

# Covid-19 - Modelagem Causal

## Parte I: Aprendizado Bayesiano de estrutura Causal na Síndrome Respiratória Aguda Grave - SRAG

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*SRAG<sup>causal modeling</sup> & COVID – 19<sup>simulations</sup>*

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*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\\_coronavir\\_us\\_6ago20\\_ajustes-finais-2.pdf](https://portalarquivos.saude.gov.br/images/af_gvs_coronavir_us_6ago20_ajustes-finais-2.pdf)

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## 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

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

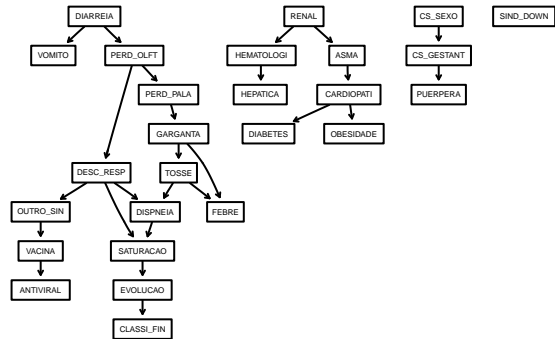
### Dados completos

```
## [1] 478866
## [1] 89470
## [1] "data.frame"

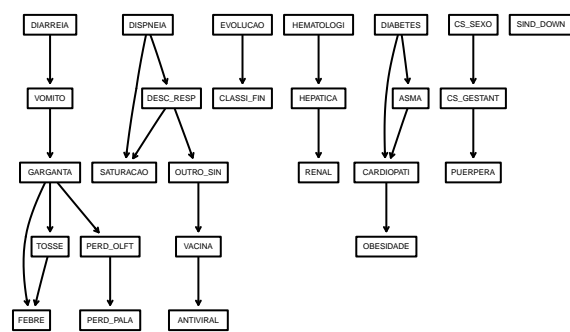
## Rows: 478,866
## Columns: 26
## $ FEBRE      <fct> 2, 1, 1, 1, 2, 2, 2, 1, 2, 2, 1, 1, 1, NA, 1, 9, 1, 1, NA, ~
## $ TOSSE      <fct> 1, 1, 1, 1, 2, 1, 1, 1, 2, 2, 2, 2, NA, 1, 1, 9, 1, 1, 1, 2~
## $ GARGANTA   <fct> 2, 2, 2, 2, 2, 1, 2, 1, 2, 2, 2, 2, NA, NA, NA, 9, NA, 2, 1~
## $ DISPNEIA   <fct> 1, 1, 2, 2, 1, 2, 1, 1, 1, 2, 2, 2, NA, NA, 1, 9, NA, 2, NA~
## $ DESC_RESP  <fct> 1, 1, 1, 1, 1, 2, 1, 1, 1, 2, 2, 2, NA, 1, 1, 1, NA, 2, NA~
## $ SATURACAO  <fct> 1, 2, 2, 1, 1, 2, 1, 1, 1, 2, 2, 2, NA, 1, 1, 9, NA, 2, NA~
## $ DIARREIA   <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 1, 1, 1, NA, 9, NA, 2, NA~
## $ VOMITO     <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, NA, NA, NA, 9, NA, 1, N~
## $ OUTRO_SIN  <fct> 2, 2, 2, 1, NA, 2, 2, 1, 2, NA, 2, 2, 1, NA, NA, 9, NA, 2, ~
## $ EVOLUCAO   <fct> NA, 1, 1, 1, NA, 1, 1, 1, 2, 1, NA, 1, 1, 1, 2, 9, NA, NA, ~
## $ RENAL      <fct> 2, 1, NA, 2, NA, NA, 2, 2, 2, NA, 2, NA, 1, NA, NA, NA, NA, ~
## $ DIABETES   <fct> 2, 1, NA, 1, NA, NA, 1, 2, 2, NA, 2, NA, 1, NA, NA, NA, NA, ~
## $ OBESIDADE  <fct> 2, 2, NA, 2, NA, NA, 2, 2, 2, NA, 2, NA, NA, NA, NA, NA, NA~
## $ PERD_OLFT  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, NA, 1, NA, 2, NA, 2, NA~
## $ PERD_PALA  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, NA, 1, NA, 9, NA, 2, NA~
## $ VACINA     <fct> 1, 9, 2, 2, NA, 1, 9, 2, 9, 2, 1, 2, NA, 9, 9, NA, 9, 2, 1,~
## $ CLASSI_FIN <fct> NA, 5, 4, 4, 4, 5, 5, 4, 5, 4, NA, 4, 5, 5, 5, 5, NA, 4, 5,~
## $ CS_SEXO    <fct> F, F, M, F, M, F, F, M, M, M, F, M, F, M, F, F, M, M, M,~
## $ CS_GESTANT <fct> 6, 5, 6, 5, 6, 5, 5, 6, 6, 6, 5, 6, 6, 6, 6, 6, 6, 6, 6,~
## $ PUERPERA   <fct> 2, 2, NA, 2, NA, NA, 2, 2, 2, NA, 2, NA, NA, NA, NA, NA, NA~
## $ CARDIOPATI <fct> 1, 1, NA, 1, NA, NA, 2, 2, 2, NA, 2, NA, NA, NA, NA, NA, NA~
## $ HEMATOLOGI <fct> 2, 2, NA, 2, NA, NA, 2, 2, 2, NA, 2, NA, NA, NA, NA, NA, NA~
## $ SIND_DOWN  <fct> 2, 2, NA, 2, NA, NA, 2, 2, 2, NA, 2, NA, NA, NA, NA, NA, NA~
## $ HEPATICA   <fct> 2, 2, NA, 2, NA, NA, 2, 2, 2, NA, 2, NA, NA, NA, NA, NA, NA~
```

```
## $ ASMA      <fct> 2, 2, NA, 2, NA, NA, 2, 1, 2, NA, 2, NA, NA, NA, NA, NA, NA~
## $ ANTIVIRAL <fct> 2, 2, 2, 2, NA, 1, 2, 2, 2, 9, 2, 2, 2, 9, 2, 2, 9, 2, 2, 1~
```

