Model Selection Results

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```
library(tidyverse)
library(kableExtra)

source("aux_functions.R")
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Model Selection

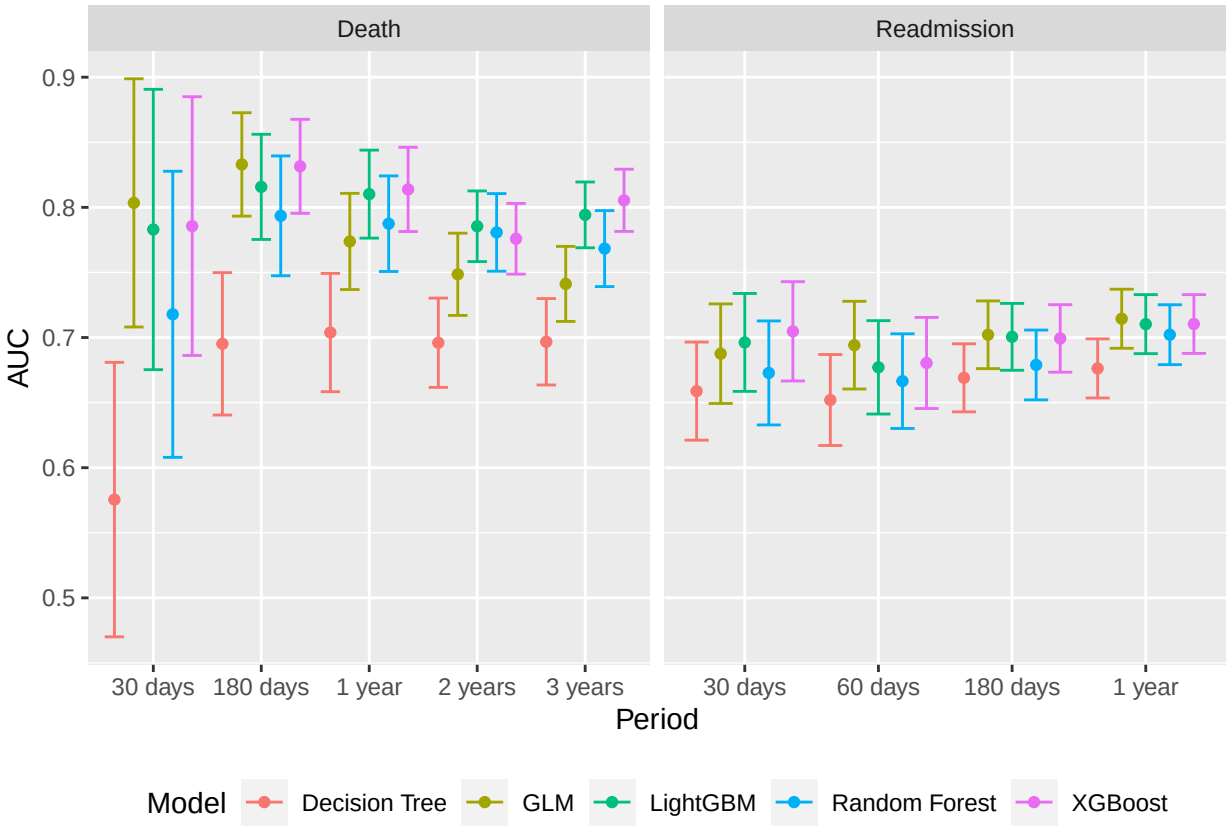

Table 1: Readmission models comparison

Period	Model	AUC	Lower Limit	Upper Limit
180 days	XGBoost	0.70	0.67	0.73
180 days	LightGBM	0.70	0.67	0.73
180 days	GLM	0.70	0.68	0.73
180 days	Decision Tree	0.67	0.64	0.70
180 days	Random Forest	0.68	0.65	0.71
1 year	XGBoost	0.71	0.69	0.73
1 year	LightGBM	0.71	0.69	0.73
1 year	GLM	0.71	0.69	0.74
1 year	Decision Tree	0.68	0.65	0.70
1 year	Random Forest	0.70	0.68	0.73
30 days	XGBoost	0.70	0.67	0.74

