

First author name	Country	Study type	Size of validation sample	Risk prediction model	Intervention	Primary outcome measure(s)	Internal (I) / External (E) validation	Predictive ability	Evaluation of impact
Aguado et al. (2008) [75]	Spain	Observational study	65,630	Johns Hopkins ACG System (ACG)	-	Healthcare costs	E	R ² = 0.39	-
Ash et al. (2013) [74]	US	Observational study	457,000	Primary Care Activity Levels Index (PCAL)	-	Healthcare costs	I	R ² = 0.67	-
Baker et al. (2012) [73]	UK	Prospective cohort study	96	Nairn Case Finder	Case management	Hospital admissions	I	-	Significant reduction AD = 42.5%, p = 0.002
Billings et al. (2006) [72]	UK	Observational study	-	Patients At Risk for Re-hospitalisation algorithm (PARR)	-	Readmission	I	C = 0.69	-
Boult et al. (2013) [71]	US	RCT	850	Hierarchical Condition Category (HCC)	Care coordination Case management	Access of primary care services	E	-	Non-significant increase, OR = 1.02 (0.91–1.14)
						Emergency department attendance	E	-	Non-significant increase, OR = 1.04 (0.81–1.34)
						Hospital admissions	E	-	Non-significant reduction, OR = 0.79 (0.53–1.16)
						Readmission	E	-	Non-significant increase, OR = 1.01 (0.83–1.23)
Brilleman et al. (2013) [70]	UK	Observational study	95,372	Charlson Comorbidity Index (CCI)	-	Mortality	E	R ² = 0.42	-
Brilleman et al. (2014) [69]	UK	Observational study	86,100	Johns Hopkins ACG System (ACG), Charlson Comorbidity Index (CCI)	-	Access of primary care services	E	ACG R ² = 0.37 CCI R ² = 0.26	-
						Healthcare costs	E	ACG R ² = 0.41 CCI R ² = 0.41	-
Charlson et al. (2008) [68]	US	Observational study	5,861	Charlson Comorbidity Index (CCI)	-	Healthcare costs	E	R ² = 0.22	-
Chen et al. (2020) [67]	US	Observational study	41,076	Machine Learning (Decision Tree)	-	Emergency department attendance	I	C = 0.84	-
						Hospital admissions	I	C = 0.79	-
Crane et al. (2010) [66]	US	Observational study	12,650	Elder Risk Assessment Index	-	Hospital admissions	I	C = 0.70	-
Cumming et al. (2002) [65]	US	Observational study	749,145	Johns Hopkins ACG System (ACG), Chronic Illness and Disability Payment System	-	Healthcare costs	E	ACG R ² = 0.17 CDPS R ² = 0.20 ERG R ² = 0.23	-

				(CDPS), Episode Risk Groups (ERG), Hierarchical Condition Category (HCC), Medicaid Rx, RxGroups, RxRisk				HCC $R^2 = 0.22$ MedicaidRx $R^2 = 0.20$ RxGroups $R^2 = 0.22$ RxRisk $R^2 = 0.18$	
Donnan et al. (2006) [64]	UK	Observational study	93,156	Predicting Emergency Admissions Over the Next Year (PEONY) 1	-	Hospital admissions	I	C = 0.80	-
Dudley et al. (2003) [63]	US	Observational study	319,209	Hierarchical Condition Category (HCC)	-	Healthcare costs	E	$R^2 = 0.08$	-
Falasca et al. (2011) [62]	Italy	Observational study	147,654	Modello Statistico Combinato (MoSaiCo)	-	Hospital admissions	I	C = 0.77	-
Fishman et al. (2003) [61]	US	Observational study	1,500,000	Johns Hopkins ACG System (ACG), Hierarchical Condition Category (HCC), RxRisk	-	Healthcare costs	I	ACG $R^2 = 0.10$ HCC $R^2 = 0.15$ RxRisk $R^2 = 0.09$	-
Greenwald et al. (2022) [60]	US	Observational study	272,220	Machine Learning (Random Forest [RF], XGBoost, Auto ML, RuleFit)	-	Hospital admissions	I	AutoML C = 0.70 RuleFit C = 0.70 RF C = 0.70 XGBoost C = 0.70	-
Haas et al. (2013) [59]	US	Observational study	83,187	Johns Hopkins ACG System (ACG), Charlson Comorbidity Index (CCI), Hierarchical Condition Category (HCC)	-	Emergency department attendance	E	ACG C = 0.67 CCI C = 0.57 HCC C = 0.58	-
						Healthcare costs (>90th percentile)	E	ACG C = 0.76 CCI C = 0.70 HCC C = 0.70	-
						Hospital admissions	E	ACG C = 0.73 CCI C = 0.67 HCC C = 0.68	-
Hippisley-Cox et al. (2013) [58]	UK	Observational study	2,849,381	QAdmissions	-	Hospital admissions	I	C = 0.78	-
Inouye et al. (2008) [57]	US	Observational study	3,919	Charlson Comorbidity Index (CCI)	-	Hospital admissions	E	C = 0.72	-
Juncosa et al. (1999) [56]	Spain	Observational study	2,467	Johns Hopkins ACG System (ACG)	-	Access of primary care services	E	$R^2 = 0.64$	-
						Healthcare costs	E	$R^2 = 0.31$	-
						Hospital admissions	E	$R^2 = 0.44$	-
Jung et al. (2023) [55]	US	Observational study	365,106	Machine Learning (LASSO, Random Forest [RF], XGBoost)	-	Hospital admissions	I	LASSO C = 0.83 RF C = 0.90 XGBoost C = 0.90	-
Khanna et al. (2019) [54]	Australia	Observational study	117,970	Proprietary algorithm	-	Hospital admissions	I	C = 0.67	-