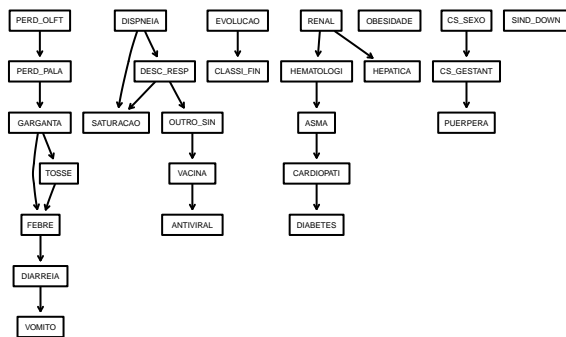
N = 10000 1



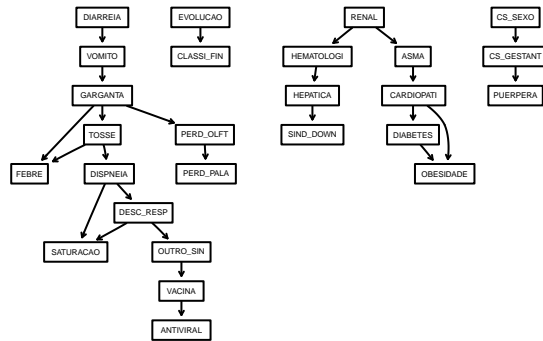
N = 10000 2



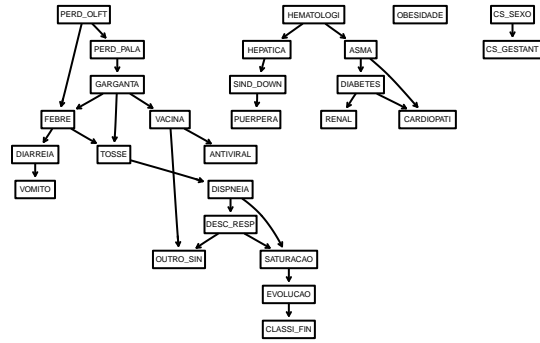
N = 10000 3



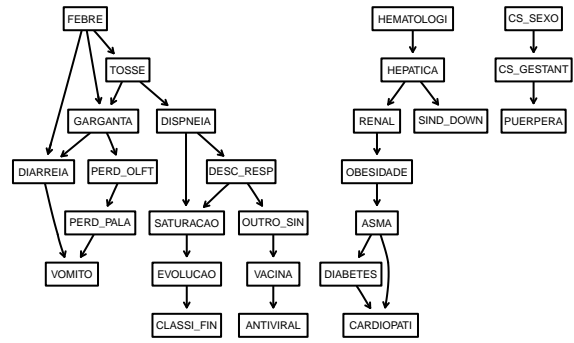
N = 10000 4



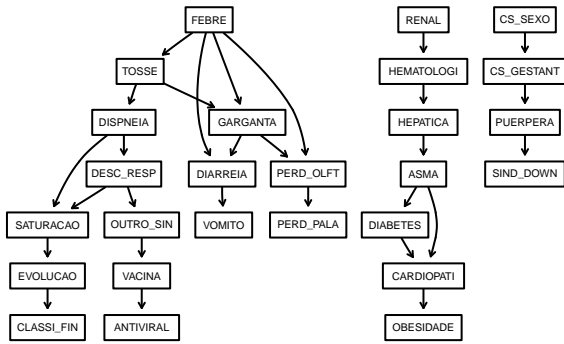
N = 20000 1



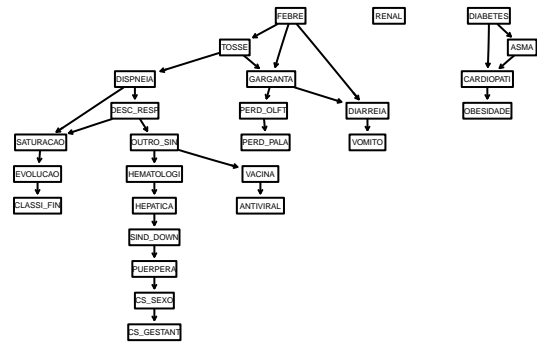
N = 20000 2



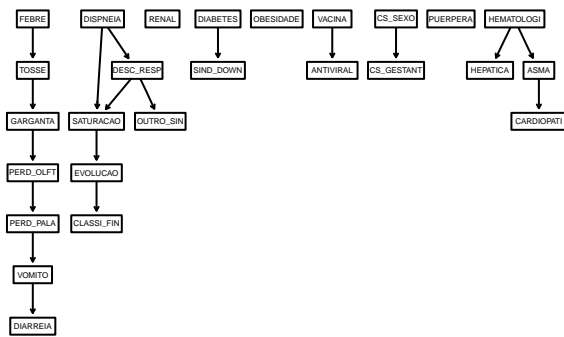
N = 20000 3



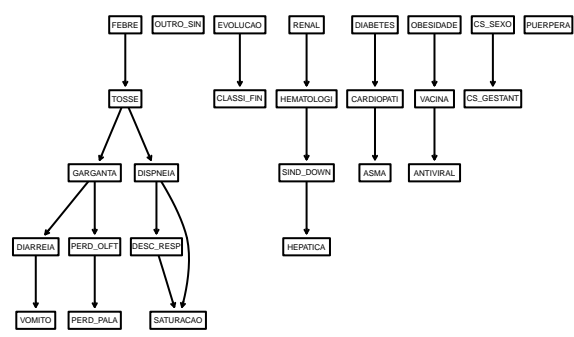
N = 20000 4



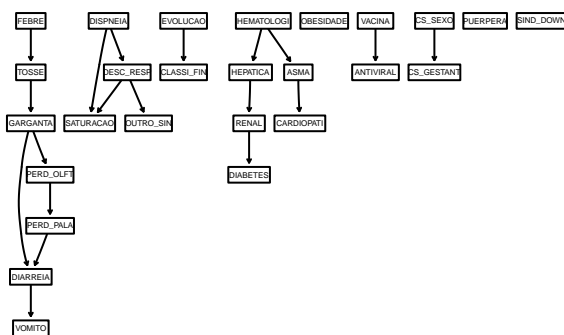
N = 49000 1



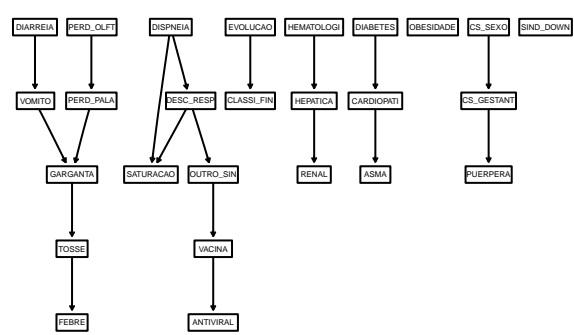
N = 49000 2



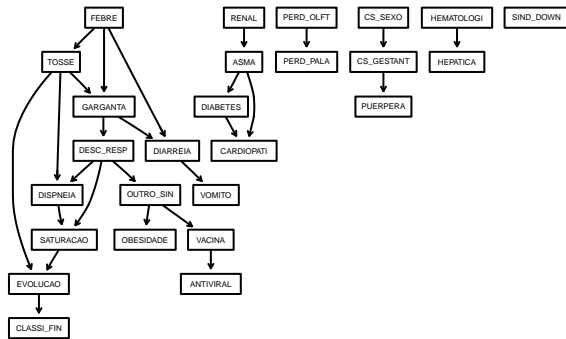
N = 49000 3



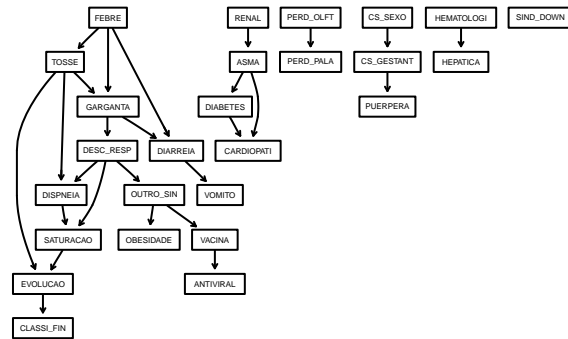
N = 49000 4



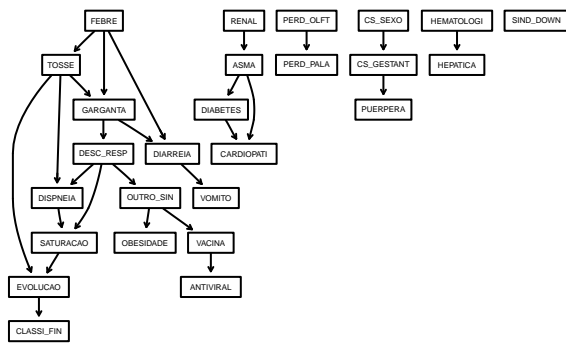
N = Todos 92825



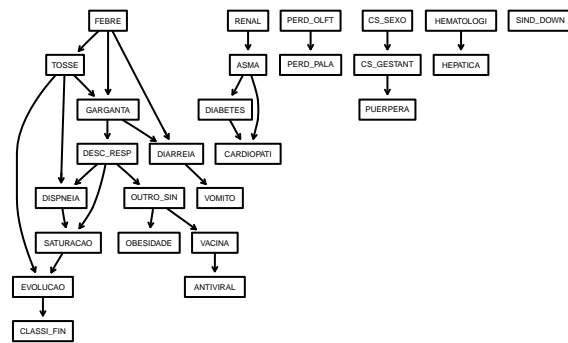
N = Todos 92825



N = Todos 92825