Table 1: Readmission models comparison *(continued)*

Period	Model	AUC	Lower Limit	Upper Limit
30 days	LightGBM	0.70	0.66	0.73
30 days	GLM	0.69	0.65	0.73
30 days	Decision Tree	0.66	0.62	0.70
30 days	Random Forest	0.67	0.63	0.71
60 days	XGBoost	0.68	0.65	0.72
60 days	LightGBM	0.68	0.64	0.71
60 days	GLM	0.69	0.66	0.73
60 days	Decision Tree	0.65	0.62	0.69
60 days	Random Forest	0.67	0.63	0.70

Table 2: Death models comparison

Period	Model	AUC	Lower Limit	Upper Limit
180 days	XGBoost	0.83	0.80	0.87
180 days	LightGBM	0.82	0.78	0.86
180 days	GLM	0.83	0.79	0.87
180 days	Decision Tree	0.70	0.64	0.75
180 days	Random Forest	0.79	0.75	0.84
1 year	XGBoost	0.81	0.78	0.85
1 year	LightGBM	0.81	0.78	0.84
1 year	GLM	0.77	0.74	0.81
1 year	Decision Tree	0.70	0.66	0.75
1 year	Random Forest	0.79	0.75	0.82
2 years	XGBoost	0.78	0.75	0.80
2 years	LightGBM	0.79	0.76	0.81
2 years	GLM	0.75	0.72	0.78
2 years	Decision Tree	0.70	0.66	0.73
2 years	Random Forest	0.78	0.75	0.81
30 days	XGBoost	0.79	0.69	0.89
30 days	LightGBM	0.78	0.68	0.89
30 days	GLM	0.80	0.71	0.90
30 days	Decision Tree	0.58	0.47	0.68
30 days	Random Forest	0.72	0.61	0.83
3 years	XGBoost	0.81	0.78	0.83
3 years	LightGBM	0.79	0.77	0.82
3 years	GLM	0.74	0.71	0.77
3 years	Decision Tree	0.70	0.66	0.73
3 years	Random Forest	0.77	0.74	0.80