Kronick et al. (2000) [53]	US	Observational study	900,000	Chronic Illness and Disability Payment System (CDPS)	-	Healthcare costs	I	R ² = 0.18	-
Lemke et al. (2012) [52]	US	Observational study	4,700,000	Johns Hopkins ACG System (ACG), Charlson Comorbidity Index (CCI)	-	Hospital admissions	E	ACG C = 0.80 CCI C = 0.78	-
Levine et al. (2012) [51]	US	RCT	298	SCAN Health Plan Model	Case management	Emergency department attendance	E	-	Non-significant reduction, AD = 4.7%, $\chi^2 = 1.09$, p = 0.19
						Hospital admissions	E	-	Significant reduction, AD = 11.5%, $\chi^2 = 4.56$, p = 0.02
Liu et al. (2003) [50]	US	Observational study	126,076	Johns Hopkins ACG System (ACG), Chronic Illness and Disability Payment System (CDPS), Hierarchical Condition Category (HCC), RxRisk	-	Access of primary care services	E	ACG R ² = 0.21 CDPS R ² = 0.25 HCC R ² = 0.26 RxRisk R ² = 0.21	-
Lopez-Aguila et al. (2011) [49]	Spain	Observational study	14,215	Proprietary algorithm	-	Hospital admissions	I	C = 0.76	-
Lugo-Palacios et al. (2019) [48]	UK	Prospective cohort study	235,800	QAdmissions	Telemonitoring Quality improvement initiative for local care services	Emergency department attendance	E	-	Non-significant reduction, DiD -76.4 (-264.9–112.1), p = 0.41
						Hospital admissions	E	-	Significant increase, DiD 79.8 (21.2–138.4), p = 0.01
Maltenfort et al. (2019) [47]	US	Observational study	920,051	Johns Hopkins ACG System (ACG)	-	Hospital admissions	E	C = 0.82	-
Mosley et al. (2009) [46]	US	Observational study	3,954	Hierarchical Condition Category (HCC)	-	Hospital admissions	E	C = 0.64	-
Orueta et al. (2018) [45]	Spain	Observational study	84,136	Johns Hopkins ACG System (ACG)	-	Access of primary care services	E	C = 0.53	-
Orueta et al. (2018) [44]	Spain	Observational study	1,946,884	Forming and Identifying New Groups of Expected Risks (FINGER)	-	Healthcare costs (>95th percentile)	I	C = 0.83	-
						Hospital admissions	I	C = 0.80	-
						Mortality	I	C = 0.89	-

