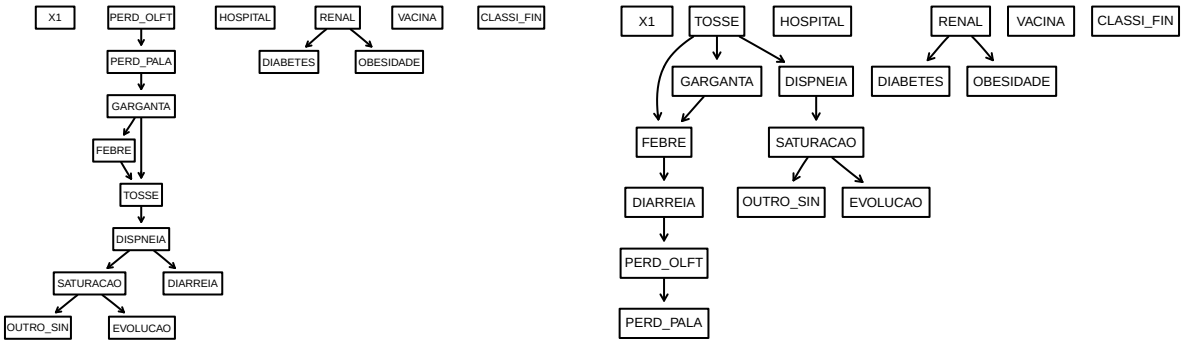
```
# #
bn.covid.vac.1 <- mmhc(sample_frac(tbl = srag.covid.vac, size = .9, replace = FALSE))
bn.covid.vac.2 <- mmhc(sample_frac(tbl = srag.covid.vac, size = .9, replace = FALSE))
bn.covid.vac.3 <- mmhc(sample_frac(tbl = srag.covid.vac, size = .9, replace = FALSE))
bn.covid.vac.4 <- mmhc(sample_frac(tbl = srag.covid.vac, size = .9, replace = FALSE))
par(mfrow=c(2,2))
graphviz.plot(bn.covid.vac.1, main="COVID VACINADOS 1. N = 12612", shape="rectangle")
graphviz.plot(bn.covid.vac.2, main="COVID VACINADOS 2. N = 12612", shape="rectangle")
graphviz.plot(bn.covid.vac.3, main="COVID VACINADOS 3. N = 12612", shape="rectangle")
graphviz.plot(bn.covid.vac.4, main="COVID VACINADOS 4. N = 12612", shape="rectangle")
```



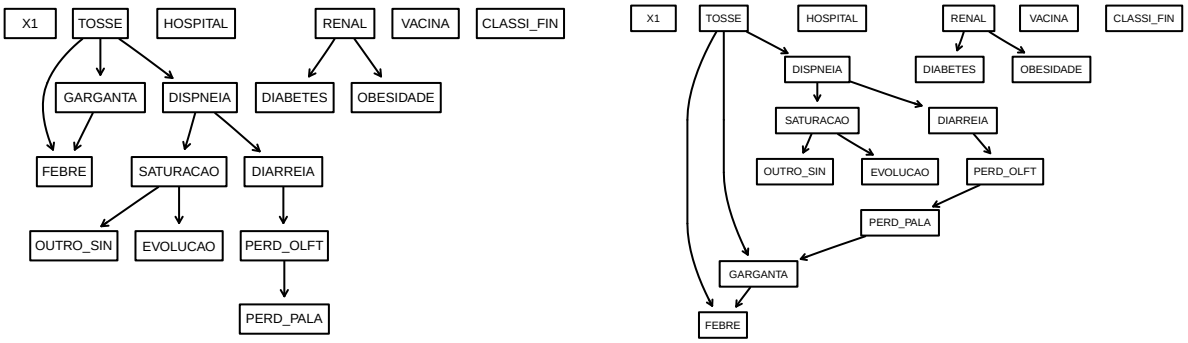
NÃO COVID não vacinados

```
#
bn.nao.covid.nao.vac.1 <- mmhc(sample_frac(tbl = srag.nao.covid.nao.vac, size = .9, replace = FALSE))
bn.nao.covid.nao.vac.2 <- mmhc(sample_frac(tbl = srag.nao.covid.nao.vac, size = .9, replace = FALSE))
bn.nao.covid.nao.vac.3 <- mmhc(sample_frac(tbl = srag.nao.covid.nao.vac, size = .9, replace = FALSE))
bn.nao.covid.nao.vac.4 <- mmhc(sample_frac(tbl = srag.nao.covid.nao.vac, size = .9, replace = FALSE))
par(mfrow=c(2,2))
graphviz.plot(bn.nao.covid.nao.vac.1, main="NAO COVID NÃO VACINADOS 1. N = 7503", shape="rectangle")
graphviz.plot(bn.nao.covid.nao.vac.2, main="NAO COVID NÃO VACINADOS 2. N = 7503", shape="rectangle")
graphviz.plot(bn.nao.covid.nao.vac.3, main="NAO COVID NÃO VACINADOS 3. N = 7503", shape="rectangle")
graphviz.plot(bn.nao.covid.nao.vac.4, main="NAO COVID NÃO VACINADOS 4. N = 7503", shape="rectangle")
```