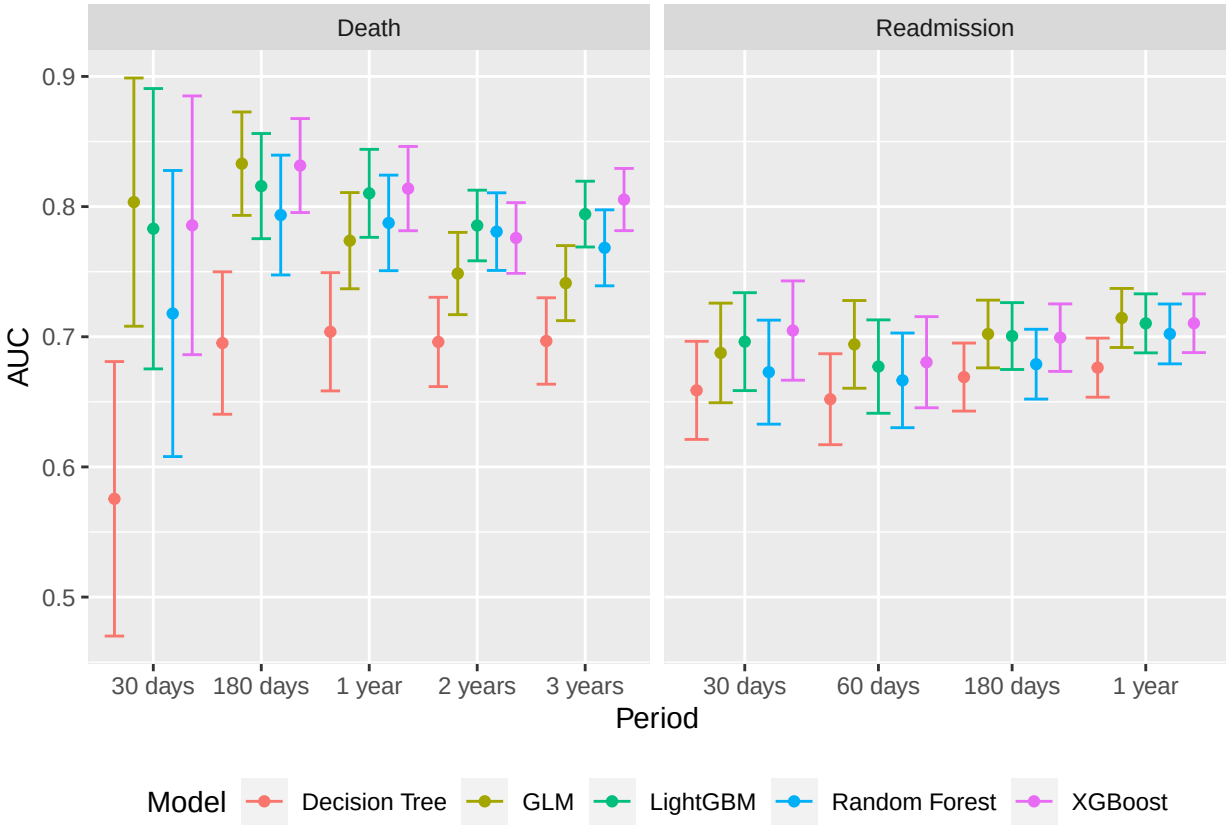

Table 3: Readmission models comparison

Period	Model	AUC	Lower Limit	Upper Limit
180 days	XGBoost	0.70	0.67	0.73
180 days	LightGBM	0.70	0.67	0.73
180 days	GLM	0.70	0.68	0.73
180 days	Decision Tree	0.67	0.64	0.70
180 days	Random Forest	0.68	0.65	0.71
1 year	XGBoost	0.71	0.69	0.73
1 year	LightGBM	0.71	0.69	0.73
1 year	GLM	0.71	0.69	0.74
1 year	Decision Tree	0.68	0.65	0.70
1 year	Random Forest	0.70	0.68	0.73
30 days	XGBoost	0.70	0.67	0.74
30 days	LightGBM	0.70	0.66	0.73
30 days	GLM	0.69	0.65	0.73
30 days	Decision Tree	0.66	0.62	0.70
30 days	Random Forest	0.67	0.63	0.71
60 days	XGBoost	0.68	0.65	0.72
60 days	LightGBM	0.68	0.64	0.71
60 days	GLM	0.69	0.66	0.73
60 days	Decision Tree	0.65	0.62	0.69
60 days	Random Forest	0.67	0.63	0.70

Table 4: Death models comparison

Period	Model	AUC	Lower Limit	Upper Limit
180 days	XGBoost	0.83	0.80	0.87
180 days	LightGBM	0.82	0.78	0.86

Table 4: Death models comparison *(continued)*

Period	Model	AUC	Lower Limit	Upper Limit
180 days	GLM	0.83	0.79	0.87
180 days	Decision Tree	0.70	0.64	0.75
180 days	Random Forest	0.79	0.75	0.84
1 year	XGBoost	0.81	0.78	0.85
1 year	LightGBM	0.81	0.78	0.84
1 year	GLM	0.77	0.74	0.81
1 year	Decision Tree	0.70	0.66	0.75
1 year	Random Forest	0.79	0.75	0.82
2 years	XGBoost	0.78	0.75	0.80
2 years	LightGBM	0.79	0.76	0.81
2 years	GLM	0.75	0.72	0.78
2 years	Decision Tree	0.70	0.66	0.73
2 years	Random Forest	0.78	0.75	0.81
30 days	XGBoost	0.79	0.69	0.89
30 days	LightGBM	0.78	0.68	0.89
30 days	GLM	0.80	0.71	0.90
30 days	Decision Tree	0.58	0.47	0.68
30 days	Random Forest	0.72	0.61	0.83
3 years	XGBoost	0.81	0.78	0.83
3 years	LightGBM	0.79	0.77	0.82
3 years	GLM	0.74	0.71	0.77
3 years	Decision Tree	0.70	0.66	0.73
3 years	Random Forest	0.77	0.74	0.80

