

A simple model to predict the risk of frequent ED utilization

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Introduction

Many chronic conditions can be effectively managed by primary care services with appropriate medical screening, monitoring and follow-up, thus decreasing emergency department (ED) use. These conditions are often defined as ambulatory care sensitive conditions (ACSC) [1]. Being able to identify patients at risk of frequent ED use would allow healthcare professionals to redirect them to more appropriate health services [2] such as case management programs [3].

Objectives

- To determine predictive factors associated with frequent ED utilization in an adult population with ACSC
- To evaluate the impact of including different sets of predictors among sociodemographic status (SDS), physical and mental comorbidities, and prior healthcare utilization on the performance of the predictive models

Methods

Design & data sources

Observational population-based cohort study extracted from Québec's administrative data

Study cohort

Inclusion criteria: Patients with an ED visit between Jan 2012 and Dec 2013 (index visit=random sample), aged 18-74 years, previously diagnosed with an ACSC

Exclusion criteria: Patients with dementia, living in remote areas, and those that died within 1 year

Variables

Outcome : ≥ 4 ED visits 1 year after index date

Potential predictors:

- SDS: Age; Sex; Public Prescription Drug Insurance Plan (PPDIP); Type of residential area
- Comorbidities: Type of ACSC; Comorbidity index; Mental health disorders
- Prior healthcare use: Previous hospitalizations (2 years); Number of previous ED visits (1 year)

Statistical Analyses

Multiple logistic regressions (7 Models)

- Temporal split: derivation cohort (2012) and validation cohort (2013)
- 7 logistic regression models developed with the derivation sample, validated on the validation cohort