N = Todos 92825



```
x <- sample_n(tbl = dados_clinicos_no_na, size = 49000, replace = FALSE)
dag <- mmhc(x)
fitted = bn.fit(dag, x)
```

*# Netica style.*

```
graphviz.chart(fitted, grid = TRUE, bg = "beige", bar.col = "black")
```

```
## Loading required namespace: gRain
```

```
## Warning in from.bn.fit.to.grain(x): NaN conditional probabilities in DIARREIA,
## replaced with a uniform distribution.
```

```
##
```

```
## Attaching package: 'gRbase'
```

```
## The following objects are masked from 'package:bnstruct':
```

```
##
```

```
## dag, observations, observations<-
```

```
## The following objects are masked from 'package:igraph':
```

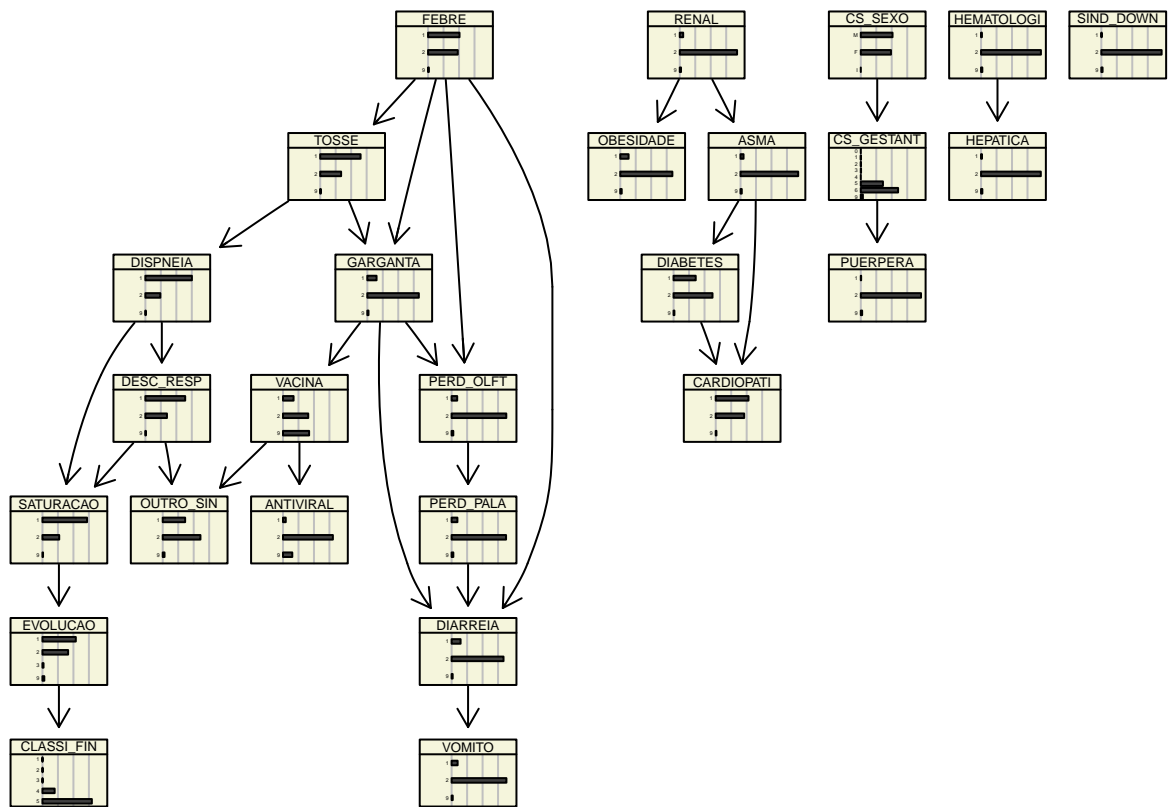
```
##
```

```
## is_dag, topo_sort
```

```
## The following objects are masked from 'package:bnlearn':
```

```
##
```

