

Validação - Somente COVID-19

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Variáveis selecionadas

```
## Rows: 76,666
## Columns: 11
## $ IDADE      <fct> "(37,73]", "(37,73]", "(73,109]", "(37,73]", "(73,109]", "(~
## $ EVOLUCAO   <fct> 2, 1, 1, 1, 2, 1, 2, 2, 1, 2, 1, 2, 2, 2, 1, 1, 1, 1, 1, 1,~
## $ RENAL      <fct> 2, 2, 2, 1, 2, 1, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ DIABETES   <fct> 2, 1, 2, 1, 2, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2,~
## $ OBESIDADE  <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 1, 2, 2, 9, 2,~
## $ NEUROLOGIC <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 9, 2, 2, 2,~
## $ PNEUMOPATI <fct> 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
## $ UTI        <fct> 1, 1, 2, 1, 2, 2, 1, 2, 2, 2, 2, 2, 1, 1, 2, 2, 1, 2, 2, 2,~
## $ CARDIOPATI <fct> 2, 2, 2, 1, 1, 2, 2, 1, 1, 1, 1, 1, 1, 1, 2, 2, 1, 1, 1, 1,~
## $ SUPORT_VEN <fct> 2, 2, 2, 9, 3, 3, 2, 2, 3, 2, 2, 3, 1, 1, 3, 3, 2, 3, 9, 3,~
## $ ANTIVIRAL  <fct> 2, 2, 2, 9, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,~
```

Imposição de estrutura com arcos que fazem sentido clínico (*White list*)

```
s1 <- sample_frac(ddf, .8, FALSE)
cat(nrow(ddf) - nrow(s1))

## 15333

wl = matrix(c("OBESIDADE", "DIABETES",
              "IDADE", "DIABETES",
              "IDADE", "SUPORT_VEN",
              "IDADE", "NEUROLOGIC",
              "DIABETES", "RENAL",
              "DIABETES", "CARDIOPATI",
              "UTI", "EVOLUCAO"),
            ncol = 2, byrow = TRUE, dimnames = list(NULL, c("from", "to")))

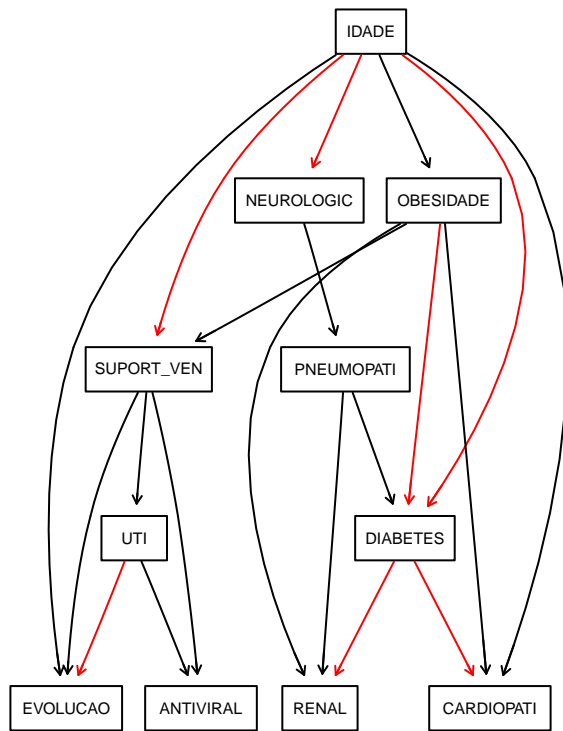
bn1 <- mmhc(s1, whitelist = wl)

#sem WL
bn2 <- mmhc(s1, whitelist = NULL)
```

