10.1071/AH23017
Australian Health Review

Supplementary Material

External validation of the Health Care Homes hospital admission risk stratification tool in the Aboriginal Australian population of the Northern Territory

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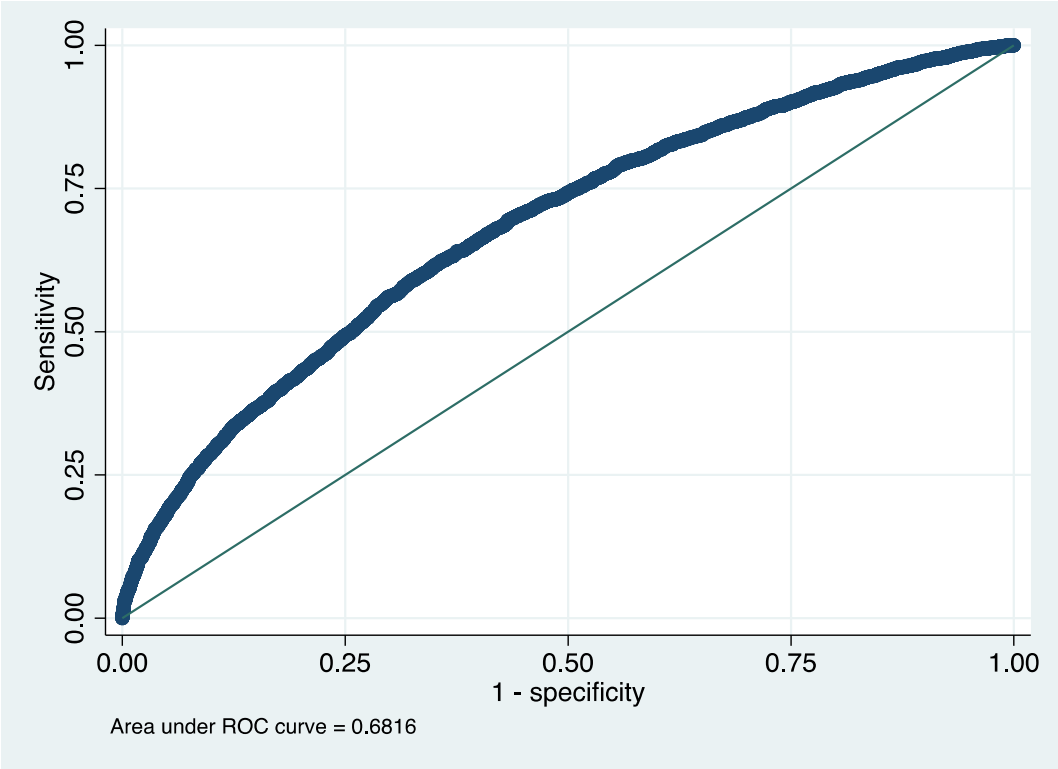
Supplementary material

Supplementary results



Supplementary figure 1: Receiver-operating characteristic curve for the refitted model without history of previous hospitalisation (AUC=0.68)

Supplementary tables

Supplementary table 1: Demographic predictors and definitions

Predictor	Definition
Age	Age at prediction date
Sex	Male or female
Indigenous status	Indigenous, non-Indigenous or not recorded
SEIFA IRSAD	1-10, unknown

SEIFA = socioeconomic indexes for areas; IRSAD = index of relative socioeconomic advantage and disadvantage

Supplementary table 2: Risk factor predictors and definitions

Predictor	Definition
Body mass index	<25; [25, 30); [30, 35); [35, 40); 40+; Not recorded
Smoking status	Non-smoker, Ex-smoker, Smoker, Unknown
Alcohol consumption	Non-drinker, Drinker, Not recorded

Body mass index (BMI) was an existing variable in the primary care information system dataset and was grouped into categories. The most recent BMI value was used and where there were multiple observations for each patient during the same visit the median of these results was used.