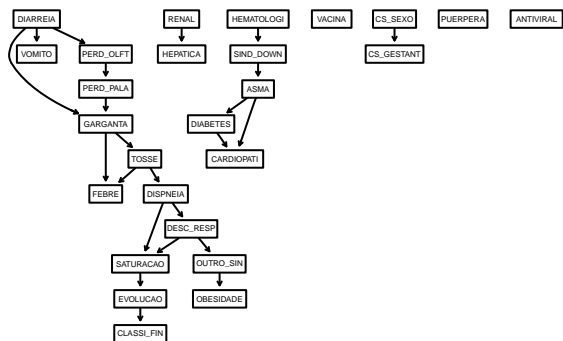
```
## ancestors, children, parents
```



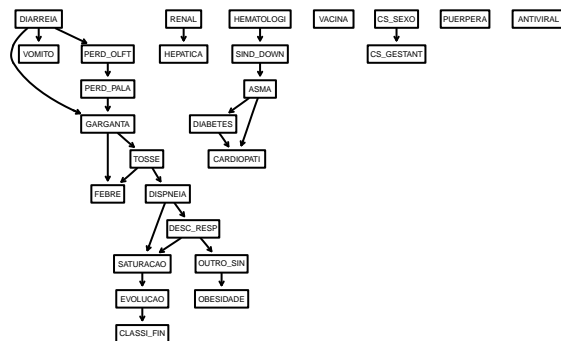
# Vacinados *versus* não vacinados

## Vacinados

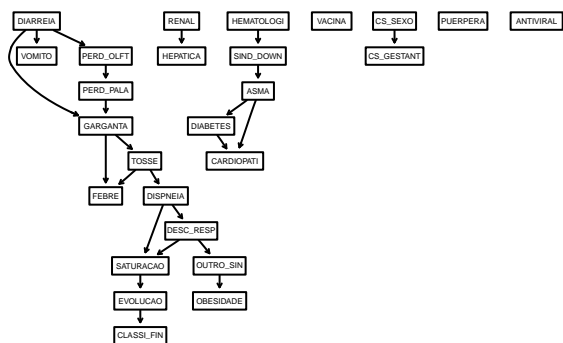
Vacinados, N = 15626, 1



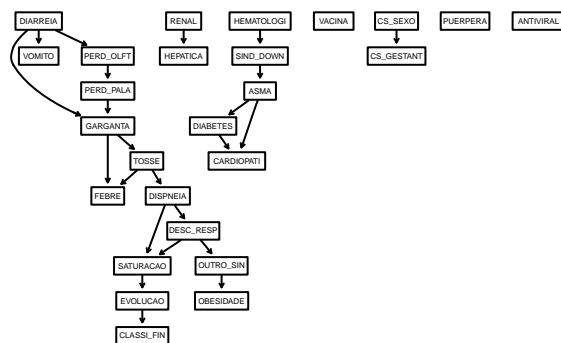
Vacinados, N = 15626, 2



Vacinados, N = 15626, 3

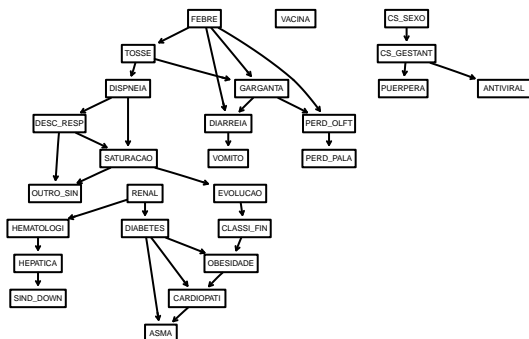


Vacinados, N = 15626, 4

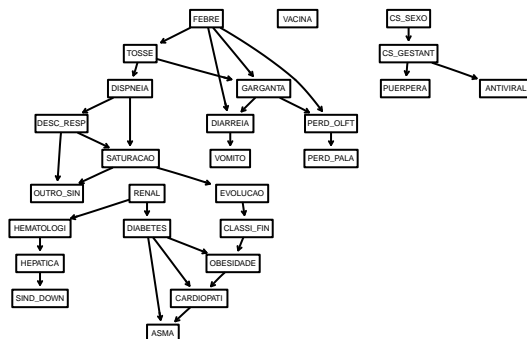


## Não Vacinados

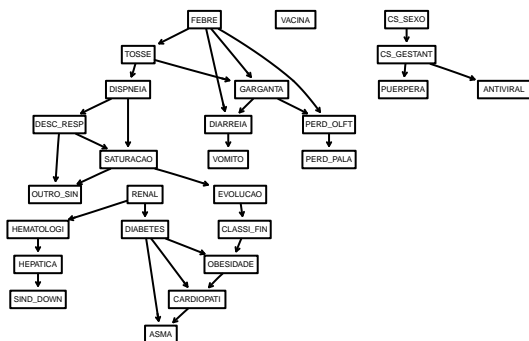
Não Vacinados, N = 37516, 1



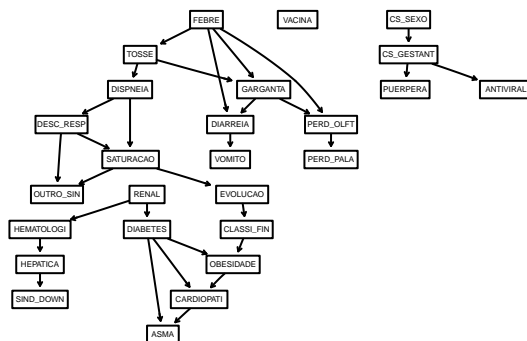
Não Vacinados, N = 37516, 2



Não Vacinados, N = 37516, 3



Não Vacinados, N = 37516, 4



## Agrupamento por Classificação final dos casos

```
## Rows: 71,404
## Columns: 26
## $ FEBRE      <fct> 1, 2, 2, 2, 2, 1, 2, 1, 1, 1, 1, 2, 1, 2, 1, 2, 2, 1, 1, 2, ~
## $ TOSSE      <fct> 1, 1, 2, 2, 2, 2, 2, 2, 1, 2, 1, 1, 2, 1, 1, 2, 2, 1, 2, 1, ~
## $ GARGANTA    <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 1, 2, 2, 2, 1, 2, 2, ~
## $ DISPNEIA    <fct> 1, 1, 1, 2, 2, 1, 2, 2, 2, 2, 2, 1, 1, 1, 1, 2, 1, 2, 1, 2, 1, ~
## $ DESC_RESP   <fct> 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 1, 1, 1, 2, 1, 1, 2, 2, 1, 2, 1, ~
## $ SATURACAO   <fct> 2, 1, 1, 1, 2, 2, 2, 2, 2, 2, 1, 2, 2, 1, 1, 1, 1, 2, 2, 2, 1, ~
## $ DIARREIA    <fct> 2, 2, 2, 1, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 1, 1, 2, 2, 1, 1, 2, ~
## $ VOMITO      <fct> 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ OUTRO_SIN   <fct> 2, 2, 2, 1, 1, 2, 1, 2, 1, 2, 2, 2, 1, 2, 1, 1, 1, 2, 1, 2, 1, ~
## $ EVOLUCAO    <fct> 1, 1, 2, 1, 1, 1, 2, 1, 2, 2, 1, 2, 1, 2, 2, 2, 1, 1, 1, 1, 1, ~
## $ RENAL       <fct> 1, 2, 2, 2, 2, 1, 2, 1, 2, 2, 2, 1, 2, 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, 2, ~
## $ OBESIDADE   <fct> 2, 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, 5, ~
## $ CS_SEXO     <fct> F, F, M, M, F, F, M, M, M, F, F, M, F, M, F, M, F, M, F, M, ~
```



```

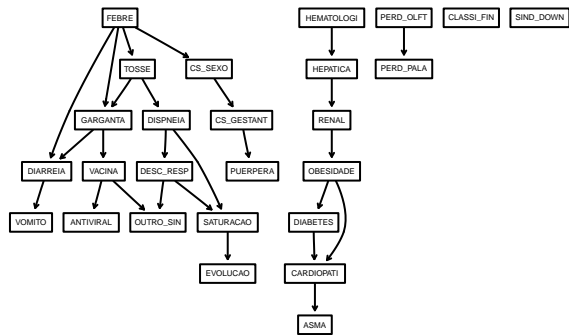