Petersen et al. (2001) [43]	US	Observational study	3,069,168	Johns Hopkins ACG System (ACG), Hierarchical Condition Category (HCC)	-	Hospital admissions	E	ACG C = 0.78 HCC C = 0.88	-
						Mortality	E	ACG C = 0.70 HCC C = 0.76	-
Rahimian et al. (2018) [42]	UK	Observational study	3,750,000	Machine Learning (Gradient Boosting Classifier [GBC]), Random Forest [RF]	-	Hospital admissions	I	GBC C = 0.85 RF C = 0.83	-
Rea et al. (2019) [41]	Italy	Observational study	5,400,000	Charlson Comorbidity Index (CCI), Chronic Related Score (CReSc)	-	Mortality	I	CCI C = 0.62 CReSc C = 0.79	-
Reid et al. (2001) [40]	Canada	Observational study	4,547,397	Johns Hopkins ACG System (ACG)	-	Healthcare costs	E	R ² = 0.23	-
Reilly et al. (2011) [39]	UK	Retrospective cohort study	867	Patients At Risk for Re-hospitalisation algorithm (PARR), Combined Predictive Model	Case management	PARR: Hospital admissions (total)	E	-	Significant reduction, AD = -0.3 (score), Z = 3.9, p < 0.001
						CPM: Hospital admissions (emergency)	E	-	Significant reduction, AD = -0.9 (score), Z = 4.7, p < 0.001
Shadmi et al. (2011) [38]	Israel	Observational study	270,000	Johns Hopkins ACG System (ACG), Charlson Comorbidity Index (CCI)	-	Access of primary care services	E	ACG R ² = 0.54 CCI R ² = 0.18	-
						Hospital admissions	E	ACG R ² = 0.24 CCI R ² = 0.11	-
Shannon et al. (2006) [37]	US	RCT	823	PacifiCare's Medicare Risk Program	Case management Telemonitoring	Emergency department attendance	E	-	Non-significant reduction, OR = 0.57 (0.31–1.05)
						Hospital admissions	E	-	Non-significant reduction, OR = 0.74 (0.43–1.28)
Sibley et al. (2010) [36]	Canada	Observational study	25,558	Johns Hopkins ACG System (ACG)	-	Access of primary care services	E	R ² = 0.33	-
Sicras-Mainar et al. (2006) [35]	Spain	Observational study	15,983	Johns Hopkins ACG System (ACG)	-	Hospital admissions	E	R ² = 0.72	-
Sicras-Mainar et al. (2009) [34]	Spain	Observational study	81,873	Johns Hopkins ACG System (ACG)	-	Hospital admissions	E	R ² = 0.73	-
Sicras-Mainar et al. (2013) [33]	Spain	Observational study	227,235	Johns Hopkins ACG System (ACG)	-	Healthcare costs	E	R ² = 0.37	-
Snooks et al. (2018) [25]	UK	RCT	230,099	Predictive Risk Stratification Model (PRISM)	Case management	Hospital admissions	I	-	Significant increase, OR = 1.44 (1.39–1.50), p < 0.001

Soto-Gordoa et al. (2019) [32]	Spain	Retrospective cohort study	13,248	Johns Hopkins ACG System (ACG)	Care coordination Case management Telemonitoring	Hospital admissions	E	-	Significant reduction in prioritised groups, OR = 0.91 (0.86–0.96) Significant increase in non-prioritised groups, OR = 1.19 (1.09–1.30)
Sylvia et al. (2008) [31]	US	Prospective cohort study	150	Johns Hopkins ACG System (ACG)	Care coordination Case management	Emergency department attendance	E	-	Non-significant reduction, AD = 0.16 attendances, p = 0.200
						Healthcare costs	E	-	Non-significant reduction, AD = \$1378 / 6 months, p = 0.347
						Hospital admissions	E	-	Non-significant reduction, AD = 0.19 admissions, p = 0.185
Takahsahi et al. (2012) [30]	US	RCT	205	Elder Risk Assessment Index	Telemonitoring	Emergency department attendance	E	-	Non-significant increase, AD 7.1%, p = 0.27
						Hospital admissions	E	-	Non-significant increase, AD 8.3%, p = 0.24
						Mortality	E	-	Significant increase, AD 10.8%, p = 0.008
Tomlin et al. (2016) [29]	New Zealand	Observational study	704,753	Predicting Emergency Admissions Over the Next Year (PEONY) 2	-	Hospital admissions	I	C = 0.72	-
Van Houtte et al. (2022) [28]	New Zealand	Observational study	319,943	Charlson Comorbidity Index (CCI)	-	Hospital admissions	E	C = 0.75	-
Wahls et al. (2004) [27]	US	Observational study	40,825	Johns Hopkins ACG System (ACG)	-	Access of primary care services	E	R ² = 0.30	-
						Hospital admissions	E	C = 0.86	-
Wallace et al. (2016) [26]	Ireland	Observational study	862	Charlson Comorbidity Index (CCI)	-	Emergency department attendance	E	C = 0.58	-

Table 1

A table summarising the characteristics of each study included in our analysis. Studies performing internal validation are differentiated from external validation in column 8 (Internal (I) / External (E) validation) where “I” represents internal validation and “E” external validation. The results of studies comparing the predictive performance of several different models are displayed in alphabetical order in each cell of column nine (Predictive ability), according to the full or abbreviated names of each model examined, followed by the corresponding outcome measure. Abbreviated names or acronyms for each model can be found in brackets after the full names in column five (Risk prediction model).

AD = absolute difference, C = c-statistic, DiD = difference-in-difference, OR = odds ratio, RCT = randomised controlled trial, UK = United Kingdom of Great Britain and Northern Ireland, US = United States of America, Z = z-score, χ^2 = chi-squared