

Predictive Risk Modelling: Options for New Zealand

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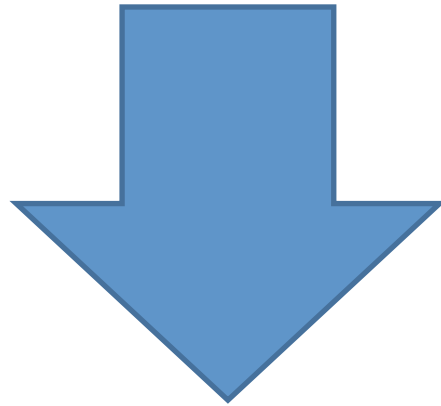
Case Finding...



Preventive requires identification

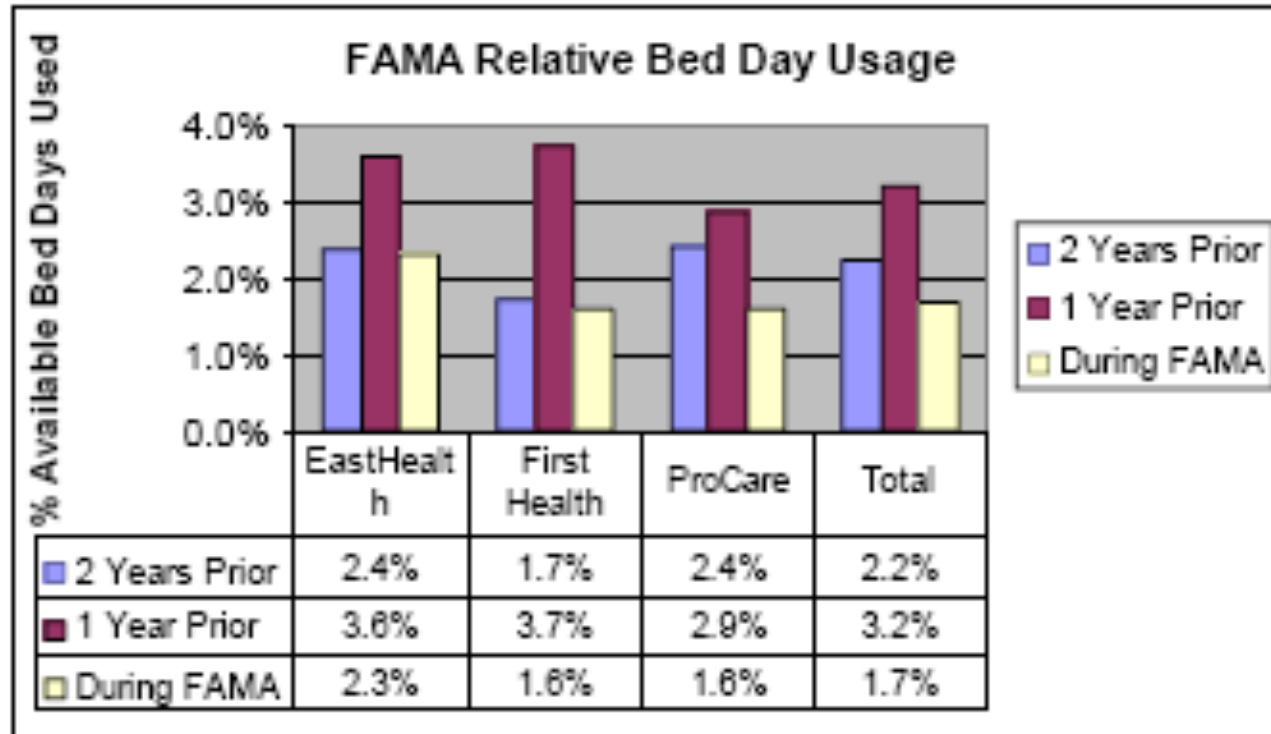
Thresholds models in Counties Manukau

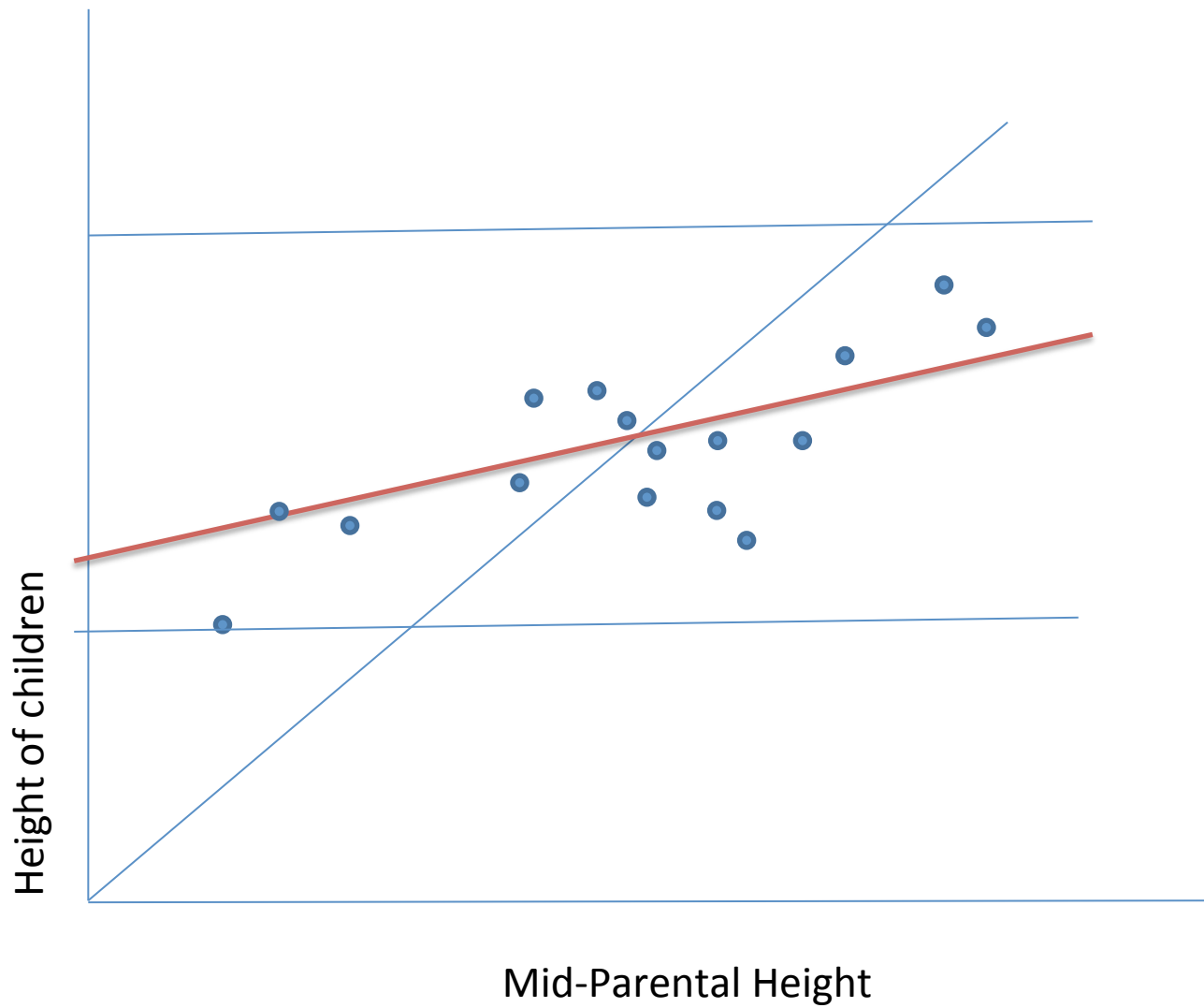
- ✓ more than 2 medical admissions ?
- ✓ more than 5 days each ?