NAO COVID NÃO VACINADOS 1. N = 7503NAO COVID NÃO VACINADOS 2. N = 7503



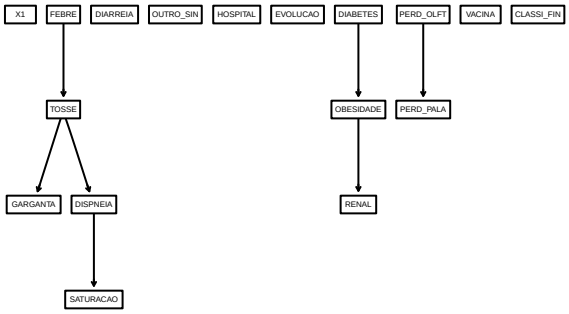
NAO COVID NÃO VACINADOS 3. N = 7503NAO COVID NÃO VACINADOS 4. N = 7503



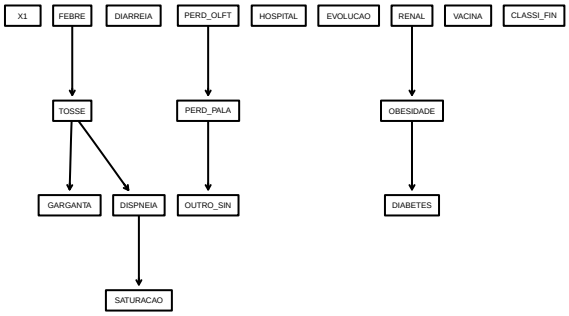
NÃO COVID vacinados

```
#
bn.nao.covid.vac.1 <- mmhc(sample_frac(tbl = srag.nao.covid.vac, size = .9, replace = FALSE))
bn.nao.covid.vac.2 <- mmhc(sample_frac(tbl = srag.nao.covid.vac, size = .9, replace = FALSE))
bn.nao.covid.vac.3 <- mmhc(sample_frac(tbl = srag.nao.covid.vac, size = .9, replace = FALSE))
bn.nao.covid.vac.4 <- mmhc(sample_frac(tbl = srag.nao.covid.vac, size = .9, replace = FALSE))
par(mfrow=c(2,2))
graphviz.plot(bn.nao.covid.vac.1, main="NAO COVID VACINADOS 1. N = 3014", shape="rectangle")
graphviz.plot(bn.nao.covid.vac.2, main="NAO COVID VACINADOS 2. N = 3014", shape="rectangle")
graphviz.plot(bn.nao.covid.vac.3, main="NAO COVID VACINADOS 3. N = 3014", shape="rectangle")
graphviz.plot(bn.nao.covid.vac.4, main="NAO COVID VACINADOS 4. N = 3014", shape="rectangle")
```

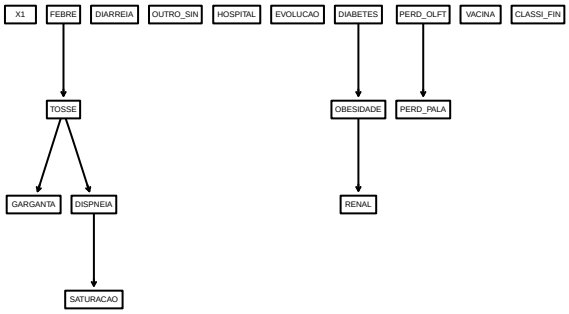
NAO COVID VACINADOS 1. N = 3014



NAO COVID VACINADOS 2. N = 3014



NAO COVID VACINADOS 3. N = 3014



NAO COVID VACINADOS 4. N = 3014