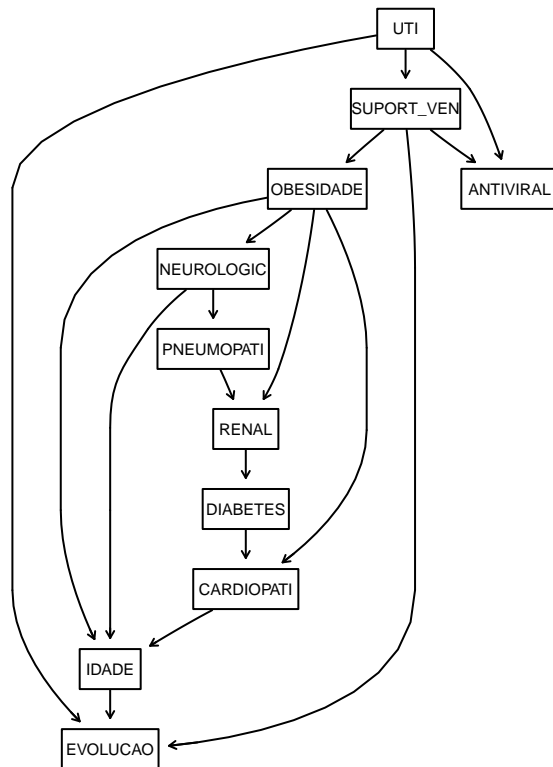
DAG (*Directed Acyclic Graph*) usando ou não *whitelisting* no algoritmo de aprendizado da estrutura da rede causal

```
par(mfrow = c(1, 2))
graphviz.plot(bn1, shape='rectangle', highlight = list(arcs = wl), main = 'DAG com imposição de uma WL'
graphviz.plot(bn2, shape='rectangle', highlight = NULL, main = 'DAG sem WL')
```

DAG com imposição de uma WL



DAG sem WL



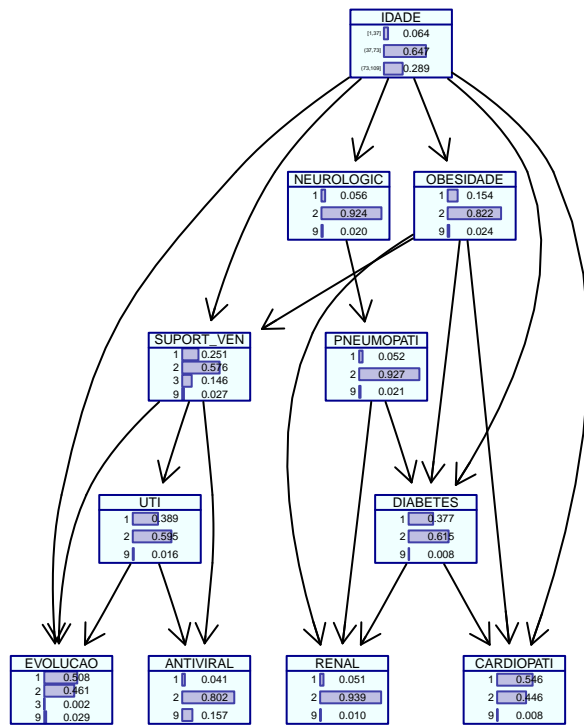
```
fitted.1 <- bn.fit(bn1, s1)
fitted.2 <- bn.fit(bn2, s1)
```

```
par(mfrow=c(1,2))
```

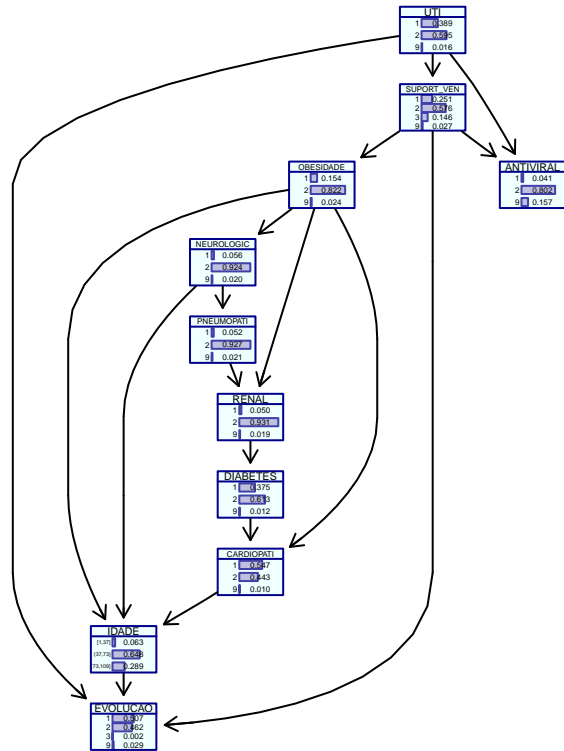
```
graphviz.chart(fitted.1,type = "barprob", col = "darkblue", bg = "azure", bar.col = "darkblue", main =
```

```
graphviz.chart(fitted.2, type = "barprob", col = "darkblue", bg = "azure", bar.col = "darkblue", main =
```