Supplementary table 3: Medication groups and search expressions

Medication Group	Definition
'STATINS'	.*(Amlodipine besylate|Atorvastatin|Atorvastatin|Amlodipine|Avena Sativa|Cerivastatin|Cholestyramine|Clofibrate|Colestipol|Colestipol Hydrochloride|Crestor|Ezetimibe|Ezetimibe|Simvastatin|Fenofibrate|Fluvastatin|Gemfibrozil|Lescol|Lipitor|Nicotinic Acid|Policosanol|Pravachol|Pravastatin|Pravastatin Sodium|Probucol|Rosuvastatin|Simvastatin|Zocor).*'
'ANTICOAGULANTS'	'.*(apixaban|Arixtra|Clexane|Coumadin|dabigatran|Daktarin|dalteparin|Eliquis|enoxaparin|fondaparinux|Fragmin|heparin|Marevan|Pradaxa|rivaroxaban|warfarin|Xarelto).*'
'ANTIDEPRESSANTS'	'.*(agomelatine|amitriptyline|citalopram|clomipramine|desvenlafaxine|dothiepin|doxepin|duloxetine|escitalopram|fluovoxamine|fluoxetine|imiprimine|mianserin|mirtazapine|moclobemide|nortriptyline|paroxetine|phenelzine|reboxetine|sertraline|tranylcypromine|trimipramine|venlafaxine).*'
'ANTIPSYCHOTICS'	'.*(Abilify|Amipride|amisulpride|Anatensol|Anxiostat|aripiprazole|asenapine|Chlorpromazine|Clopine|Clopixol|CloSyn|Clozapine|Clozaril|DBL|Deprel|Droleptan|Droperidol|Fluanxol|flupenthixol|fluphenazine|Haldol|haloperidol|Invega|Largactil|Lithicarb|Lithium|lurisidone|Modecate|Neulactil|olanzapine|Orion|paliperidone|pericyazine|quetiapine|Quilonum|Rispa|Risperdal|risperidone|Rixadone|Serenace|Seroquel|Solian|Stelazine|trifluoperazine|Zeldox|ziprasidone|zuclopenthixol|Zyprexa).*'
'ANTI_INFLAMMATORY'	'.*(Aclin|ACT3|Actiprofen|Actron|Acular|Advil|Aleve|Anaprox|Arthrexin|Arthrotec|Brufen|Bugesic|Celebrex|celecoxib|Clinoril|Clonac|Codeine|Codeine phosphate|Crysanal|Diclac|Diclofenac|Diclofenac-BC|Diclohexal|diflunisal|Dinac|Dolobid|Eazydayz|Feldene|Fenac|Hexal|Ibuprofen|Ibuprofen Lysine|Imflac|Indocid|Indomethacin|Inza|Ketoprofen|Ketorolac|Ketorolac Trometamol|Mefenamic acid|Mefic|meloxicam|Misoprostol|Mobic Vivlodex|Mobilis|nabumetone|Naprogesic|Naprosyn|Naproxen|Nurofen|Nurolasts|Orudis|Oruvail|Panafen|Pirohexal-D|Piroxicam|Ponstan|Proven|Proxen|Pseudoephedrine Hydrochloride|Rafen|Relafen|Rosig|Solaraze|Sulindac|Surgam|Tiaprofenic Acid|Toradol|Tri-Profen|Voltaren|Voltfast|Trometamol).*'
'STEROIDS'	'.*(Beclometasone dipropionate|Budesonide|Ciclesonide|Fluticasone furoate|Fluticasone propionate|Hydrocortisone|Methylprednisolone sodium succinate|prednisolon|prednisone).*'

Supplementary table 4: Pathology predictors, search expressions and morbidity categories