## $ CS_GESTANT <fct> 5, 5, 6, 6, 5, 5, 6, 6, 6, 6, 5, 6, 5, 6, 5, 6, 5, 6, 9, 6,~
## $ PUERPERA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2,~
## $ CARDIOPATI <fct> 1, 2, 2, 2, 2, 1, 1, 2, 2, 1, 1, 1, 1, 1, 1, 1, 2, 2, 1, 1,~
## $ HEMATOLOGI <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ SIND_DOWN <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ HEPATICA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ ASMA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ ANTIVIRAL <fct> 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~

## Rows: 18,066
## Columns: 26
## $ FEBRE <fct> 1, 1, 2, 2, 2, 2, 2, 1, 2, 9, 2, 1, 2, 2, 2, 1, 1, 2, 2, 1,~
## $ TOSSE <fct> 1, 1, 2, 2, 2, 2, 1, 1, 2, 9, 1, 1, 1, 2, 2, 1, 1, 2, 1, 2,~
## $ GARGANTA <fct> 2, 1, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ DISPNEIA <fct> 2, 1, 1, 2, 1, 1, 2, 1, 1, 1, 2, 1, 2, 2, 1, 1, 1, 2, 2, 2,~
## $ DESC_RESP <fct> 1, 1, 1, 2, 1, 1, 2, 1, 1, 1, 2, 1, 2, 2, 1, 2, 1, 2, 2, 2,~
## $ SATURACAO <fct> 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 2, 1, 2, 1, 2, 2, 1,~
## $ DIARREIA <fct> 2, 2, 2, 2, 2, 2, 1, 2, 2, 9, 2, 2, 1, 1, 2, 2, 2, 2, 2, 2,~
## $ VOMITO <fct> 2, 2, 2, 1, 2, 2, 1, 2, 2, 9, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2,~
## $ OUTRO_SIN <fct> 1, 1, 1, 1, 2, 2, 2, 2, 1, 9, 2, 2, 2, 2, 2, 1, 2, 2, 2, 1,~
## $ EVOLUCAO <fct> 1, 1, 1, 1, 1, 3, 1, 1, 2, 3, 1, 2, 1, 2, 2, 1, 1, 3, 2, 1,~
## $ RENAL <fct> 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, 1, 2, 2, 1, 2, 9, 2, 2, 2, 2, 2,~
## $ OBESIDADE <fct> 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, 9, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2,~
## $ PERD_PALA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2,~
## $ VACINA <fct> 2, 2, 9, 9, 1, 2, 9, 1, 2, 2, 2, 9, 9, 9, 2, 1, 1, 9, 9, 2,~
## $ CLASSI_FIN <fct> 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,~
## $ CS_SEXO <fct> F, M, M, F, M, M, F, M, M, M, M, M, M, M, F, M, F, F, F, M,~
## $ CS_GESTANT <fct> 5, 6, 6, 5, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 5, 6, 5, 5, 6, 6,~
## $ PUERPERA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2,~
## $ CARDIOPATI <fct> 1, 2, 2, 1, 1, 2, 2, 2, 1, 1, 1, 1, 1, 1, 9, 2, 2, 2, 1, 1,~
## $ HEMATOLOGI <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 9, 2, 2, 2, 2, 2,~
## $ SIND_DOWN <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2,~
## $ HEPATICA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2,~
## $ ASMA <fct> 2, 1, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 9, 2, 1, 2, 2, 2,~
## $ ANTIVIRAL <fct> 2, 2, 1, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 1, 2, 2, 2,~

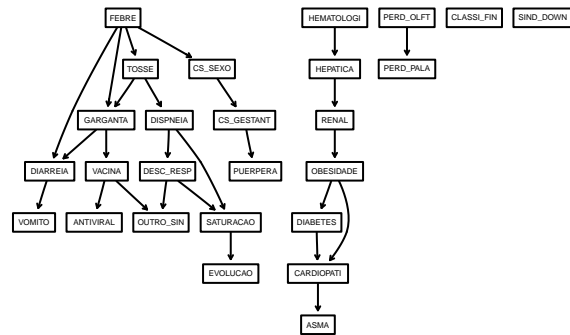
```