Figure 1: Selection of the study cohort

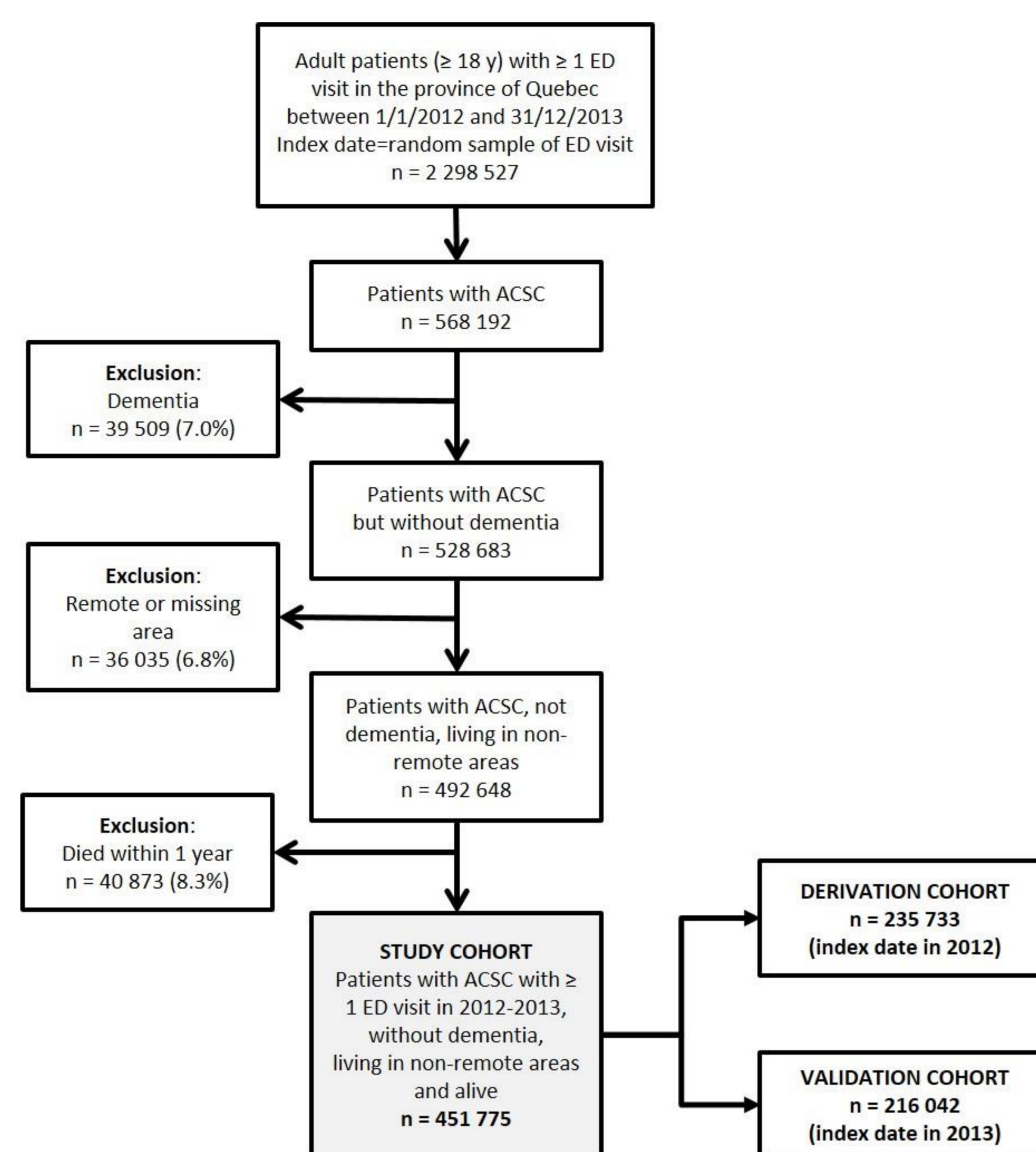
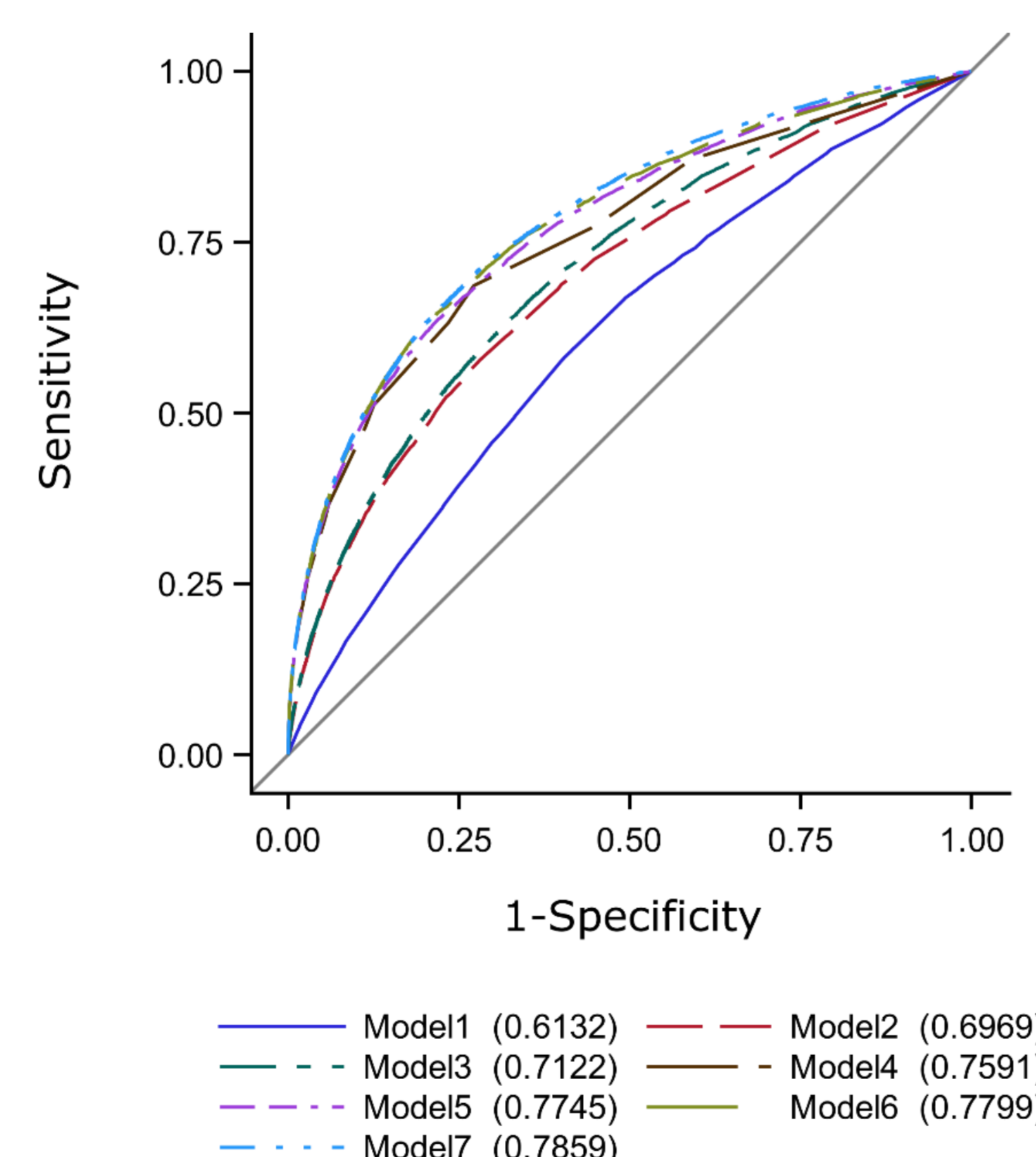