Pathology observations	Search expressions	Low morbidity	Moderate morbidity	Higher morbidity
Gamma-glutamyl transferase	G.G.T, GAMMA GT, GAMMA G.T	If M <= 2*50 (u/L) If F <= 2*35 (u/L)	If M > 2*50 (u/L) If F > 2*35 (u/L)	If M > 3*50 (u/L) If F > 3*35 (u/L)
Bilirubin	BILIRUBIN	<= 2*20 (umol/L)	>2*20 (umol/L)	> 3*20 (umol/L)
Alanine Aminotransferase	ALT, AL. T, ALT (SERUM)	If M <= 2*40 (u/L) , If F <= 2*30 (u/L)	If M > 2*40 (u/L) , If F > 2*30 (u/L)	If M > 3*40 (u/L) If F > 3*30 (u/L)
Platelets	PLATELETS	<= 480 (x $10^{9)}$/L		> 480 (x $10^{9)}$/L
Haemoglobin A1c	HBA1C, HB A1C	<= 58.5 mmol/mol	> 58.5 mmol/mol	> 69.4 mmol/mol
Albumin / creatinine ratio	ALBUMIN CREATININE RATIO, ALB/CREAT Ratio, ALBUMIN/CREATININE RATIO	<= 3 mg/mmol	If >3 mg/mmol	If > 30 mg/mmol
Total Cholesterol	CHOLESTEROL	<= 6.5 mmol/L	> 6.5 mmol/L	> 7.5 mmol/L
Blood pressure	DIASTOLIC, SYSTOLIC, BP – DIASTOLIC, BP - SYSTOLIC	<= 140/90 mmHg	> 140/90 mmHg	>160/100 mmHg
Creatinine	CREATININE	If M < 350 umol/L if F < 300 umol/L	If M >= 350 umol/L if F >= 300 umol/L	If M >= 2*350 umol/L if F >= 2*300 umol/L
Glomerular filtration rate	EGFR		30 ml/min < x <45 ml/min	<30 ml/min
Triglycerides	TRIGLYCERIDE	<= 4 mmol/L	>4 mmol/L	>8 mmol/L
Haemoglobin	HAEMOGLOBIN	If M < 130 g/L If F < 120 g/L		<=100g/L
Low-density lipoprotein	LDL	3 mmol/L < x < 4.0 mmol/L		> 4.0 mmol/L

The most recent pathology results were used and where more than one test had been performed on the same day, the median of these results was taken. For haemoglobin A1c, creatinine, and blood pressure[1], the highest value was used, and for platelets, haemoglobin, and estimated glomerular filtration rate, the lowest value was used.

[1] It was not possible to distinguish paired systolic and diastolic readings from the data when more than one reading was taken on a single visit date. Therefore the systolic and diastolic readings used in the analysis may not correspond to the same reading.

Supplementary table 5: Diagnosis groups, diagnosis families, diagnoses and related ICPC2 codes

Diagnosis group	Diagnosis family	Diagnosed conditions/diseases	ICPC2 codes
diagnosisgrp.respiratory.flag	diagnosis.asthma.flag	asthma	R96001
	diagnosis.copd.flag	chronic obstructive pulmonary disease, chronic obstructive airways disease, chronic bronchitis, emphysema, chronic asthma, bronchiectasis	R95006, R79003, R95002, R95001, R99018
diagnosisgrp.atrial_fibr.flag	diagnosis.atrial_fibr.flag	Atrial fibrillation	K78001
diagnosisgrp.cardiovascular.flag	diagnosis.coronary_heart.flag	Atherosclerotic heart disease, Coronary artery spasm/surgery/stent/blockage, angiography/angioplasty, coronary endarterectomy/occlusion/insufficiency, acute coronary syndrome, Coronary bypass, ischaemic heart disease, angina, heart attack, Atherosclerosis, Myocardial damage, myocardial insufficiency, Percutaneous transluminal angioplasty, Subendocardial infarction	K53011, K53003, K92024, K52012, K74006, K75008, K53009, K76019, K76014, K74008, K75009, K41005, K54007, K75014, K75004, K76013, K74003, K74001, K76005, K76003
	diagnosis.stroke.flag	Cerebrovascular disease, Cerebellar infarction/embolism/haemorrhage	K90028, K91006, K90006, K90020
	diagnosis.tia.flag	Transient ischemic attack	K89001
	diagnosis.cong_heart_failure.flag	Congestive heart failure, left/right ventricular failure, Cardiomyopathy, Pulmonary oedema	K77008, K77013, K77002, K84041, K77014
	diagnosis.rheumatic_heart.flag	rheumatic heart disease	K71002
diagnosisgrp.osteoarthritis.flag	diagnosis.osteoarthritis.flag	Osteoarthritis	L91003
diagnosisgrp.osteoporosis.flag	diagnosis.osteoporosis.flag	Osteoporosis	L95001
diagnosisgrp.rheumatoid.flag	diagnosis.rheumatoid.flag	Rheumatoid arthritis	L88004
diagnosisgrp.mental_health.flag	diagnosis.depression.flag	Depression	P76001
	diagnosis.anxiety.flag	Anxiety	P01003
	diagnosis.bipolar.flag	Bipolar, Manic Depression	P73004, P73002
	diagnosis.schizophrenia.flag	Schizophrenia	P72011
	diagnosis.dementia.flag	Dementia, Alzheimer's disease	P70001, P70003
	diagnosis.learning_diff.flag	Learning difficulties	P24004