Final Model

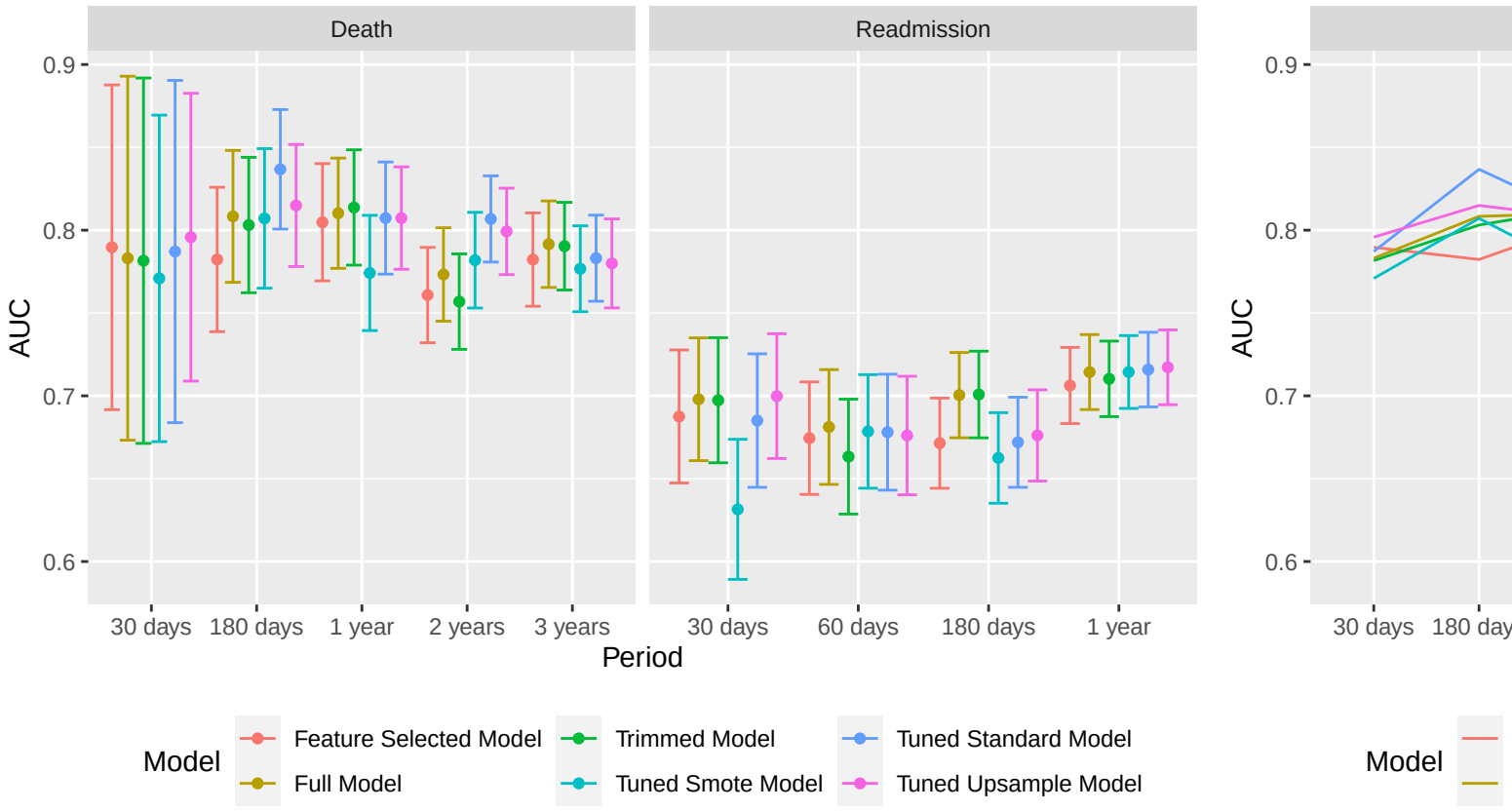

Table 5: Readmission models comparison

Period	Model	AUC	Lower Limit	Upper Limit
180 days	Full Model	0.70	0.67	0.73
180 days	Trimmed Model	0.70	0.67	0.73
180 days	Feature Selected Model	0.67	0.64	0.70
180 days	Tuned Standard Model	0.67	0.64	0.70
180 days	Tuned Smote Model	0.66	0.64	0.69
180 days	Tuned Upsample Model	0.68	0.65	0.70
1 year	Full Model	0.71	0.69	0.74
1 year	Trimmed Model	0.71	0.69	0.73
1 year	Feature Selected Model	0.71	0.68	0.73
1 year	Tuned Standard Model	0.72	0.69	0.74
1 year	Tuned Smote Model	0.71	0.69	0.74
1 year	Tuned Upsample Model	0.72	0.69	0.74
30 days	Full Model	0.70	0.66	0.73
30 days	Trimmed Model	0.70	0.66	0.74
30 days	Feature Selected Model	0.69	0.65	0.73
30 days	Tuned Standard Model	0.69	0.64	0.73
30 days	Tuned Smote Model	0.63	0.59	0.67
30 days	Tuned Upsample Model	0.70	0.66	0.74
60 days	Full Model	0.68	0.65	0.72
60 days	Trimmed Model	0.66	0.63	0.70
60 days	Feature Selected Model	0.67	0.64	0.71
60 days	Tuned Standard Model	0.68	0.64	0.71
60 days	Tuned Smote Model	0.68	0.64	0.71