Figure 2: ROC curves



In Summary

- Important predictors include: Age (U-shape risk); Insurance status; COPD; Comorbidity index; Mental health disorders; Prior hospitalization; Number of prior ED visits
- Similar discrimination between Models 4 to 7 (AUC: 0.759 to 0.786)
- Models 4 to 7 all include prior healthcare utilization predictors
- Modest advantage of using more complex models (Models 5 to 7) over the simplest (Model 4)

Results

Table 1: Multiple logistic regression conducted on the derivation cohort (n=235 733) and evaluated on the validation cohort (n=216 042) for each of the 7 models

Predictors	Total n = 451 775	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Intercept	-	-3.7526	-4.0154	-4.5197	-4.1680	-4.5371	-4.3914	-4.7284
Sociodemographic status (SDS)								
Sex F (vs M)	217 455 (48.1 %)	-		0.1110		-		-
Age category (vs 55-64)								
18-34	23 723 (5.2 %)	0.4382		0.5284		0.1945		0.2973
35-54	83 393 (18.5 %)	0.2032		0.2382		0.0836		0.1287
65-74	116 323 (25.8 %)	0.0634		-0.0529		0.0095		-0.0187
75-84	93 091 (20.6 %)	0.3134		0.1273		0.2017		0.1651
≥ 85	36 109 (8.0 %)	0.5172		0.3027		0.3648		0.3383
PPDIP (vs Not admissible)								
Admissible – regular	170 044 (37.6 %)	0.2638		0.1857		0.1839		0.1596
Admissible – ≥ 65 income supplement	118 313 (26.2 %)	0.6183		0.4482		0.4291		0.3692
Admissible – LRFA	33 810 (7.5 %)	1.3465		0.7896		0.7449		0.5979
Residential area (vs Metropolitan)								
Small town	67 685 (15.0 %)	0.1834		0.1972		0.1314		0.1492
Rural	81 993 (18.2 %)	0.1670		0.2179		0.1112		0.1453
Physical and mental conditions								
ACSC – COPD	62 975 (13.9 %)		0.6763	0.6355		0.4242		0.3992
ACSC – Asthma	47 514 (10.5 %)		0.5180	0.4445		0.2432		0.2387
ACSC – CHF	27 945 (6.2 %)		0.4420	0.3989		0.1815		0.1446
ACSC – Epilepsy	11 538 (2.6 %)		0.3120	-		-		-
ACSC – CHD	113 141 (25.0 %)		0.3099	0.3450		0.1193		0.1308
ACSC – Diabetes	151 951 (33.6 %)		0.2820	0.2782		0.1884		0.1951
ACSC – HBP	245 449 (54.3 %)		-	-		-		-
Drug abuse	6908 (1.5 %)		0.9925	0.7786		0.3872		0.2526
Alcohol abuse	10 678 (2.4 %)		0.5353	0.5090		0.2270		0.2119
Psychosis	12 342 (2.7 %)		0.5299	0.4190		-		-
Depression	47 560 (10.5 %)		0.4815	0.4475		0.1718		0.1675
Comorbidity index (vs 0)								
1-2	98 228 (21.7 %)		0.5149	0.5178		0.3122		0.2851
3-4	34 395 (7.6 %)		0.7889	0.7873		0.4017		0.3643
≥ 5	41 354 (9.2 %)		0.8700	0.9021		0.3819		0.3724
Prior healthcare utilization								
General practitioner affiliation	299 689 (66.3 %)					-		-
Prior hospitalization past 2 years	191 862 (42.5 %)					0.4963	0.4361	0.2049
Number of prior ED visits past years	0.95 (1.62 SD)					0.4595	0.4466	0.4173
PERFORMANCE MEASURES (Validation Cohort n = 216 042)								
Area under ROC curve (AUC)		0.613	0.697	0.712	0.759	0.774	0.780	0.786
Calibration		-	0.092	0.043	0.057	0.051	0.059	0.053
Corrected R²		0.023	0.084	0.094	0.158	0.167	0.173	0.178
Integrated discrimination improvement		0.011	0.048	0.048	0.127	0.131	0.135	0.138
Akaike Information Criteria (AIC)		97 094	92 209	91 397	86 010	85 339	84 830	84 348

LRFA: last-resort financial assistance

Discussion

Frequent ED users represented 5% of the cohort and accounted for 36% of all ED visits. A simple 2-variable prediction model incorporating history of hospitalization and number of previous ED use accurately predicted future frequent ED use. This model performed nearly as well as the model with all sets of predictors included (area under ROC curve 0.759 vs 0.786).

Conclusion

This simple 2-factor model performed almost as well as the full multiple factor model, which is a practical advantage for its use in an ED visit context.

References

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