Diagnosis group	Diagnosis family	Diagnosed conditions/diseases	ICPC2 codes
diagnosisgrp.cancer.flag	diagnosis.cancer.flag	Cancer, Carcinoma, Melanoma, Lymphoma	D75006, R85008, L71022, X75002, A79005, K72003, X75012, U75003, R85011, X77003, A79011, L71023, S77003, A79007, A79001, R85009, R85006, X75011, U77004, N74007, L71026, D77007, X77013, X75009, Y77002, S77011, B72002, B74002, T73001, F74003, R84005, D75009, S77014, X81013, D77008, L71025, D77017,D77010, U77003, R85013,X76002, W72003, 78005, U77005, L71021, T71002, R84006, X77004, D75007, D77011, D77018, Y78004, D75005, H75003, Y78007, D76002, A79015, L71020, L71024, X75010,D74002,R85014, D77015,R84007,N74010,U76002, D75008, X77007, D77013, X77012, A79003, A79008, B74004, B74005, B74006, B74007, D74001, D75001, D75002, D75003, D75004, D76001, D77002, D77003, D77004, D77005, D77012, D77014, D77016, F74002, H75002, K72002, L71008, L71009, L71011, L71012, L71013, L71014, L71015,N74002,N74003, N74004,N74005, N74006, R84001, R84002, R84003, R85001, R85003, R85004, R85005, S77005, T71001, T73002,U75002,U76001,U77001,U77002,U77007,W72001,X75001, X76001, X77001, X77005, X77008, X77010, X77011, Y77001, Y78001, Y78002, Y78006

Diagnosis group	Diagnosis family	Diagnosed conditions/diseases	ICPC2 codes
diagnosisgrp.digestive.flag	diagnosis.crohns.flag	Crohns disease	D94001
	diagnosis.ulcer_colitis.flag	Ulcerative colitis, inflammatory bowel disease	D94009, D94002
	diagnosis.coeliac.flag	Coeliac disease	D99003
	diagnosis.steatorrhea.flag	Steatorrhea	D99039
	diagnosis.malabsorp_syndr.flag	Intestinal malabsorption, Malabsorption syndrome, fructose malabsorption	D99028, T99088
	diagnosis.chronic_liver.flag	Liver cirrhosis/dysfunction/failure/fibrosis, hepatic disease	D97013, D97012, D97007, D97005
	diagnosis.pancreatitis.flag	Pancreatitis, Pancreatic insufficiency	D99043, D99032
diagnosisgrp.hypertension.flag	diagnosis.hypertension.flag	Hypertension	K86005
diagnosisgrp.bloodfats.flag	diagnosis.hyperlipidaemia.flag	Hyperlipidaemia	T93008
	diagnosis.hypercholesterolaemia.flag	Hypercholesterolaemia	T93001
	diagnosis.hypertriglyceridaemia.flag	Hypertriglyceridaemia	T93005
diagnosisgrp.chronic_kidney.flag	diagnosis.chronic_kidney.flag	chronic kidney disease, chronic renal failure/insufficiency, chronic glomerulonephritis, end stage renal disease, renal impairment, dialysis, Macroalbuminuria, Macroproteinuria, Proteinuria	U99034, U88008, U88J96, U59001, U99023, U99032, U98007, U98002, U99030, U99031, U28001
diagnosisgrp.diabetes_type_1.flag	diagnosis.diabetes_type_1.flag	Diabetes mellitus type 1	T89002
diagnosisgrp.diabetes_type_2.flag	diagnosis.diabetes_type_2.flag	Diabetes mellitus type 2	T90009
diagnosisgrp.venous_thrombo.flag	diagnosis.venous_thrombo.flag	Venous thromboembolism, Pulmonary embolism, DVT	K93002, K94004, K93005
diagnosisgrp.other.flag	diagnosis.falls.flag	Fall	A29016
	diagnosis.epilepsy.flag	Epilepsy	N88006