✓ FAMA
Programme

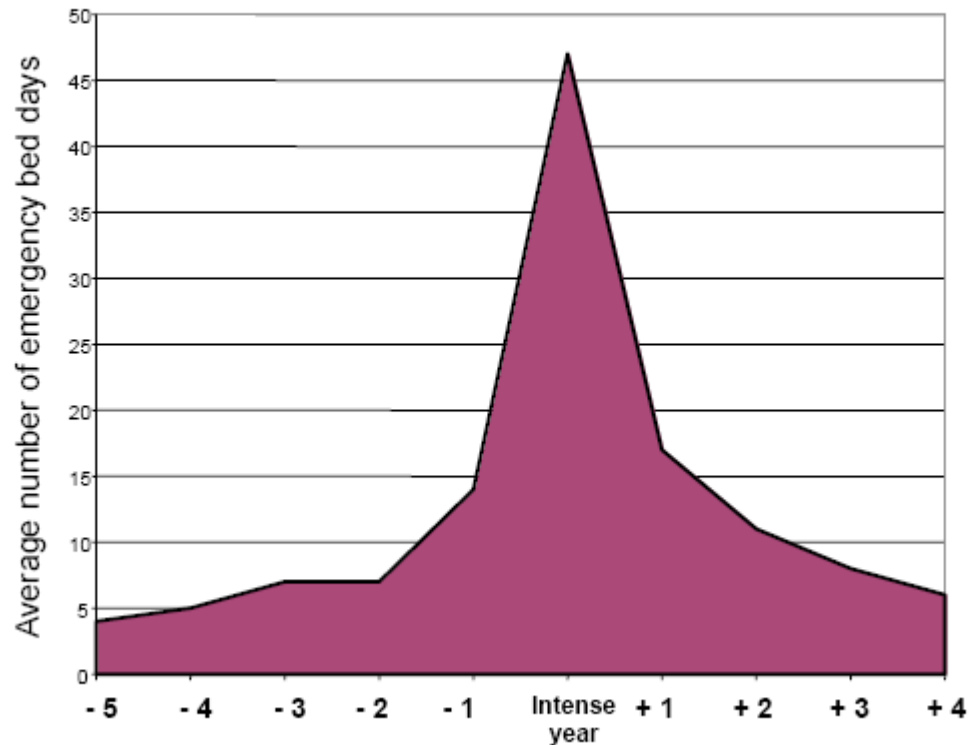
Did it work?