## SRAG por COVID

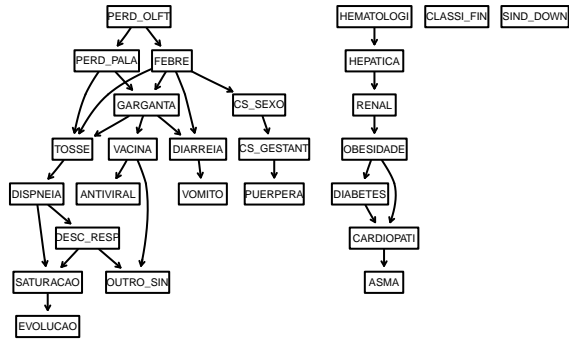
### SRAG POR COVID 1



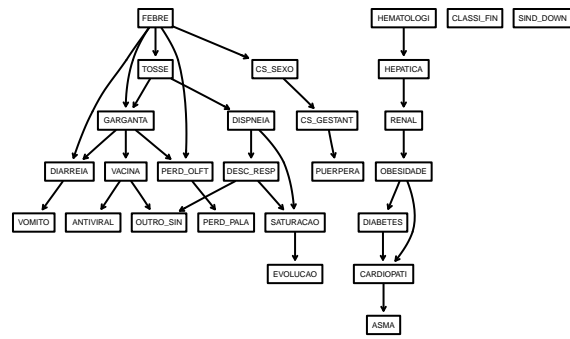
### SRAG POR COVID 2



### SRAG POR COVID 3

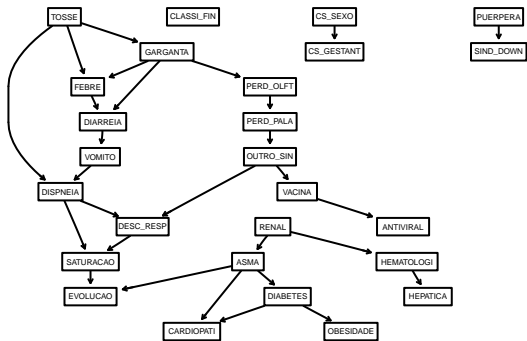


### SRAG POR COVID 4

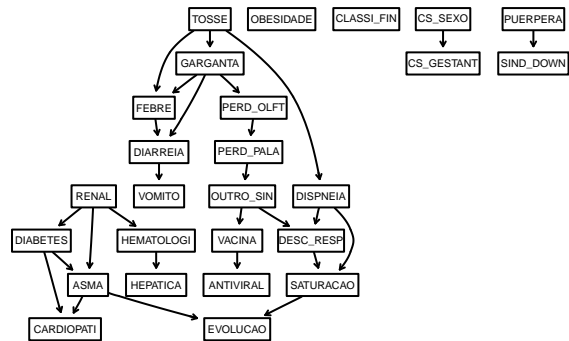


## SRAG por causas não COVID

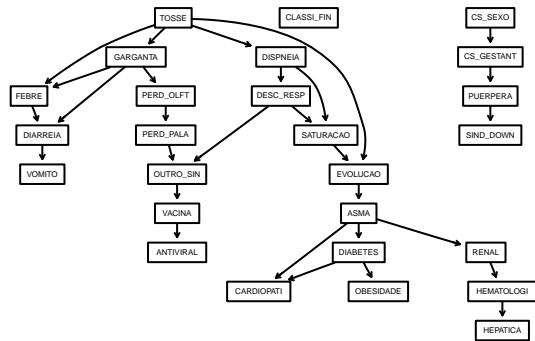
SRAG NÃO COVID 1



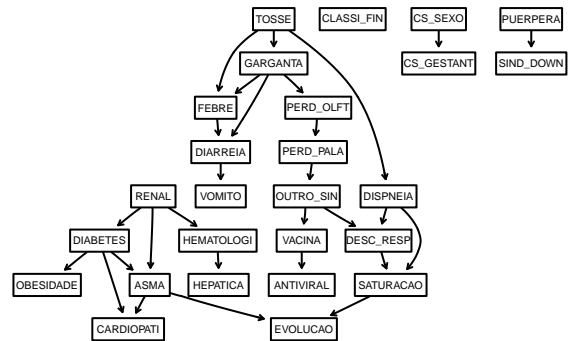
SRAG NÃO COVID 2



SRAG NÃO COVID 3



SRAG NÃO COVID 4



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

```

## Rows: 12,157
## Columns: 26
## $ FEBRE      <fct> 1, 1, 2, 1, 2, 2, 1, 2, 1, 1, 1, 2, 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, ~
## $ GARGANTA    <fct> 2, 2, 1, 1, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 1, 1, 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, ~
## $ DESC_RESP   <fct> 2, 2, 1, 1, 2, 2, 1, 2, 2, 1, 1, 1, 1, 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, 1, 2, 1, 1, ~
## $ DIARREIA    <fct> 2, 1, 2, 1, 2, 2, 2, 1, 2, 2, 2, 2, 2, 1, 2, 1, 2, 1, 2, 2, 1, ~
## $ VOMITO      <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 1, 2, 2, 2, 2, ~
## $ OUTRO_SIN   <fct> 2, 1, 2, 2, 1, 2, 2, 2, 1, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, ~
## $ EVOLUCAO    <fct> 1, 2, 2, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 2, 2, 1, 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, ~
## $ CS_SEXO     <fct> M, M, M, M, M, M, M, F, M, F, F, M, F, M, F, M, F, M, M, F, ~
## $ CS_GESTANT  <fct> 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 5, 6, 9, 6, 5, 6, 5, 6, 6, 5, ~

```

```

## $ PUERPERA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ CARDIOPATI <fct> 2, 2, 1, 2, 1, 1, 2, 2, 1, 1, 2, 1, 1, 1, 2, 2, 2, 2, 2, 2, ~
## $ HEMATOLOGI <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ SIND_DOWN <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ HEPATICA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ ASMA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, ~
## $ ANTIVIRAL <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, ~

## Rows: 28,997
## Columns: 26
## $ FEBRE <fct> 1, 1, 1, 2, 2, 2, 1, 2, 2, 2, 1, 1, 2, 1, 2, 1, 2, 1, 2, 2, ~
## $ TOSSE <fct> 2, 1, 2, 1, 2, 1, 1, 2, 1, 1, 2, 2, 2, 1, 1, 1, 1, 1, 1, 1, ~
## $ GARGANTA <fct> 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 1, ~
## $ DISPNEIA <fct> 2, 1, 1, 1, 2, 1, 2, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ~
## $ DESC_RESP <fct> 1, 1, 2, 1, 2, 1, 2, 1, 1, 1, 1, 1, 1, 1, 2, 1, 1, 1, 2, 2, ~
## $ SATURACAO <fct> 1, 2, 1, 1, 2, 1, 2, 1, 1, 1, 1, 1, 1, 1, 2, 1, 2, 2, 1, 1, ~
## $ DIARREIA <fct> 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, ~
## $ VOMITO <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ OUTRO_SIN <fct> 2, 2, 1, 2, 1, 2, 2, 2, 9, 1, 2, 2, 2, 1, 2, 2, 2, 1, 2, 1, ~
## $ EVOLUCAO <fct> 2, 1, 1, 2, 1, 1, 1, 1, 1, 2, 1, 1, 2, 2, 1, 2, 2, 2, 1, 2, ~
## $ RENAL <fct> 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 1, 2, 2, 2, 1, 2, 2, 2, ~
## $ DIABETES <fct> 2, 2, 1, 1, 1, 2, 1, 1, 9, 2, 2, 2, 1, 2, 1, 2, 2, 2, 2, 1, ~
## $ OBESIDADE <fct> 2, 2, 2, 1, 2, 2, 2, 1, 9, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ PERD_OLFT <fct> 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 1, 2, 2, 2, 1, 2, 2, 2, 2, ~
## $ PERD_PALA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 1, 2, 2, 2, 1, 2, 2, 2, 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, ~
## $ CS_SEXO <fct> F, F, F, M, F, M, F, F, M, M, M, M, F, M, M, M, M, M, F, M, ~
## $ CS_GESTANT <fct> 6, 5, 5, 6, 5, 6, 5, 5, 6, 6, 6, 6, 5, 6, 6, 6, 6, 6, 5, 6, ~
## $ PUERPERA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ CARDIOPATI <fct> 1, 1, 1, 1, 2, 1, 2, 2, 1, 1, 2, 2, 1, 1, 2, 2, 1, 2, 1, 2, ~
## $ HEMATOLOGI <fct> 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ SIND_DOWN <fct> 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ HEPATICA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ ASMA <fct> 1, 2, 2, 2, 2, 2, 2, 2, 9, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ ANTIVIRAL <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, ~

## Rows: 2,899
## Columns: 26
## $ FEBRE <fct> 2, 1, 1, 1, 2, 1, 2, 1, 2, 2, 1, 1, 1, 1, 2, 2, 2, 1, 2, 1, ~
## $ TOSSE <fct> 2, 1, 1, 1, 2, 1, 2, 1, 2, 1, 2, 2, 1, 1, 1, 1, 1, 2, 2, 1, ~
## $ GARGANTA <fct> 2, 2, 2, 2, 2, 2, 2, 1, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, ~
## $ DISPNEIA <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 1, 1, 1, 1, 1, 1, 1, 1, 2, ~
## $ DESC_RESP <fct> 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 1, 1, 1, 2, 1, ~
## $ SATURACAO <fct> 1, 1, 2, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 2, 1, 1, 1, 2, 2, ~
## $ DIARREIA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ VOMITO <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 1, 2, 1, 1, 2, 2, 2, 2, 2, ~
## $ OUTRO_SIN <fct> 2, 2, 1, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 1, 2, 2, 2, 1, 2, 2, ~
## $ EVOLUCAO <fct> 1, 1, 1, 1, 1, 1, 1, 2, 1, 1, 1, 1, 3, 1, 1, 1, 2, 1, 2, 1, ~
## $ RENAL <fct> 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, ~
## $ DIABETES <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 1, 2, 1, 1, ~
## $ OBESIDADE <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 1, 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> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ~