60 days	Tuned Upsample Model	0.68	0.64	0.71

Table 6: Death models comparison

Period	Model	AUC	Lower Limit	Upper Limit
180 days	Full Model	0.81	0.77	0.85
180 days	Trimmed Model	0.80	0.76	0.84
180 days	Feature Selected Model	0.78	0.74	0.83
180 days	Tuned Standard Model	0.84	0.80	0.87
180 days	Tuned Smote Model	0.81	0.76	0.85
180 days	Tuned Upsample Model	0.81	0.78	0.85
1 year	Full Model	0.81	0.78	0.84
1 year	Trimmed Model	0.81	0.78	0.85
1 year	Feature Selected Model	0.80	0.77	0.84
1 year	Tuned Standard Model	0.81	0.77	0.84
1 year	Tuned Smote Model	0.77	0.74	0.81
1 year	Tuned Upsample Model	0.81	0.78	0.84
2 years	Full Model	0.77	0.75	0.80
2 years	Trimmed Model	0.76	0.73	0.79
2 years	Feature Selected Model	0.76	0.73	0.79
2 years	Tuned Standard Model	0.81	0.78	0.83
2 years	Tuned Smote Model	0.78	0.75	0.81
2 years	Tuned Upsample Model	0.80	0.77	0.83
30 days	Full Model	0.78	0.67	0.89
30 days	Trimmed Model	0.78	0.67	0.89
30 days	Feature Selected Model	0.79	0.69	0.89
30 days	Tuned Standard Model	0.79	0.68	0.89
30 days	Tuned Smote Model	0.77	0.67	0.87
30 days	Tuned Upsample Model	0.80	0.71	0.88