DAG sem WL



DAG com WL



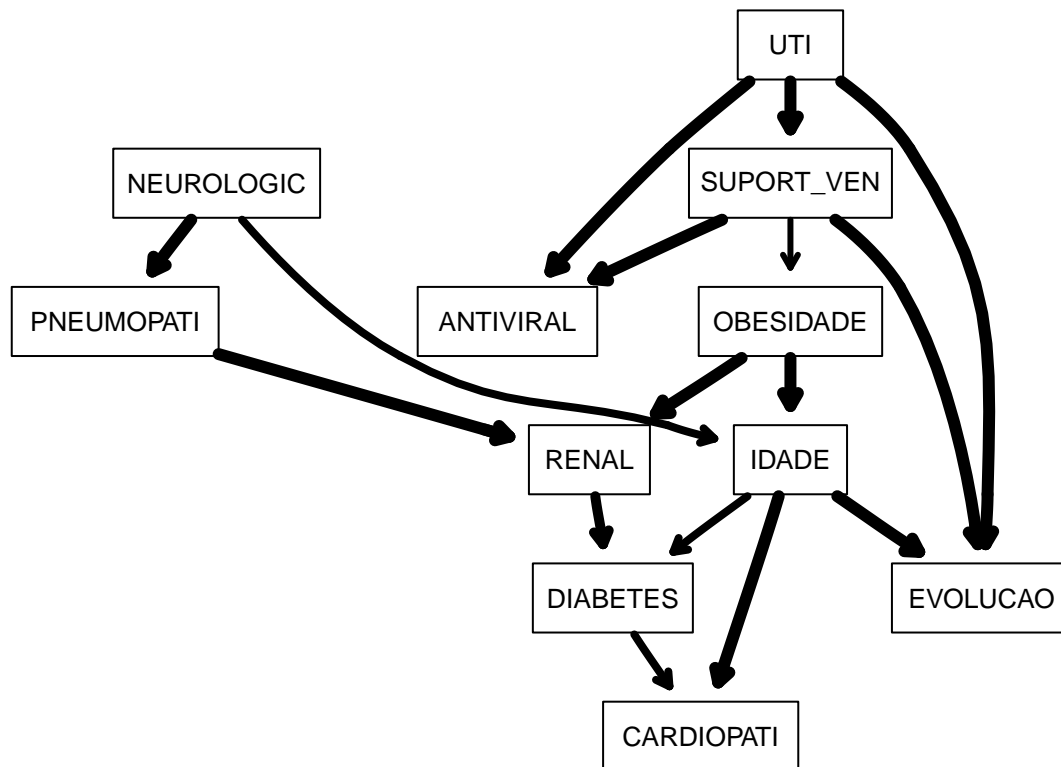
Bootstrapping com WL

```
boots.trap <- 200
str.diff = suppressMessages(boot.strength(s1, R = boots.trap, algorithm = "mmhc"))
cat(paste('Threshold: ', attr(str.diff, "threshold")))

## Threshold: 0.68

avg.diff = averaged.network(str.diff)
strength.plot(avg.diff, str.diff, shape = "rectangle", main = paste("Iterações = ", boots.trap))
```

