

Supplementary Online Content

Donzé J, Aujesky D, Williams D, Schnipper JL. Potentially avoidable 30-day hospital readmissions in medical patients: derivation and validation of a prediction model. *JAMA Intern Med*. Published online March 25, 2013. doi:10.1001/jamainternmed.2013.3023.

eTable 1. Multivariable model with all predictors

eTable 2. Final multivariable model

eTable 3. Scoring system details in the derivation (A) and validation (B) sets

eTable 4. Observed and expected likelihood of readmission by decile in the derivation (A) and validation (B) sets

eTable 5. Observed vs. predicted 30-day potentially avoidable readmissions in the entire cohort

This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Multivariable Model with All Predictors

Parameter	Beta-coefficient	P-value	Odds Ratio	95% Wald confidence limits	
Intercept	-4.1414	<.0001	-	-	-
Age >75 years	0.0425	.7583	1.043	0.796	1.368
Male sex	-0.00241	.9804	0.998	0.823	1.209
Ethnicity Non-Hispanic black ^a	0.0123	.9287	1.012	0.773	1.327
Ethnicity Hispanic ^a	-0.1174	.6636	0.889	0.524	1.509
Ethnicity Other ^a	-0.6280	.1197	0.534	0.242	1.177
First language Spanish ^b	0.2874	.3727	1.333	0.709	2.508
First language other ^b	-0.4669	.1611	0.627	0.326	1.205
Single/never married ^c	0.0590	.6288	1.061	0.835	1.347
Separated / Divorced / Widowed / No answer ^c	-0.0789	.5418	0.924	0.717	1.191
Insurance Medicaid ^d	0.2939	.1194	1.342	0.927	1.942
Private Insurance ^d	0.0391	.7149	1.040	0.843	1.283
No insurance ^d	1.3152	.0774	3.726	0.865	16.038
Direct from home/outpatient clinic ^e	0.0664	.6030	1.069	0.832	1.373
Nursing home/ Rehabilitation / Other hospital ^e	0.0539	.7417	1.055	0.766	1.455
Length of stay > 4 days	0.3595	.0003	1.433	1.178	1.742
Urgent or Emergent index admission ^f	0.2850	.1105	1.330	0.937	1.887
Discharge from oncology division	0.5048	.0004	1.657	1.251	2.194
1-5 admissions in the previous year^g	0.4693	<.0001	1.599	1.308	1.954
>5 admissions in the previous year^g	1.1596	<.0001	3.189	2.198	4.626
Identified caregiver at discharge	0.1348	.4917	1.144	0.779	1.681
7-9 medications at discharge ^h	0.0142	.9238	1.014	0.758	1.358
10-13 medications at discharge ^h	0.00916	.9523	1.009	0.748	1.363
>13 medications at discharge ^h	0.2173	.1529	1.243	0.923	1.674
≥ 1 procedures during index admission	0.3424	.0010	1.408	1.148	1.727
Serum sodium level at discharge < 135 mEq/L	0.2976	.0075	1.347	1.083	1.675
GFR < 30 ⁱ	0.2616	.1185	1.299	0.935	1.804
GFR 30-59 ⁱ	0.0918	.4595	1.096	0.859	1.398
Hemoglobin at discharge ≤ 12 g/dL	0.2238	.0513	1.251	0.999	1.567
Diabetes	0.1519	.1794	1.164	0.933	1.453

eTable 1. Multivariable Model with All Predictors - continued

ischemic heart disease	-0.0242	.8402	0.976	0.771	1.235
Heart failure	0.2274	.0717	1.255	0.980	1.608
Atrial fibrillation	-0.0542	.6998	0.947	0.719	1.248
COPD	0.0171	.9143	1.017	0.745	1.389
Neoplasm	0.2992	.0403	1.349	1.013	1.795

^a versus non-Hispanic white

^b versus English

^c versus married or partner

^d versus Medicare

^e versus from emergency department

^f versus elective admission

^g versus no admission

^h versus 6 or less

ⁱ versus 60 or more

eTable 2. Final Multivariable Model

Parameter	Beta-coefficient	P-value	Odds Ratio	95% Wald confidence limits	
Intercept	-3.7603	<.0001	-	-	-
Length of stay > 4 days	0.4285	<.0001	1.535	1.275	1.848
Urgent or Emergent index admission ^a	0.3100	.0334	1.363	1.025	1.814
Discharge from oncology division	0.5854	<.0001	1.796	1.476	2.185
1-5 admissions in the previous year	0.5497	<.0001	1.733	1.426	2.105
> 5 admissions in the previous year ^b	1.3416	<.0001	3.825	2.646	5.529
≥ 1 procedures during index admission	0.3482	.0006	1.417	1.161	1.729
Hemoglobin level at discharge ≤ 12 g/dL	0.2717	.0130	1.312	1.059	1.626
Serum sodium level at discharge < 135 mEq/L	0.3267	.0030	1.386	1.118	1.720