Table 6: Death models comparison *(continued)*

Period	Model	AUC	Lower Limit	Upper Limit
3 years	Full Model	0.79	0.77	0.82
3 years	Trimmed Model	0.79	0.76	0.82
3 years	Feature Selected Model	0.78	0.75	0.81
3 years	Tuned Standard Model	0.78	0.76	0.81
3 years	Tuned Smote Model	0.78	0.75	0.80
3 years	Tuned Upsample Model	0.78	0.75	0.81

death_180days

1. hospital_stay
2. age
3. laboratorio
4. vasodilatador
5. espironolactona
6. year_adm_t0
7. ieca_bra
8. analises_clinicas_qtde
9. admission_pre_t0_count
10. comorbidities_count
11. icu_t0
12. equipe_multiprof
13. meds_cardiovasc_qtde
14. meds_antimicrobianos
15. diuretico
16. classe_meds_qtde
17. antiarritmico
18. estatina
19. admission_pre_t0_180d
20. dva
21. insuf_cardiaca
22. psicofarmacos
23. exames_imagem_qtde
24. ecocardiograma
25. stroke
26. metodos_graficos_qtde
27. cied_final_group_1
28. admission_t0_emergency
29. cateterismo
30. citologia
31. interconsulta
32. proced_invasivos_qtde
33. cintilografia
34. renal_failure
35. ultrassom
36. af
37. sex
38. cancer
39. copd
40. tomografia
41. diabetes
42. cultura
43. prior_mi
44. holter
45. reop_type_1
46. heart_failure
47. hypertension

48. procedure_type_new
49. digoxina
50. nyha_basal
51. endoscopia

death_1year

1. age
2. hospital_stay
3. year_adm_t0
4. comorbidities_count
5. admission_pre_t0_count
6. vasodilatador
7. laboratorio
8. espironolactona
9. metodos_graficos_qtde
10. meds_cardiovasc_qtde
11. classe_meds_qtde
12. psicofarmacos
13. meds_antimicrobianos
14. ieca_bra
15. icu_t0
16. diuretico
17. estatina
18. insuf_cardiaca
19. equipe_multiprof
20. exames_imagem_qtde
21. antiarritmico
22. education_level
23. cied_final_group_1
24. dva

death_2year

1. sex
2. age
3. education_level
4. heart_disease
5. hypertension
6. prior_mi
7. heart_failure
8. af
9. valvopathy
10. diabetes
11. renal_failure
12. hemodialysis
13. stroke
14. comorbidities_count
15. procedure_type_1
16. cied_final_1
17. cied_final_group_1
18. admission_pre_t0_count
19. admission_pre_t0_180d
20. year_adm_t0
21. icu_t0
22. dialysis_t0
23. admission_t0_emergency
24. aco
25. antiarritmico
26. ieca_bra

27. dva
28. digoxina
29. estatina
30. diuretico
31. vasodilatador
32. insuf_cardiaca
33. espironolactona
34. antiplaquetario_ev
35. psicofarmacos
36. antiviral
37. classe_meds_qtde
38. meds_cardiovasc_qtde
39. meds_antimicrobianos
40. vni
41. ventilacao_mecanica
42. transplante_cardiaco
43. icp
44. angioplastia
45. cateterismo
46. proced_invasivos_qtde
47. transfusao
48. interconsulta
49. equipe_multiprof
50. teste_esforco
51. tilt_teste
52. metodos_graficos_qtde
53. laboratorio
54. cultura
55. analises_clinicas_qtde
56. citologia
57. histopatologia_qtde
58. cintilografia
59. ecocardiograma
60. pet_ct
61. ultrassom
62. tomografia
63. exames_imagem_qtde
64. hospital_stay

death_30days

1. sex
2. age
3. education_level
4. underlying_heart_disease
5. heart_disease
6. nyha_basal
7. hypertension
8. prior_mi
9. heart_failure
10. af
11. valvopathy
12. diabetes
13. renal_failure
14. hemodialysis
15. cancer
16. comorbidities_count
17. procedure_type_1
18. reop_type_1
19. procedure_type_new
20. cied_final_1