```

```

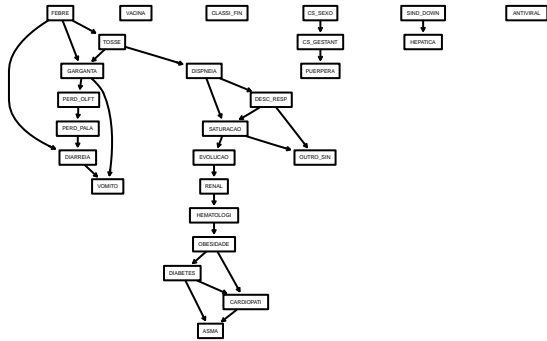
## $ CLASSI_FIN <fct> 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,~
## $ CS_SEXO <fct> M, M, M, F, F, M, M, F, F, F, M, F, M, F, M, F, M, M, F,~
## $ CS_GESTANT <fct> 6, 6, 6, 5, 5, 6, 6, 6, 5, 5, 6, 5, 6, 5, 6, 3, 6, 6, 6, 5,~
## $ PUERPERA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ CARDIOPATI <fct> 1, 2, 2, 2, 1, 1, 2, 2, 1, 1, 1, 1, 2, 1, 2, 2, 1, 1, 2, 1,~
## $ HEMATOLOGI <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ SIND_DOWN <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ HEPATICA <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ ASMA <fct> 2, 1, 2, 1, 1, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ ANTIVIRAL <fct> 9, 2, 1, 2, 2, 2, 1, 2, 2, 1, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2,~

## Rows: 7,296
## Columns: 26
## $ FEBRE <fct> 1, 1, 2, 2, 9, 2, 2, 1, 1, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2,~
## $ TOSSE <fct> 1, 1, 2, 2, 9, 1, 2, 2, 2, 2, 2, 1, 2, 1, 1, 1, 2, 2, 1, 2,~
## $ GARGANTA <fct> 2, 1, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ DISPNEIA <fct> 2, 1, 1, 1, 1, 2, 1, 2, 1, 2, 1, 1, 1, 2, 1, 1, 1, 1, 1, 1,~
## $ DESC_RESP <fct> 1, 1, 1, 1, 1, 2, 1, 2, 2, 2, 1, 1, 1, 2, 1, 1, 1, 2, 1, 2,~
## $ SATURACAO <fct> 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 1, 1, 1, 2, 2, 2, 2, 1, 1, 2,~
## $ DIARREIA <fct> 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2,~
## $ VOMITO <fct> 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 1, 2,~
## $ OUTRO_SIN <fct> 1, 1, 2, 1, 9, 2, 2, 1, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2,~
## $ EVOLUCAO <fct> 1, 1, 3, 2, 3, 1, 2, 1, 1, 2, 1, 2, 2, 1, 1, 1, 9, 1, 1, 1,~
## $ RENAL <fct> 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2,~
## $ DIABETES <fct> 1, 2, 1, 2, 1, 2, 9, 2, 2, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2,~
## $ OBESIDADE <fct> 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ PERD_OLFT <fct> 2, 2, 2, 2, 9, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2,~
## $ PERD_PALA <fct> 2, 2, 2, 2, 9, 2, 2, 2, 1, 2, 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, 4, 2, 4, 4, 4, 4,~
## $ CS_SEXO <fct> F, M, M, M, M, M, F, M, M, M, M, F, M, M, F, M, M, M, F, M,~
## $ CS_GESTANT <fct> 5, 6, 6, 6, 6, 6, 5, 6, 6, 6, 6, 5, 6, 6, 5, 6, 6, 6, 5, 6,~
## $ PUERPERA <fct> 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ CARDIOPATI <fct> 1, 2, 2, 1, 1, 1, 9, 1, 1, 1, 2, 2, 1, 2, 2, 1, 2, 1, 1, 2,~
## $ HEMATOLOGI <fct> 2, 2, 2, 2, 2, 1, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ SIND_DOWN <fct> 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ HEPATICA <fct> 2, 2, 2, 2, 2, 2, 9, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ ASMA <fct> 2, 1, 2, 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ ANTIVIRAL <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2,~

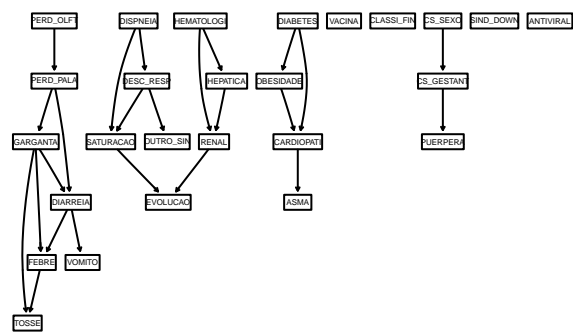
```

