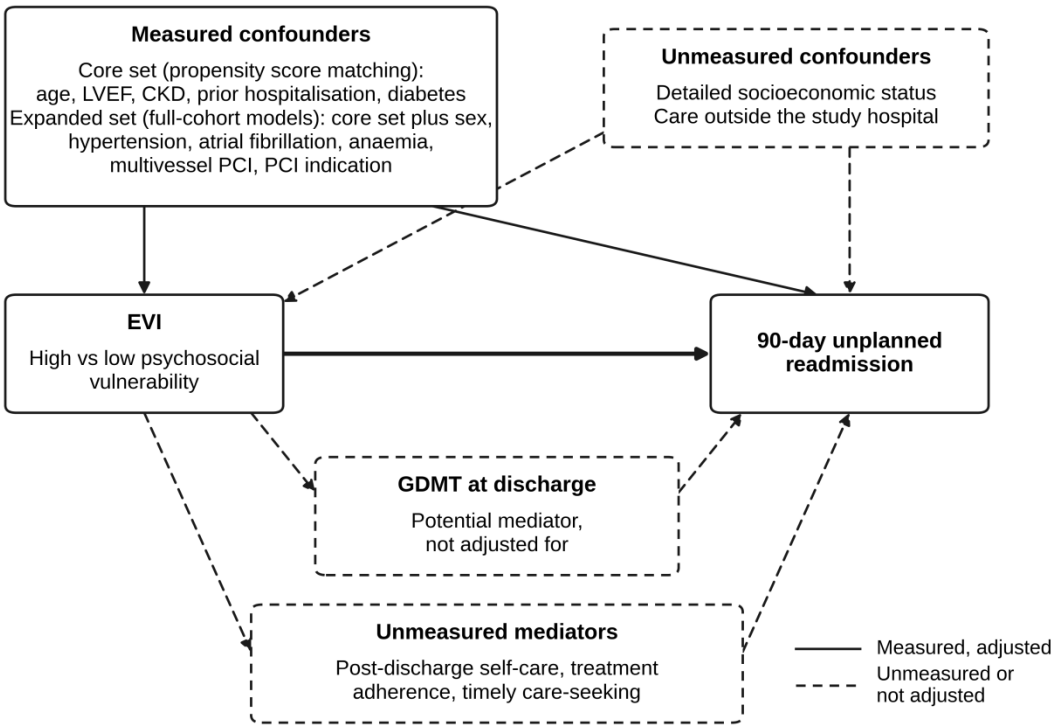
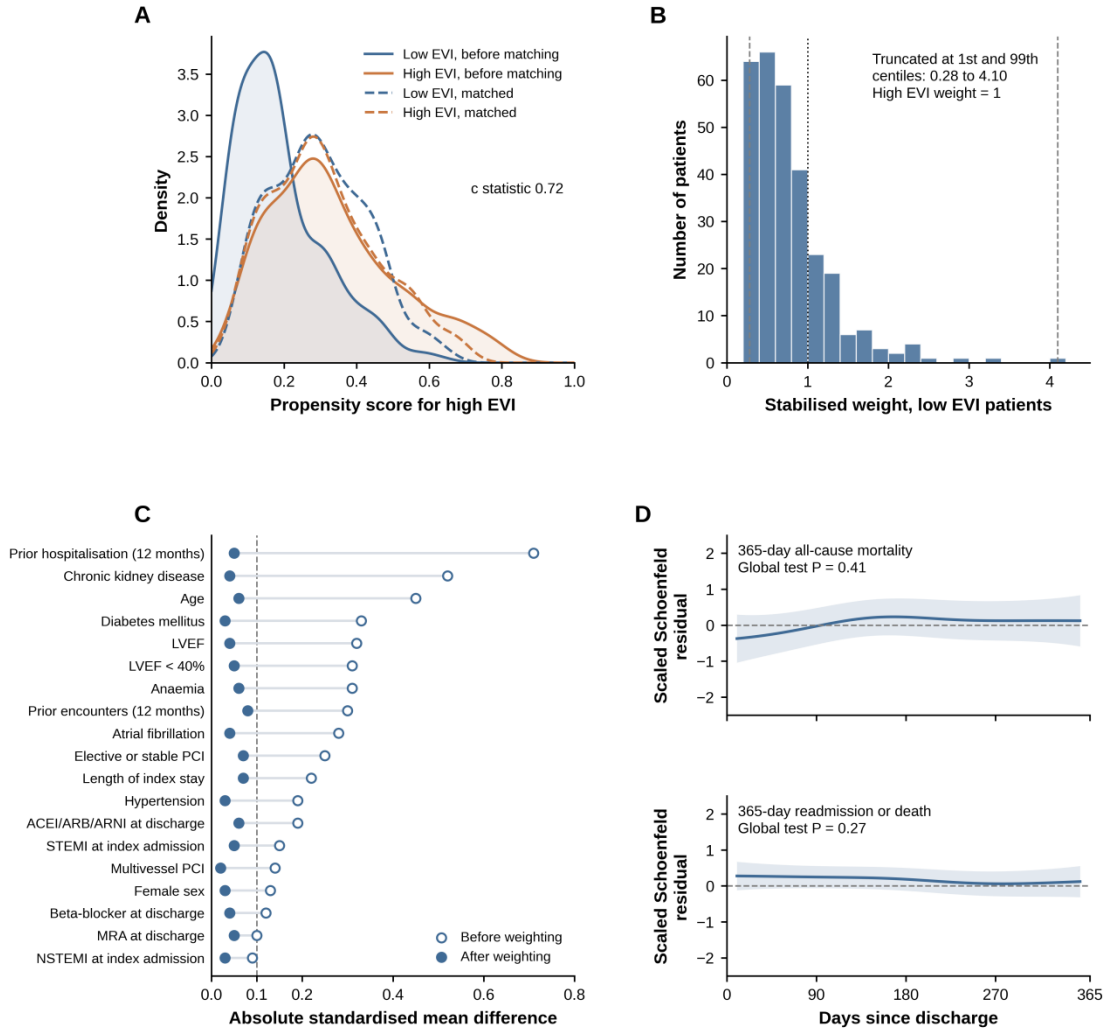