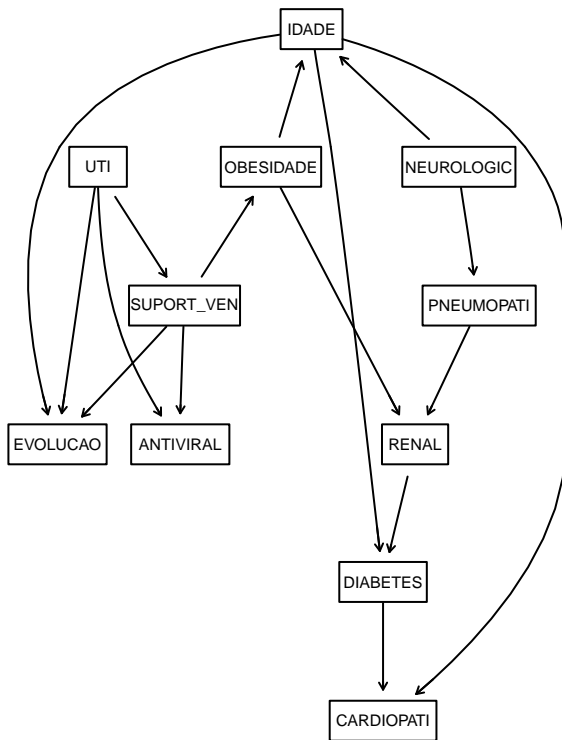
Iterações = 200



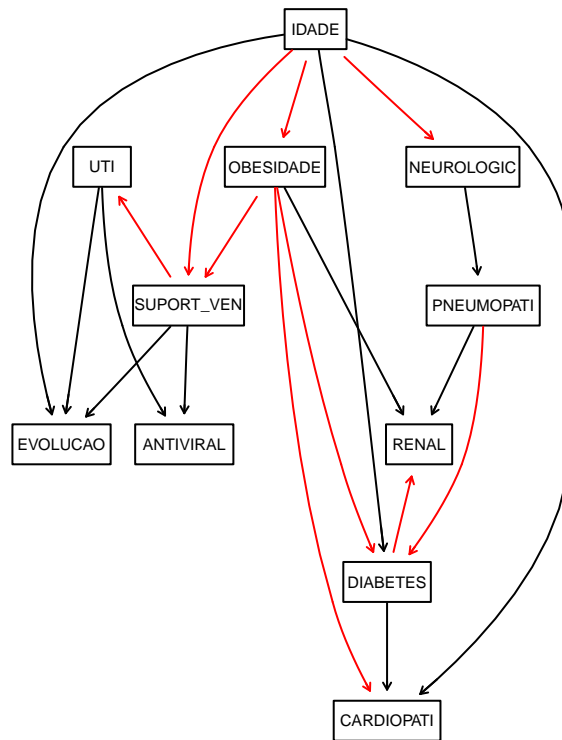
How can we compare the averaged network (avg.diff) with the network we originally learned in from all the data? The most qualitative way is to plot the two networks side by side, with the nodes in the same positions, and highlight the arcs that appear in one network and not in the other, or that appear with different directions.

```
par(mfrow = c(1, 2))
graphviz.compare(avg.diff, bn1, shape = "rectangle", main = c("DAG médio sem WL", "DAG médio com WL"))
```