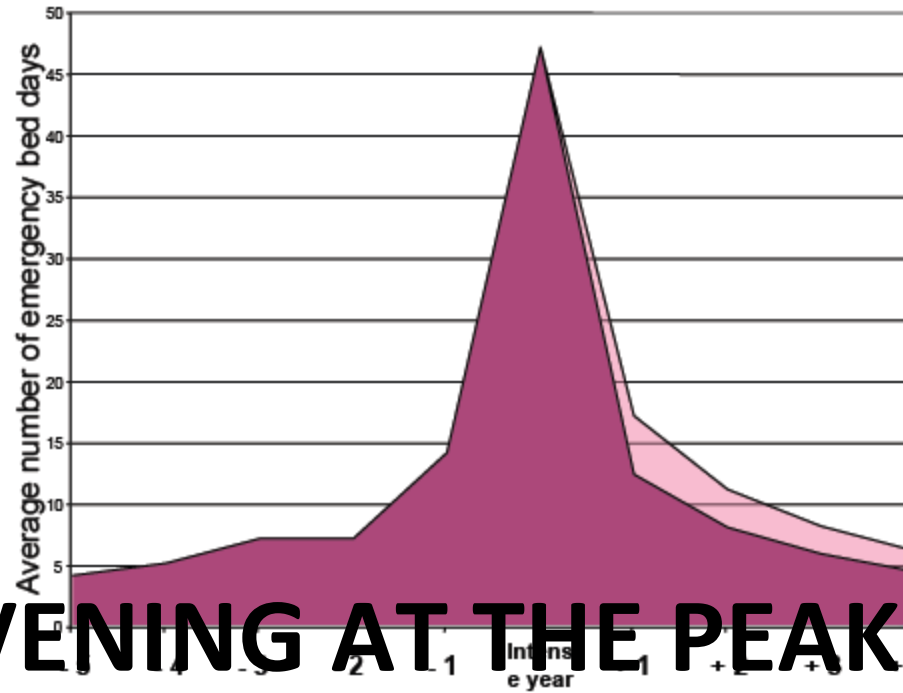




Regression to the mean

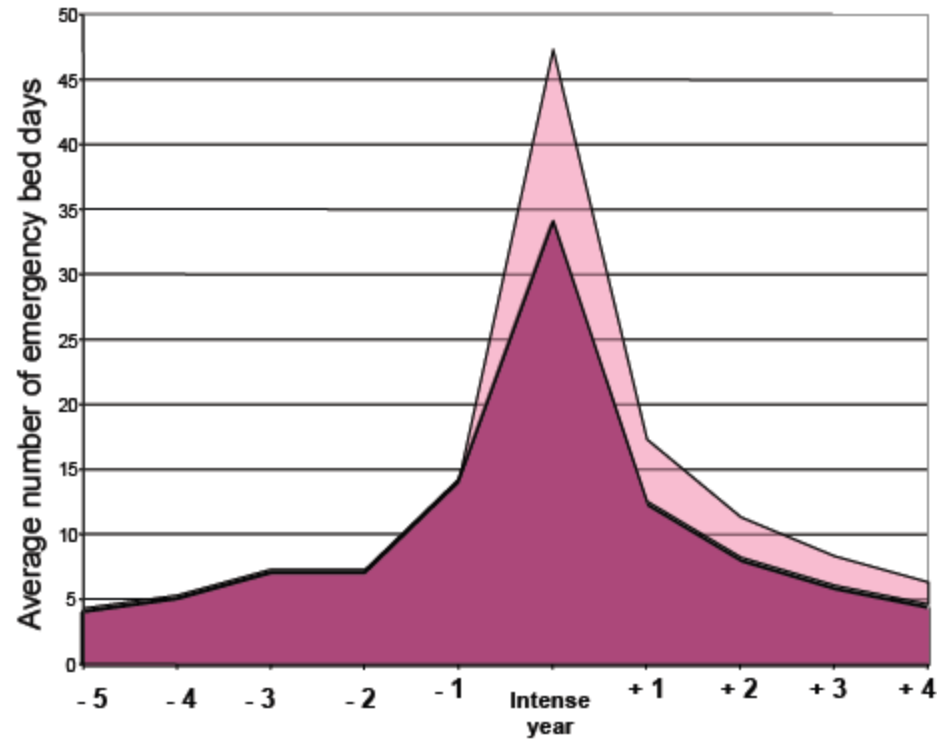
Frequently-admitted patients



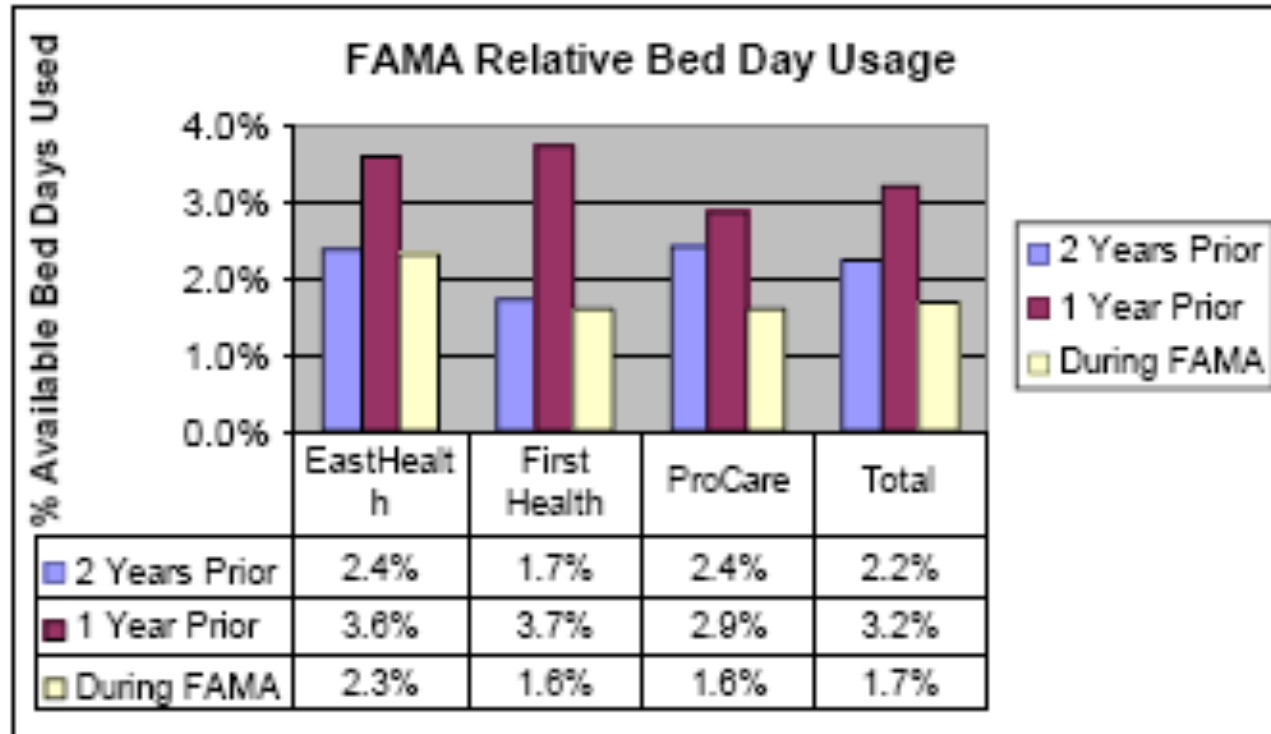


INTERVENING AT THE PEAK...