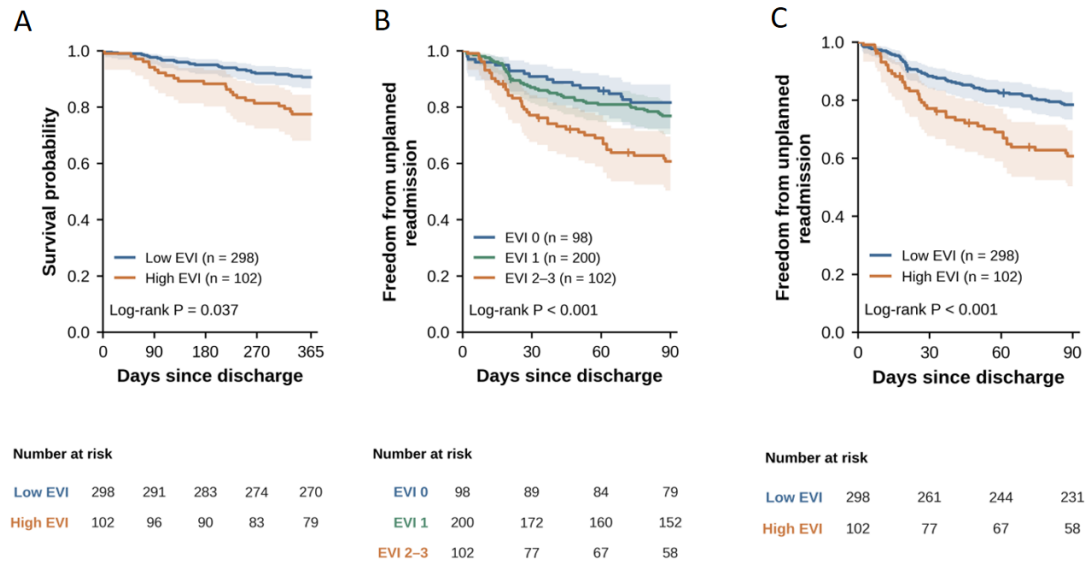
Supplementary Figure 1 Directed acyclic graph of the assumed relationship between psychosocial vulnerability and 90-day unplanned readmission. Solid boxes and arrows denote measured variables and adjusted paths; dashed boxes and arrows denote unmeasured or unadjusted constructs. The core covariate set (age, left ventricular ejection fraction, chronic kidney disease, prior hospitalisation within 12 months, diabetes mellitus) was used for propensity score matching in the primary analysis; the expanded set added sex, hypertension, atrial fibrillation, anaemia, multivessel percutaneous coronary intervention and percutaneous coronary intervention indication and was used in all full-cohort models and in the expanded weighting analysis. Guideline-directed medical therapy at discharge is positioned as a potential mediator between psychosocial vulnerability and readmission and was intentionally not adjusted for, because the study targets the total association. Post-discharge self-care, adherence and timely care-seeking are unmeasured mediators; detailed socioeconomic status and care outside the study hospital are unmeasured confounders, motivating the E-values reported in Supplementary Table 5. CKD:

Chronic kidney disease; EVI: Electronic medical record-derived psychosocial vulnerability index; GDMT: Guideline-directed medical therapy; LVEF: Left ventricular ejection fraction; PCI: Percutaneous coronary intervention.



Supplementary Figure 2 Propensity score and model diagnostics. A: Density of the estimated propensity score for high electronic medical record-derived psychosocial vulnerability index (EVI) (core covariate set; c statistic 0.72) before matching (solid lines) and in the matched cohort (dashed lines), showing overlap across the full range; 2 of 102 high-EVI patients were not matched within the caliper; B: Distribution of stabilised inverse probability of treatment weights (average treatment effect in the treated) among low-EVI patients from the expanded covariate model (c statistic 0.77), truncated at the 1% and 99% (0.28-4.10); high-EVI patients received a weight of 1; C:

Absolute standardised mean differences for all 19 baseline variables before (open circles) and after (filled circles) expanded-set weighting; the dashed line marks 0.10 and the maximum post-weighting value was 0.08; D: Smoothed scaled Schoenfeld residuals with 95% bands for high *vs* low EVI in the stratified Cox models for 365-day all-cause mortality (global test $P = 0.41$) and for the composite of 365-day unplanned readmission or death (global test $P = 0.27$). EVI: Electronic medical record-derived psychosocial vulnerability index.



Supplementary Figure 3 Unadjusted time-to-event outcomes in the full analytic cohort (*n* = 400). A: Overall survival to 365 days by electronic medical record-derived psychosocial vulnerability index (EVI) group (log-rank $P = 0.037$); numbers at risk at days 0, 90, 180, 270 and 365 were 298, 291, 283, 274 and 270 for low EVI and 102, 96, 90, 83 and 79 for high EVI; B: Freedom from unplanned readmission within 90 days across EVI categories 0 ($n = 98$), 1 ($n = 200$) and 2-3 ($n = 102$) (log-rank $P < 0.001$); C: Freedom from unplanned readmission within 90 days by EVI group, with deaths before first readmission censored (log-rank $P < 0.001$); numbers at risk at days 0, 30, 60 and 90 were 298, 261, 244 and 231 for low EVI and 102, 77, 67 and 58 for high EVI. Shaded areas denote 95% confidence intervals and tick marks censoring. These analyses are unadjusted for the baseline imbalance shown in Table 1 and Figure 2D;

they are descriptive, are not comparable with the adjusted estimates in Tables 2 and 3, and the unadjusted survival difference in panel B should not be interpreted as evidence of a mortality effect, which was not significant after matching (Table 3, Figure 3B). EVI: Electronic medical record-derived psychosocial vulnerability index.

Supplementary Table 1 Cohort construction, excluded patients, missing data, outcome components, death ascertainment and censoring, *n* (%)

Item	Total, *n*	High EVI, *n*	Low EVI, *n*
Cohort construction			
PCI hospitalisations screened, 1 January 2020 to 31 December 2024	472	-	-
Excluded: no concomitant heart failure	38	-	-
Potentially eligible patients	434	-	-
Excluded: died during index admission or discharged to palliative/long-term care	18	-	-
Survivors discharged home	416	-	-
Excluded: Staged PCI or other elective readmission already scheduled at discharge for within 90 days	6	-	-
Excluded: residence outside the hospital catchment area, determined at discharge	5	-	-
Excluded: missing key variables (EVI component documentation, *n* = 3; echocardiographic LVEF, *n* = 2)	5	-	-
Full analytic cohort (84.7% of screened)	400	102	298