DAG médio sem WL

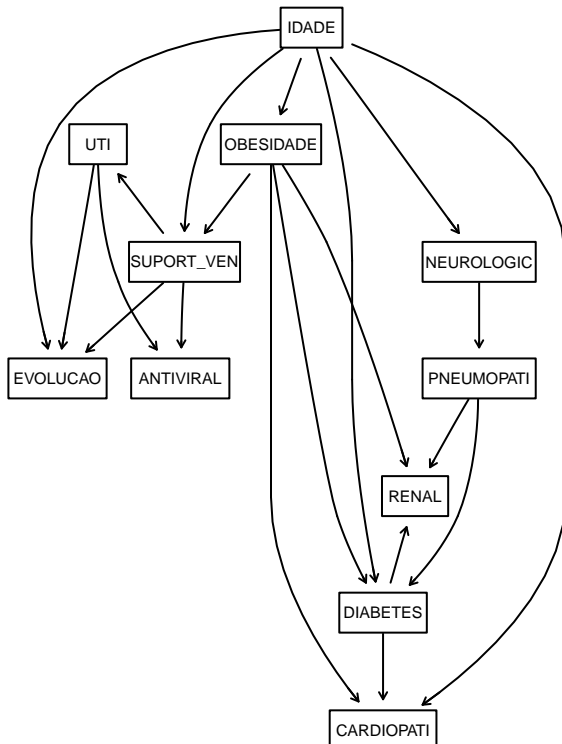


DAG médio com WL

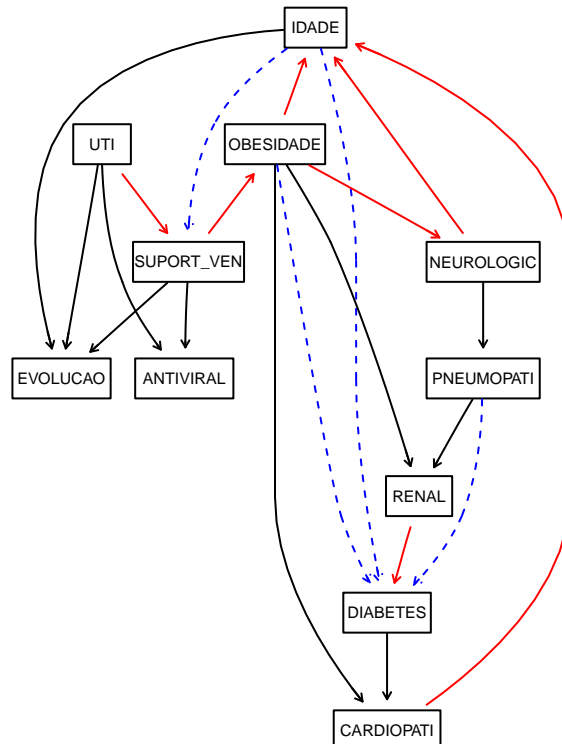


```
par(mfrow = c(1, 2))
graphviz.compare(bn1, bn2, shape = "rectangle", main = c("DAG único sem WL", "DAG único com WL"))
```

DAG único sem WL



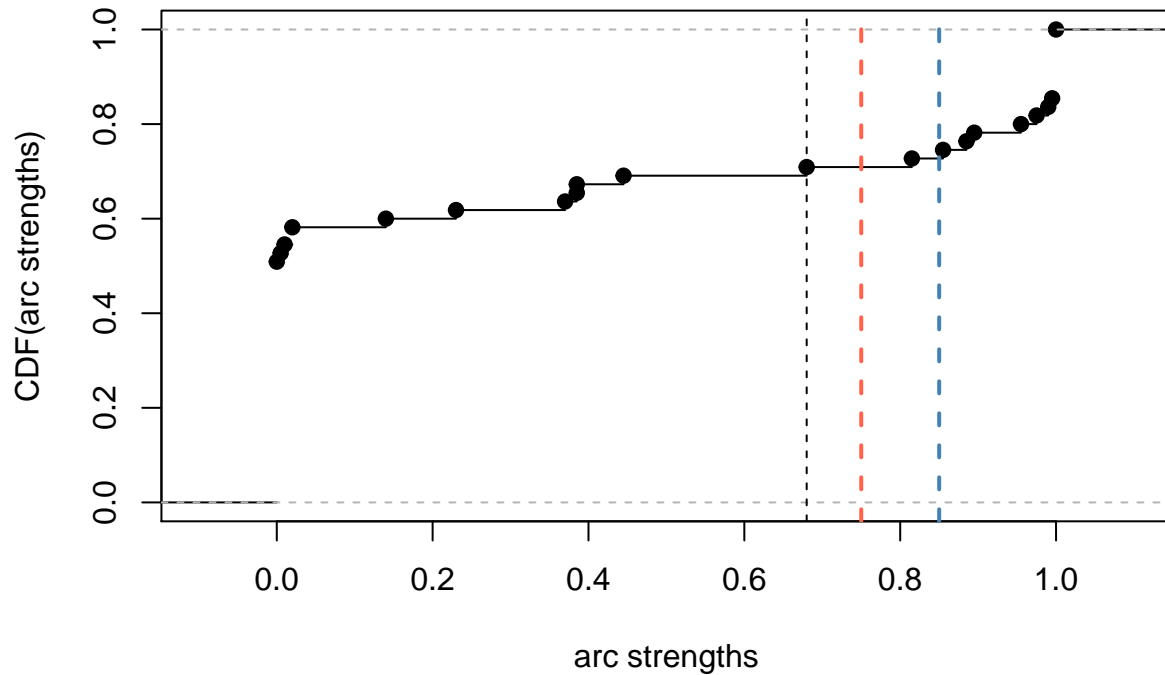
DAG único com WL



It is also a good idea to look at the threshold with respect to the distribution of the arc strengths

```
plot(str.diff)
abline(v = 0.75, col = "tomato", lty = 2, lwd = 2)
abline(v = 0.85, col = "steelblue", lty = 2, lwd = 2)
```