ICPC = International Classification of Primary Care Revised Second Edition (ICPC-2)

Section/Topic		Checklist Item	Page
Title and abstract			
Title	1	Identify the study as developing and/or validating a multivariable prediction model, the target population, and the outcome to be predicted.	1
Abstract	2	Provide a summary of objectives, study design, setting, participants, sample size, predictors, outcome, statistical analysis, results, and conclusions.	1
Introduction			
Background and objectives	3a	Explain the medical context (including whether diagnostic or prognostic) and rationale for developing or validating the multivariable prediction model, including references to existing models.	2-3
	3b	Specify the objectives, including whether the study describes the development or validation of the model or both.	3
Methods			
Source of data	4a	Describe the study design or source of data (e.g., randomized trial, cohort, or registry data), separately for the development and validation data sets, if applicable.	4
	4b	Specify the key study dates, including start of accrual; end of accrual; and, if applicable, end of follow-up.	4
Participants	5a	Specify key elements of the study setting (e.g., primary care, secondary care, general population) including number and location of centres.	4-5
	5b	Describe eligibility criteria for participants.	4-5
	5c	Give details of treatments received, if relevant.	n\a
Outcome	6a	Clearly define the outcome that is predicted by the prediction model, including how and when assessed.	4
	6b	Report any actions to blind assessment of the outcome to be predicted.	n\a
Predictors	7a	Clearly define all predictors used in developing or validating the multivariable prediction model, including how and when they were measured.	4-5
	7b	Report any actions to blind assessment of predictors for the outcome and other predictors.	n\a
Sample size	8	Explain how the study size was arrived at.	4-5
Missing data	9	Describe how missing data were handled (e.g., complete-case analysis, single imputation, multiple imputation) with details of any imputation method.	4-5
Statistical analysis methods	10c	For validation, describe how the predictions were calculated.	5-6 and Supp. material p.2-7
	10d	Specify all measures used to assess model performance and, if relevant, to compare multiple models.	5-6
	10e	Describe any model updating (e.g., recalibration) arising from the validation, if done.	5-6
Risk groups	11	Provide details on how risk groups were created, if done.	6
Development vs. validation	12	For validation, identify any differences from the development data in setting, eligibility criteria, outcome, and predictors.	8-10
Results			
Participants	13a	Describe the flow of participants through the study, including the number of participants with and without the outcome and, if applicable, a summary of the follow-up time. A diagram may be helpful.	7
	13b	Describe the characteristics of the participants (basic demographics, clinical features, available predictors), including the number of participants with missing data for predictors and outcome.	7
	13c	For validation, show a comparison with the development data of the distribution of important variables (demographics, predictors and outcome).	7-8, Tables 1 and 3
Model performance	16	Report performance measures (with CIs) for the prediction model.	7-8, Tables 3-4
Model-updating	17	If done, report the results from any model updating (i.e., model specification, model performance).	7-8, Tables 3-4
Discussion			
Limitations	18	Discuss any limitations of the study (such as nonrepresentative sample, few events per predictor, missing data).	9-10
Interpretation	19a	For validation, discuss the results with reference to performance in the development data, and any other validation data.	8-10
	19b	Give an overall interpretation of the results, considering objectives, limitations, results from similar studies, and other relevant evidence.	8-11
Implications	20	Discuss the potential clinical use of the model and implications for future research.	8-11
Other information			

Supplementary information	21	Provide information about the availability of supplementary resources, such as study protocol, Web calculator, and data sets.	Supp. material
Funding	22	Give the source of funding and the role of the funders for the present study.	During submission