Missing-data handling: Complete-case analysis; no imputation of exposures, covariates or outcomes	-	-	-
Excluded discharged survivors (n = 16) *vs* full analytic cohort (n = 400)	Excluded (n = 16)	Included (n = 400)	-
Age, years, mean (SD)	70.4 (9.8)	69.4 (9.5)	-
Female sex	6 (37.5)	154 (38.5)	-
LVEF, %, mean (SD) (available in 14 of 16 excluded)	41.0 (9.6)	41.1 (9.9)	-
Chronic kidney disease	7 (43.8)	165 (41.3)	-
Prior hospitalisation (12 months)	6 (37.5)	155 (38.8)	-
Diabetes mellitus	7 (43.8)	184 (46.0)	-
EVI classifiable	13 (81.3)	400 (100)	-
Full analytic cohort outcomes (n = 400)			
90-day unplanned readmission, n/N (%)	103/400 (25.8)	39/102 (38.2)	64/298 (21.5)
Death before first unplanned readmission within 90 days (competing event)	8	5	3
365-day all-cause death, n/N (%)	51/400 (12.8)	23/102 (22.5)	28/298 (9.4)
Deaths ascertained from in-hospital records at the study hospital	31	14	17
Deaths ascertained from death registry linkage or follow-up clinic documentation	20	9	11
Patients with successful death registry linkage	400	102	298

Propensity score-matched cohort (n = 200)			
30 days: First unplanned readmission	36	22	14
30 days: Death before first readmission (competing event)	3	2	1
30 days: Alive and event-free	161	76	85
90 days: First unplanned readmission	63	38	25
90 days: Death before first readmission (competing event)	8	5	3
90 days: Alive and event-free	129	57	72
365-day composite: First event was unplanned readmission	83	48	35
365-day composite: First event was death	12	7	5
365-day composite: Total patients with an event	95	55	40
365-day composite: Administratively censored alive and event-free	105	45	60
365-day deaths, total (of which after a prior unplanned readmission)	35 (23)	22 (15)	13 (8)
365-day deaths ascertained in hospital/by registry or clinic documentation	21/14	13/9	8/5
Alive at 365 days	165	78	87
Lost to follow-up before 365 days	0	0	0

Group columns refer to the full analytic cohort in the upper sections and to the propensity score matched cohort in the lower section. Both exclusion criteria applied to discharged survivors were determinable at the time of discharge (time zero): A documented plan for staged percutaneous coronary intervention or elective readmission within 90 days, and residence outside the catchment area; no patient was

excluded on the basis of events occurring after discharge, and elective admissions arising after discharge were not counted as unplanned readmissions but did not lead to exclusion. Characteristics of the 16 excluded survivors are shown where recorded; a formal comparison was not performed because of the small number and incomplete profiles. Readmissions were ascertained at the study hospital only; deaths were ascertained from in-hospital records and from linkage with the local death registry, which was achieved for all 400 patients, supplemented by follow-up clinic documentation. In the binary primary endpoint, patients who died before a first unplanned readmission were counted as not readmitted, as prespecified; in cumulative incidence analyses they were treated as competing events. Within each group and time window, counts sum to the group size (for example, 22 + 2 + 76 = 100). The numbers alive and event-free correspond to the at-risk values in Figure 3 and Supplementary Figure S3. EVI: Electronic medical record-derived psychosocial vulnerability index; LVEF: Left ventricular ejection fraction; PCI: Percutaneous coronary intervention.