## COVID não vacinados

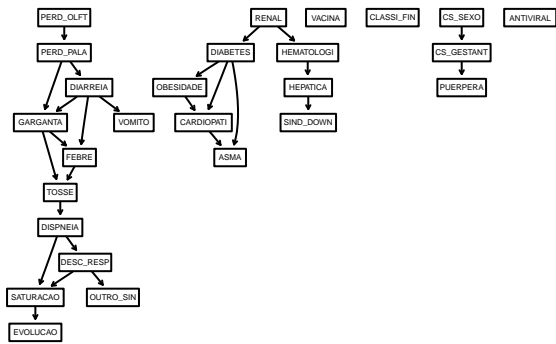
COVID NÃO VACINADOS 1. N = 30013



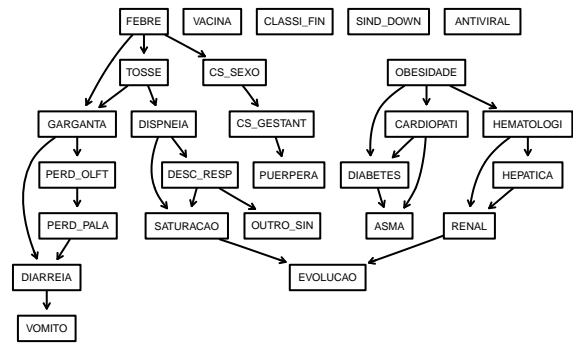
COVID NÃO VACINADOS 2. N = 30013



COVID NÃO VACINADOS 3. N = 30013

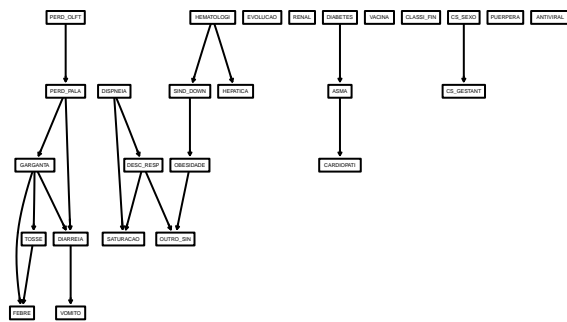


COVID NÃO VACINADOS 4. N = 30013

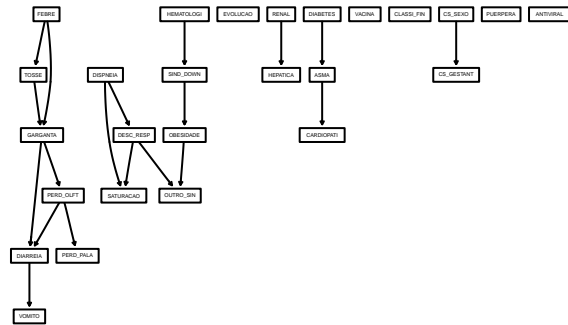


## COVID vacinados

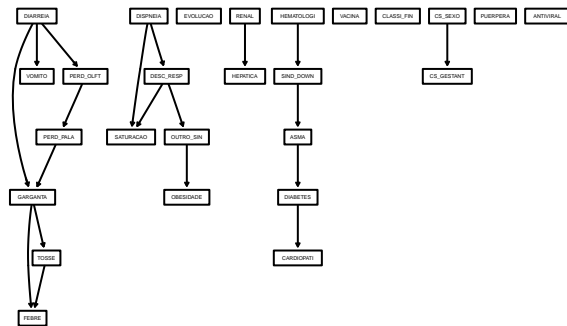
COVID VACINADOS 1. N = 12612



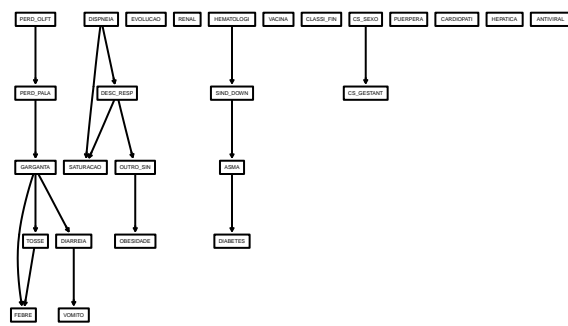
COVID VACINADOS 2. N = 12612



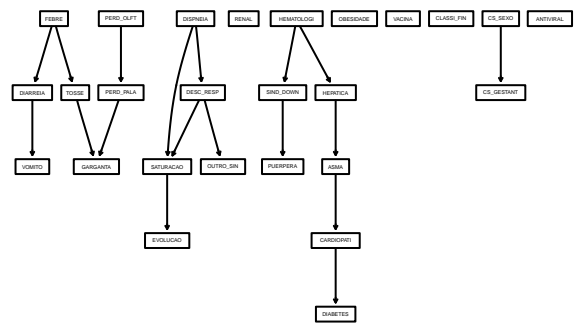
COVID VACINADOS 3. N = 12612



COVID VACINADOS 4. N = 12612



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



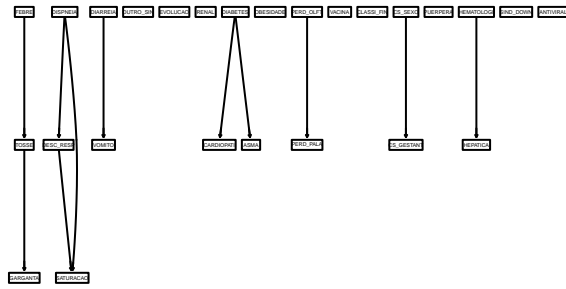
```

graph TD
    FERD_OULT --> FERD_PULA
    FERD_PULA --> SARGANTA
    SARGANTA --> FEBRE
    FEBRE --> TOSSE
    FEBRE --> DIARREIA
    TOSSE --> DISPNEIA
    DIARREIA --> VOMITO
    DISPNEIA --> RESC_RESI
    RESC_RESI --> SATURACAC
    RESC_RESI --> OUTRO_SIN
    RENAL --> DIABETES
    RENAL --> NEMATOLOGI
    DIABETES --> CARDIOPAT
    DIABETES --> ASMA
    CARDIOPAT --> EVOLUCAC
    ASMA --> EVOLUCAC
    OBESIDADE --> EVOLUCAC
    VACINA --> EVOLUCAC
    CLASSI_FIN --> EVOLUCAC
    CS_SEX --> CS_GESTAN
    CS_GESTAN --> EVOLUCAC
    PUERPERA --> BIND_DOWN
    BIND_DOWN --> EVOLUCAC
    HEPTICA --> EVOLUCAC
    ANTIVIRAL --> EVOLUCAC

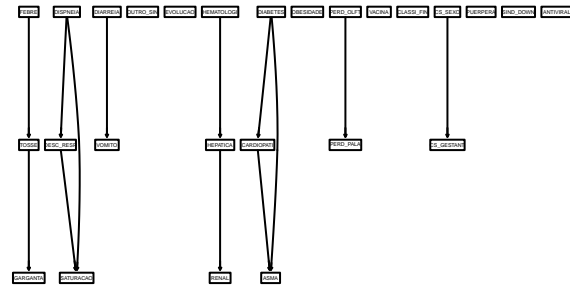
```



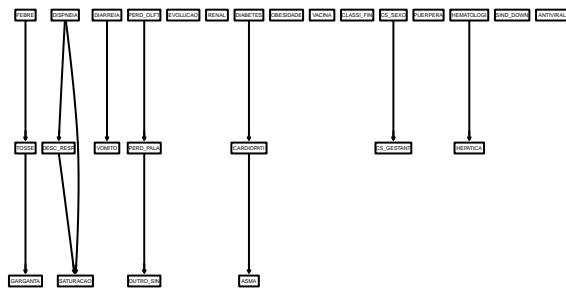
NAO COVID VACINADOS 1. N = 3014



NAO COVID VACINADOS 2. N = 3014



NAO COVID VACINADOS 3. N = 3014



NAO COVID VACINADOS 4. N = 3014