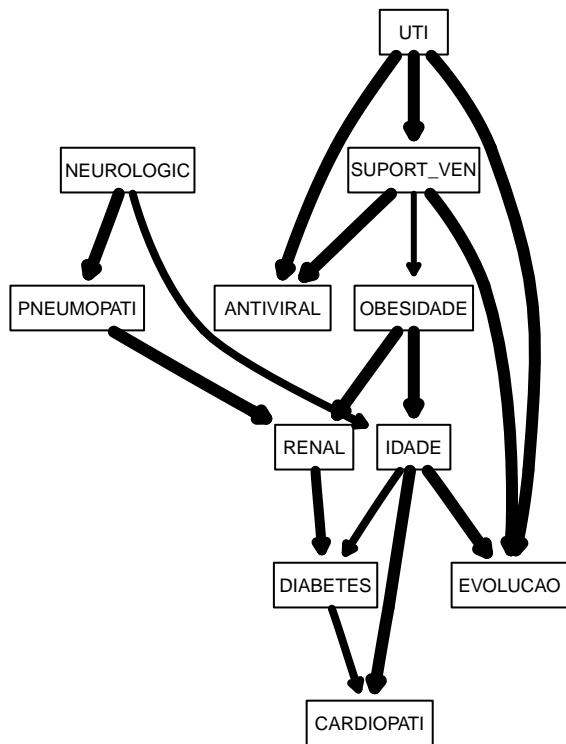
threshold = 0.68



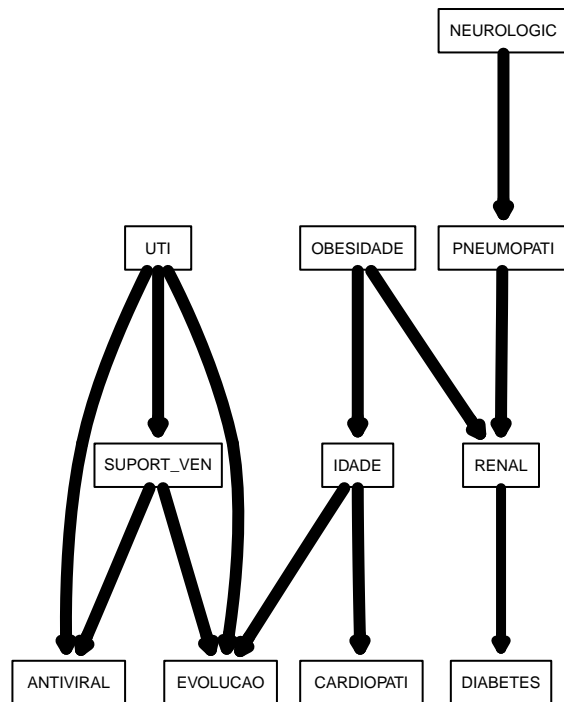
The simpler network we obtain by setting threshold = 0.8 in averaged.network() is shown below; it is certainly easier to reason with from a qualitative point of view.

```
par(mfrow = c(1, 2))
avg.simpler = averaged.network(str.diff, threshold = 0.95)
strength.plot(avg.diff, str.diff, shape = "rectangle",
              main = paste("Iterações = ", boots.trap, " Thr = ", attr(str.diff, "threshold")))
strength.plot(avg.simpler, str.diff, shape = "rectangle", main = 'Iterações = 100 Thr = 0.95')
```

Iterações = 200 Thr = 0.68



Iterações = 100 Thr = 0.95



Markov Blanket da variável evolução

```
cat (mb(x = avg.diff, node = 'EVOLUCAO'))
```

```
## IDADE UTI SUPORT_VEN
```

```
##
```

```
cat (mb(x = avg.simpler, node = 'EVOLUCAO'))
```

```
## IDADE UTI SUPORT_VEN
```