Supplementary Table 2 Distribution, ascertainment, inter-rater agreement and domain overlap of the electronic medical record-derived psychosocial vulnerability index, with crude and adjusted associations with 90-day unplanned readmission in the full cohort (*n* = 400), *n* (%)

EVI measure	Patients	First-met criterion: structured/pharmacy/free-text, n	Kappa (60-record subsample)	90-day unplanned readmission, *n/N* (%)	Unadjusted OR (95%CI)	Adjusted OR (95%CI), *P* value
EVI score						

EVI = 0	98 (24.5)	-	-	18/98 (18.4)	1.00 (reference)	1.00 (reference)
EVI = 1	200 (50.0)	-	-	46/200 (23.0)	1.33 (0.73-2.42)	1.20 (0.65-2.22), 0.56
EVI = 2	72 (18.0)	-	-	25/72 (34.7)	2.36 (1.17-4.79)	1.85 (0.90-3.80), 0.09
EVI = 3	30 (7.5)	-	-	14/30 (46.7)	3.89 (1.61-9.38)	2.65 (1.05-6.70), 0.04
Per 1-point increase in EVI	-	-	-	-	-	1.40 (1.05-1.87), 0.02
Low EVI (score 0-1)	298 (74.5)	-	-	64/298 (21.5)	1.00 (reference)	1.00 (reference)
High EVI (score ≥ 2)	102 (25.5)	-	-	39/102 (38.2)	2.26 (1.39-3.68)	1.72 (1.03-2.87), 0.04
Individual EVI domains						
Mental health domain present	149 (37.3)	61 / 64 / 24	0.88	46/149 (30.9)	1.52 (0.96-2.40)	1.30 (0.78-2.16), 0.31
Cognitive/functional domain present	138 (34.5)	25 / NA / 113	0.82	48/138 (34.8)	2.01 (1.27-3.18)	1.68 (1.02-2.78), 0.04
Social/economic domain present	147 (36.8)	96 / NA / 51	0.87	44/147 (29.9)	1.40 (0.89-2.21)	1.22 (0.74-2.02), 0.44
Domain overlap patterns						

No domain positive	98 (24.5)	-	-	-	-	-
Mental health only	69 (17.3)	-	-	-	-	-
Cognitive/functional only	66 (16.5)	-	-	-	-	-
Social/economic only	65 (16.3)	-	-	-	-	-
Mental health + cognitive/functional	20 (5.0)	-	-	-	-	-
Mental health + social/economic	30 (7.5)	-	-	-	-	-
Cognitive/functional + social/economic	22 (5.5)	-	-	-	-	-
All three domains	30 (7.5)	-	-	-	-	-

Total positive domain assignments (149 + 138 + 147 = 434) equal 200 × 1 + 72 × 2 + 30 × 3, and patients positive in ≥ 2 domains (20 + 30 + 22 + 30 = 102) constitute the high-Electronic medical record-derived psychosocial vulnerability index (EVI) group. Ascertainment reflects the first-met criterion under the prespecified hierarchy; the cognitive/functional and social/economic domains had no pharmacy criterion. The overall kappa for domain assignment was 0.86. Adjusted odds ratios for EVI score categories, for the per-point increase and for high *vs* low EVI derive from multivariable logistic regression with the expanded covariate set (age, sex, left ventricular ejection fraction, chronic kidney disease, prior hospitalisation, diabetes mellitus, hypertension, atrial fibrillation, anaemia, multivessel percutaneous coronary intervention, percutaneous coronary intervention indication); the score-category estimates are those displayed in Figure 2C and the high *vs* low estimate is that shown

in Supplementary Table 5. Adjusted odds ratios for individual domains derive from a single model containing all three domains simultaneously plus the expanded covariate set, so that each domain estimate is adjusted for the other two; these estimates are exploratory. Among the 102 high-EVI patients, 31 (30.4%) met the ≥ 2-domain criterion only when documentation generated during the index admission was counted. Eleven patients met the mental health domain solely through the N05C pharmacy criterion, 6 of whom were classified as high EVI (Supplementary Table 3). CI: Confidence interval; EVI: Electronic medical record-derived psychosocial vulnerability index; NA: Not applicable; OR: Odds ratio.