21. cied_final_group_1
22. admission_pre_t0_count
23. admission_pre_t0_180d
24. year_adm_t0
25. icu_t0
26. antiarritmico
27. antihipertensivo
28. betabloqueador
29. dva
30. diuretico
31. vasodilatador
32. espironolactona
33. antiplaquetario_ev
34. insulina
35. psicofarmacos
36. antifungico
37. classe_meds_qtde
38. meds_cardiovasc_qtde
39. meds_antimicrobianos
40. ventilacao_mecanica
41. intervencao_cv
42. cateter_venoso_central
43. proced_invasivos_qtde
44. transfusao
45. interconsulta
46. equipe_multiprof
47. holter
48. metodos_graficos_qtde
49. laboratorio
50. cultura
51. analises_clinicas_qtde
52. citologia
53. histopatologia_qtde
54. angio_tc
55. angiografia
56. cintilografia
57. ecocardiograma
58. flebografia
59. ultrassom
60. tomografia
61. ressonancia
62. exames_imagem_qtde
63. bic
64. hospital_stay

death_3year

1. hospital_stay
2. admission_pre_t0_count
3. year_adm_t0
4. espironolactona
5. age
6. classe_meds_qtde
7. education_level
8. comorbidities_count
9. ieca_bra
10. diuretico
11. insuf_cardiaca
12. meds_antimicrobianos
13. laboratorio
14. metodos_graficos_qtde

15. vasodilatador
16. meds_cardiovasc_qtde
17. equipe_multiprof
18. psicofarmacos
19. icu_t0
20. antiarritmico

readmission_180d

1. hospital_stay
2. age
3. meds_cardiovasc_qtde
4. admission_pre_t0_count
5. icu_t0
6. laboratorio
7. ieca_bra
8. classe_meds_qtde
9. meds_antimicrobianos
10. vasodilatador
11. metodos_graficos_qtde
12. antiarritmico
13. exames_imagem_qtde
14. diuretico
15. psicofarmacos
16. equipe_multiprof
17. estatina
18. cied_final_1
19. dva
20. histopatologia_qtde
21. comorbidities_count
22. espironolactona
23. proced_invasivos_qtde

readmission_1year

1. hospital_stay
2. admission_pre_t0_count
3. meds_cardiovasc_qtde
4. vasodilatador
5. admission_pre_t0_180d
6. icu_t0
7. classe_meds_qtde
8. diuretico
9. year_adm_t0
10. antiarritmico
11. cied_final_1
12. equipe_multiprof
13. age
14. metodos_graficos_qtde
15. reop_type_1
16. admission_t0_emergency
17. ieca_bra
18. insuf_cardiaca
19. espironolactona
20. laboratorio
21. bloq_calcio
22. meds_antimicrobianos
23. cied_final_group_1
24. procedure_type_new
25. estatina

26. dva
27. education_level
28. psicofarmacos
29. analises_clinicas_qtde
30. exames_imagem_qtde
31. proced_invasivos_qtde
32. sex
33. heart_failure
34. patient_state
35. aco
36. digoxina
37. cultura
38. comorbidities_count
39. holter
40. betabloqueador
41. nyha_basal
42. prior_mi
43. valvopathy
44. histopatologia_qtde
45. underlying_heart_disease
46. outros_proced_cirurgicos
47. ressonancia
48. cardiac_arrest
49. ventilacao_mecanica
50. anticonvulsivante
51. heart_disease

readmission_30d

1. hospital_stay
2. analises_clinicas_qtde
3. meds_antimicrobianos
4. vasodilatador
5. classe_meds_qtde
6. metodos_graficos_qtde
7. exames_imagem_qtde
8. icu_t0
9. meds_cardiovasc_qtde
10. admission_pre_t0_count
11. estatina
12. diuretico
13. bic
14. equipe_multiprof
15. psicofarmacos
16. anticonvulsivante
17. antiarritmico
18. comorbidities_count
19. insuf_cardiaca
20. digoxina
21. angio_rm

readmission_60d

1. age
2. underlying_heart_disease
3. heart_disease
4. prior_mi
5. heart_failure
6. af
7. transplant