^a versus elective

^b versus no admission

eTable 3A. Scoring System Details in the Derivation Set (n=6,141)

HOSPITAL score	Number of admissions	Number of admissions followed by a 30-day PAR ^a	Observed proportion (%)	Expected probability (%)
0	24	0	0.0	2.3
1	475	12	2.5	3.1
2	707	29	4.1	4.2
3	739	37	5.0	5.2
4	1082	85	7.9	6.7
5	874	66	7.6	8.8
6	743	79	10.6	11.0
7	710	106	14.9	14.1
8	344	65	18.9	17.9
9	263	60	22.8	21.9
10	124	34	27.4	27.5
11	27	6	22.2	33.4
12	25	7	28.0	38.3
13	4	2	50.0	46.3

^a potentially avoidable readmission

eTable 3B. Scoring System Details in the Validation Set (n=3,071)

HOSPITAL score	Number of admissions	Number of admissions followed by a 30-day PAR ^a	Observed proportion (%)	Expected probability (%)
0	12	0	0.0	2.3
1	219	2	0.9	3.1
2	309	9	2.9	4.2
3	349	11	3.2	5.2
4	539	43	8.0	6.7
5	467	47	10.1	8.8
6	388	36	9.3	10.9
7	384	61	15.9	14.1
8	177	38	21.5	17.8
9	140	26	18.6	21.9
10	66	14	21.2	27.3
11	9	1	11.1	31.4
12	9	3	33.3	38.5
13	3	0	0.0	46.3

^a potentially avoidable readmission

eTable 4A. Observed and Expected Likelihood of Readmission by Decile in the Derivation Set (*n*= 6,141)

Deciles	Total N	Potentially avoidable readmissions			No 30-day readmission		
		Observed N	Expected N	O/E ^a ratios	Observed N	Expected N	O/E ratios
1	522	13	16.1	0.8	509	505.9	1.0
2	678	28	28.4	1.0	650	649.7	1.0
3	524	30	26.7	1.1	494	497.3	1.0
4	635	31	38.4	0.8	604	596.6	1.0
5	614	57	42.5	1.3	557	571.5	1.0
6	571	32	47.2	0.7	539	523.9	1.0
7	617	60	59.8	1.0	557	557.2	1.0
8	533	62	61.8	1.0	471	471.2	1.0
9	645	100	91.0	1.1	545	554.0	1.0
10	802	175	176.2	1.0	627	625.8	1.0

^a Observed/expected

eTable 4B. Observed and Expected Likelihood of Readmission by Decile in the Validation Set (*n*= 3,071)

Deciles	Total	Potentially avoidable readmissions			No 30-day readmission		
		Observed N	Expected N	O/E ^a ratios	Observed N	Expected N	O/E ratios
1	300	3	7.8	0.4	297	292.2	1.0
2	302	9	11.4	0.8	293	290.6	1.0
3	307	11	14.2	0.8	296	292.8	1.0
4	311	25	17.4	1.4	286	293.6	1.0
5	307	15	20.6	0.7	292	286.5	1.0
6	302	34	25.4	1.3	268	276.6	1.0
7	299	29	29.5	1.0	270	269.5	1.0
8	311	39	37.6	1.0	272	273.4	1.0
9	298	50	47.2	1.1	248	250.8	1.0
10	334	76	80.1	0.9	258	253.9	1.0

^a Observed/expected

eTable 5. Observed vs. Predicted 30-day Potentially Avoidable Readmissions in the Entire Cohort without Exclusion of Non-Avoidable Readmissions ($n=10,731$)

Points	Risk category	Patients in each category, n (%)	Observed probability of PAR ^a , %	Estimated risk of PAR ^a , %
0-4	Low	4,849 (45.2)	4.7	4.6
5-6	Intermediate	2,941 (27.4)	7.8	8.2
≥ 7	High	2,941 (27.4)	14.4	14.2

Cross-validated C-statistic = 0.67

^a Potentially avoidable readmission