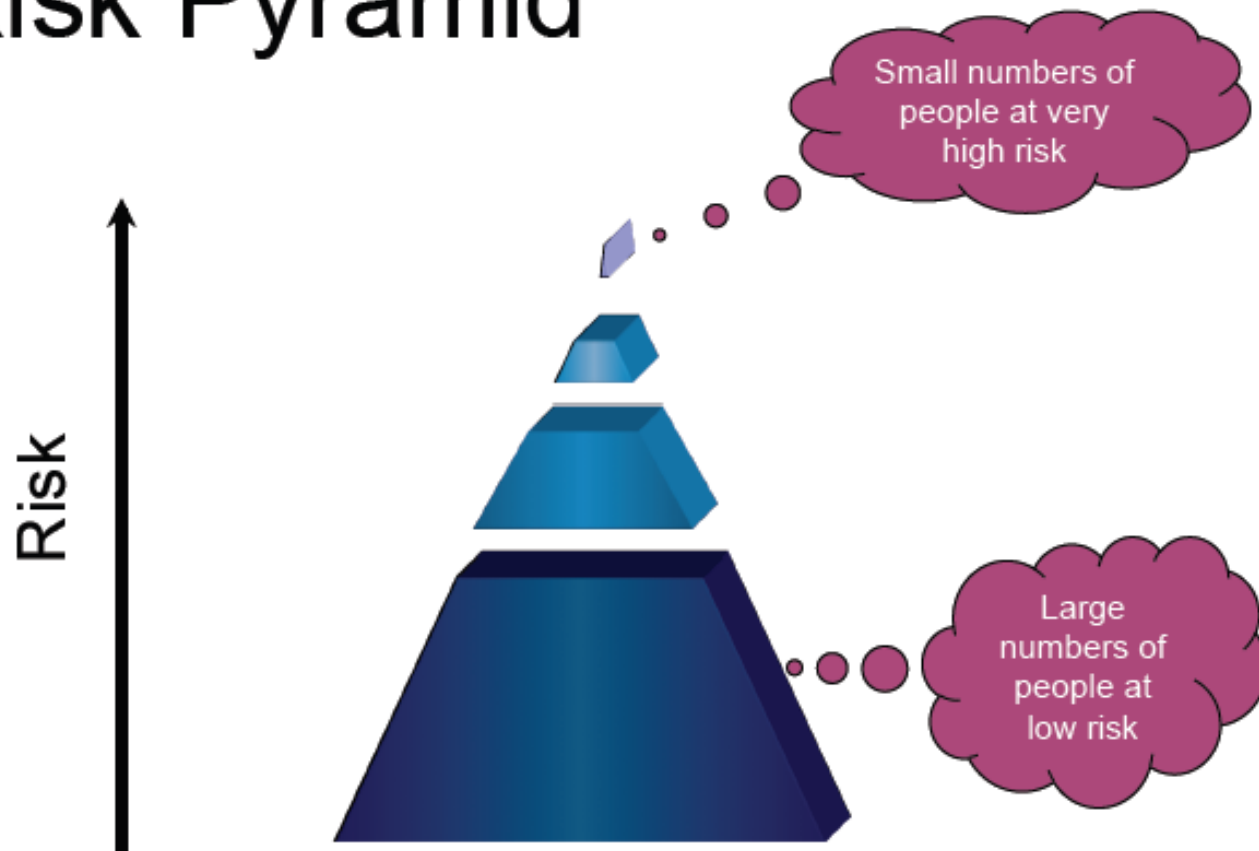
Intervening before the peak



Did it work?



Risk Pyramid



Size of shape is proportional to number of patients

Evercare in UK

- Evercare was used in the US with a great deal of success (reduced hospitalisation by 50%)
- Introduced to UK in 2002
- Enrolled patients over 65 with a history of 2 or more acute admissions in previous
- Intervention had no significant impact on admission rates
- Why? Used on the wrong population?