8. hemodialysis
9. comorbidities_count
10. procedure_type_1
11. reop_type_1
12. procedure_type_new
13. cied_final_group_1
14. admission_pre_t0_count
15. admission_pre_t0_180d
16. icu_t0
17. dialysis_t0
18. admission_t0_emergency
19. aco
20. antiarritmico
21. betabloqueador
22. ieca_bra
23. dva
24. estatina
25. diuretico
26. vasodilatador
27. insuf_cardiaca
28. espironolactona
29. bloq_calcio
30. antiplaquetario_ev
31. insulina
32. anticonvulsivante
33. psicofarmacos
34. antiviral
35. classe_meds_qtde
36. meds_cardiovasc_qtde
37. meds_antimicrobianos
38. cec
39. transplante_cardiaco
40. cir_toracica
41. icp
42. angioplastia
43. cateterismo
44. proced_invasivos_qtde
45. equipe_multiprof
46. holter
47. teste_esforco
48. espiro_ergoespiro
49. tilt_teste
50. metodos_graficos_qtde
51. laboratorio
52. cultura
53. analises_clinicas_qtde
54. biopsia
55. histopatologia_qtde
56. angio_rm
57. arteriografia
58. cintilografia
59. ecocardiograma
60. endoscopia
61. pet_ct
62. ultrassom
63. exames_imagem_qtde
64. bic
65. hospital_stay

Union

1. hospital_stay
2. age
3. laboratorio
4. vasodilatador
5. espironolactona
6. year_adm_t0
7. ieca_bra
8. analises_clinicas_qtde
9. admission_pre_t0_count
10. comorbidities_count
11. icu_t0
12. equipe_multiprof
13. meds_cardiovasc_qtde
14. meds_antimicrobianos
15. diuretico
16. classe_meds_qtde
17. antiarritmico
18. estatina
19. admission_pre_t0_180d
20. dva
21. insuf_cardiaca
22. psicofarmacos
23. exames_imagem_qtde
24. ecocardiograma
25. stroke
26. metodos_graficos_qtde
27. cied_final_group_1
28. admission_t0_emergency
29. cateterismo
30. citologia
31. interconsulta
32. proced_invasivos_qtde
33. cintilografia
34. renal_failure
35. ultrassom
36. af
37. sex
38. cancer
39. copd
40. tomografia
41. diabetes
42. cultura
43. prior_mi
44. holter
45. reop_type_1
46. heart_failure
47. hypertension
48. procedure_type_new
49. digoxina
50. nyha_basal
51. endoscopia
52. education_level
53. heart_disease
54. valvopathy
55. hemodialysis
56. procedure_type_1
57. cied_final_1
58. dialysis_t0
59. aco

60. antiplaquetario_ev
61. antiviral
62. vni
63. ventilacao_mecanica
64. transplante_cardiaco
65. icp
66. angioplastia
67. transfusao
68. teste_esforco
69. tilt_teste
70. histopatologia_qtde
71. pet_ct
72. underlying_heart_disease
73. antihipertensivo
74. betabloqueador
75. insulina
76. antifungico
77. intervencao_cv
78. cateter_venoso_central
79. angio_tc
80. angiografia
81. flebografia
82. ressonancia
83. bic
84. bloq_calcio
85. patient_state
86. outros_proced_cirurgicos
87. cardiac_arrest
88. anticonvulsivante
89. angio_rm
90. transplant
91. cec
92. cir_toracica
93. espiro_ergoespiro
94. biopsia
95. arteriografia