PRM

- Are all designed to be build using routinely collected data
- Estimate beta weights from a logistic regression model

$$\text{Pr}(\text{ADMIT}_t) = a + bX_{t-1}$$

- Beta weights go into a software
- Software runs off currently collected data
- Every month runs the model on the patient database

Example: WDHB

- We obtain 3 years of data
- Used 10% of sample
- Use half the sample as a development data
- Estimate variety of regression models
- Sample is 13,246 individuals



Model Selection

- Based on trade off between
 - false positives (people identified as at risk who are not)
 - False negatives (people identified as not at risk who are)
 - Optimal model depends on loss function
 - Will differ for different loss functions

UK PARR

Variables included in PARR case finding algorithm

- Alcohol related diagnoses
- Cerebrovascular disease
- Chronic obstructive pulmonary disease
- Connective tissue disease/rheumatoid arthritis
- Developmental disability
- Diabetes
- Ischaemic heart disease
- Peripheral vascular disease
- Renal failure
- Sickle cell disease
- Previous admission for respiratory infection
- Number of different treatment specialists seen
- Age 65-74, age 75+
- Sex
- Ethnicity
- Previous admission for a reference condition
- Number of emergency admissions in previous 90, 180, and 365 days
- Number of non-emergency admissions in previous 365 days
- Total number of previous emergency admissions in previous three years
- Average number of episodes per spell for emergency admissions
- Observed:expected ratio for practice style sensitive admissions in ward of residence
- Observed:expected ratio for rate of readmissions for hospital of current admission
- Diagnostic cost groups/hierarchical condition category

WDHB

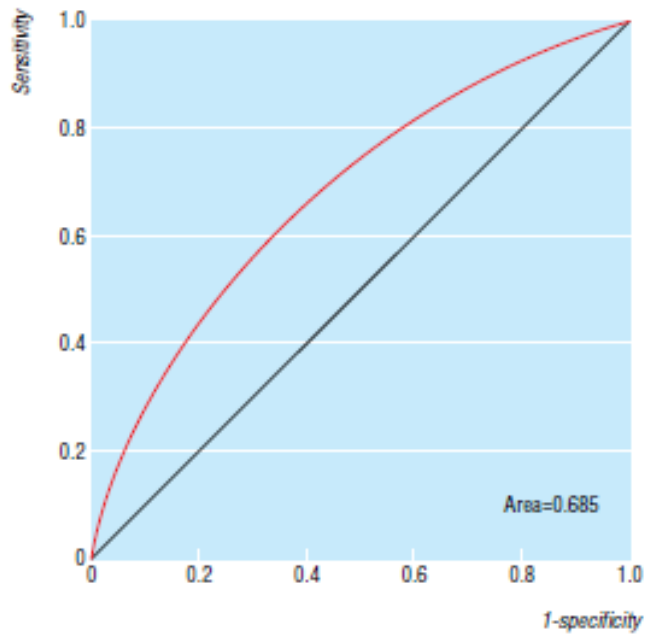
```
Iteration 0: log likelihood = -6136.8278
Iteration 1: log likelihood = -7322.6647
Iteration 2: log likelihood = -7300.8115
Iteration 3: log likelihood = -7300.7896
Iteration 4: log likelihood = -7300.7896
```

```
Logistic regression      Number of obs   =    13426
                        LR chi2(41)    =   1716.08
                        Prob > chi2     =    0.0000
                        Pseudo R2      =    0.1052
```

re_hospital	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
female	.201595	.0517163	3.90	0.000	.1002329	.3029571
dage40	.0676857	.0729562	0.93	0.354	-.0753059	.2106773
dage50	.2887515	.0946371	3.05	0.002	.1032663	.4742368
dage60a	.5244922	.1190529	4.41	0.000	.2911529	.7578316
dage65a	.3855142	.0887631	4.34	0.000	.2115417	.5594867
dage70a	.4791811	.0923592	5.19	0.000	.2981604	.6602017
dage75a	.8170699	.1150756	7.10	0.000	.5915259	1.042614
dage80a	.5997988	.0873306	6.87	0.000	.428634	.7709636
dage85a	.6789359	.0977295	6.95	0.000	.4873897	.8704822
dage90a	1.242925	.2231631	5.57	0.000	.8055336	1.680317
dage95a	.6527984	.2602299	2.51	0.012	.1427572	1.16284
female_50	-.3067716	.1270791	-2.41	0.016	-.555842	-.0577011
female_60	-.2723832	.1650134	-1.65	0.099	-.5958036	.0510371
female_75	-.2556056	.1469141	-1.74	0.082	-.5435519	.0323408
female_90	-.5369546	.2693343	-1.99	0.046	-1.06484	-.0090692
Copd_dage90a	-1.656789	1.007921	-1.64	0.100	-3.632277	.3186994
Cereb_da~70a	-.9665372	.5889857	-1.64	0.101	-2.120928	.1878536
Cereb_da~80a	-1.894049	.5955579	-3.18	0.001	-3.061321	-.7267768
maori	.2790485	.0608975	4.58	0.000	.1596915	.3984054
asian	-.1821225	.1023819	-1.78	0.075	-.3827875	.0185424
pacific	.0255931	.0817571	0.31	0.754	-.1346479	.1858341
other	-.2814796	.1040822	-2.70	0.007	-.485477	-.0774822
stay_length	.0127288	.0047093	2.70	0.007	.0034988	.0219588
pcc1	.0681795	.015676	4.35	0.000	.0374551	.0989038
cost_weight	-.0540414	.0184237	-2.93	0.003	-.0901513	-.0179316
D_Heart	.1401411	.1175756	1.19	0.233	-.0903028	.370589
D_Copd	.6013041	.1434089	4.19	0.000	.3202277	.8823804
D_Asthma	.4434653	.2121056	2.09	0.037	.027746	.8591846
D_Diab	.2436467	.1812114	1.34	0.179	-.111521	.5988145
D_Cereb	-.223435	.1812438	-1.23	0.218	-.5786662	.1317963
D_F	.6464009	.1092966	5.91	0.000	.4321835	.8606184
D_H	-.545247	.211564	-2.58	0.010	-.9599048	-.1305892
D_I	.241156	.0799104	3.02	0.003	.0845345	.3977776
D_O	-.4189247	.0997866	-4.20	0.000	-.6145028	-.2233466
D_S	-.4457977	.0682221	-6.53	0.000	-.5795105	-.3120849
D_Z	-.3256491	.1611033	-2.02	0.043	-.6414057	-.0098925
p_90	-.2220631	.0587962	-3.78	0.000	-.3373015	-.1068247
p_180	.1045873	.0507175	2.06	0.039	.0051829	.2039918
p_total	.2796227	.0185821	15.05	0.000	.2432025	.316043
past_refer~e	.2768852	.0814594	3.40	0.001	.1172277	.4365427
past_resp	.05556	.1076651	0.52	0.606	-.1554597	.2665797
_cons	-1.653773	.0608089	-27.20	0.000	-1.772956	-1.53459

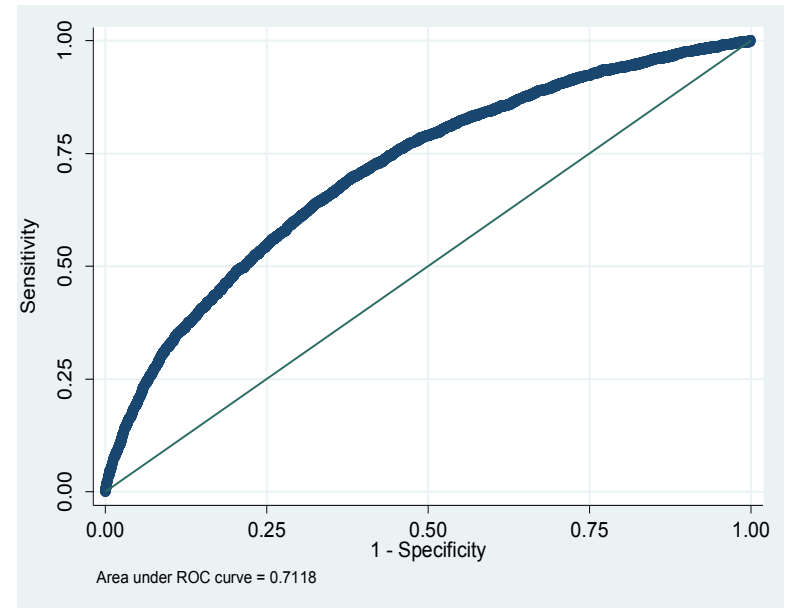
Predictive Accuracy

UK PARR



Receiver operating characteristic curve for the algorithm

WDHB



What next?

- Find an intervention to match with the Risk stratification tool
- Might be able to risk stratify other features
e.g.:LOS, Cost weight
- Obtain consents to trial the PRM