Supplementary Table 3 Sensitivity analyses of the primary association: alternative electronic medical record-derived psychosocial vulnerability index specifications and quantitative bias analysis for unplanned readmissions missed at other institutions

Analysis	**Exposed patients, *n***	**90-day unplanned readmission, exposed *vs* unexposed**	**Odds ratio (95% CI)**	***P* value**
Alternative EVI specifications: full cohort (*n* = 400), multivariable logistic regression with the expanded covariate set				
High EVI (score ≥ 2) *vs* low EVI (reference specification)	102	39/102 (38.2) *vs* 64/298 (21.5)	1.72 (1.03-2.87)	0.04
Any vulnerability (EVI ≥ 1) *vs* none (EVI 0)	302	85/302 (28.1) *vs* 18/98 (18.4)	1.38 (0.78-2.45)	0.27
Maximum vulnerability (EVI = 3) *vs* EVI 0-2	30	14/30 (46.7) *vs* 89/370 (24.1)	2.05 (0.92-4.55)	0.08

Two-domain index excluding the cognitive/functional domain (mental health and social/economic both positive) *vs* all other patients	60	22/60 (36.7) *vs* 81/340 (23.8)		1.55 (0.85-2.82)	0.15
High EVI *vs* low EVI after removal of N05C agents from the mental health pharmacy criterion	96	37/96 (38.5) *vs* 66/304 (21.7)		1.80 (1.07-3.02)	0.03
High EVI *vs* low EVI, additionally adjusted for length of index stay and outpatient or emergency encounters in the prior 12 months (documentation intensity)	102	39/102 (38.2) *vs* 64/298 (21.5)		1.68 (1.00-2.83)	0.051
Quantitative bias analysis: matched cohort (n = 200), bias-adjusted crude odds ratio under assumed proportions of true readmissions missed at other institutions					
No readmissions missed (observed data)	100 100	*vs*	38.0% *vs* 25.0%	1.84	-
10% missed in the low-EVI group only	100 100	*vs*	38.0% *vs* 27.8%	1.59	-
20% missed in the low-EVI group only	100 100	*vs*	38.0% *vs* 31.3%	1.35	-
10% missed in the high-EVI group only	100 100	*vs*	42.2% *vs* 25.0%	2.19	-
20% missed in the high-EVI group only	100 100	*vs*	47.5% *vs* 25.0%	2.71	-

10% missed in both groups (non-differential)	100 100	*vs*	42.2% *vs* 27.8%	1.90	-
20% missed in both groups (non-differential)	100 100	*vs*	47.5% *vs* 31.3%	1.99	-
10% missed in the high-EVI group and 20% in the low-EVI group	100 100	*vs*	42.2% *vs* 31.3%	1.61	-
20% missed in the high-EVI group and 10% in the low-EVI group	100 100	*vs*	47.5% *vs* 27.8%	2.35	-

All analyses in this table are exploratory and are not adjusted for multiplicity. Each row of the upper section replaces the exposure variable in the same multivariable logistic model (expanded covariate set: Age, sex, Left ventricular ejection fraction, chronic kidney disease, prior hospitalisation within 12 months, diabetes mellitus, hypertension, atrial fibrillation, anaemia, multivessel percutaneous coronary intervention, percutaneous coronary intervention indication); the final row of that section adds two covariates to the reference model. Removal of N05C (hypnotics and sedatives) reclassified the 11 patients whose mental health domain had been met solely by that criterion, 6 of whom moved from high to low Electronic medical record-derived psychosocial vulnerability index (EVI). In the lower section, the observed crude odds ratio in the matched cohort (38 of 100 *vs* 25 of 100) is 1.84; each row recalculates the crude odds ratio after inflating the observed readmission proportion in each group by the assumed proportion of true readmissions missed (true proportion = observed proportion/[1 - proportion missed]); these are deterministic bias-adjusted point estimates and no confidence intervals are given. Non-differential missingness leaves the estimate essentially unchanged or slightly increases it; the observed association would be reduced to 1.35 only if one fifth of true readmissions in the low-EVI group, and none in the high-EVI group, had occurred at other

institutions. CI: Confidence interval; EVI: Electronic medical record-derived psychosocial vulnerability index; OR: Odds ratio.

Supplementary Table 4 Operational definitions, code lists and keyword terms of the electronic medical record-derived psychosocial vulnerability index

Domain (scored 1 if any criterion met)	Criterion type	Operational definition	Data source (ascertainment rank)
Mental health	Diagnosis codes	ICD-10 F32-F33 (depressive disorders); F41 (anxiety disorders); F20-F29 (schizophrenia, schizotypal and delusional disorders)	Structured diagnosis fields (rank 1)
Mental health	Pharmacy criterion	≥ 2 outpatient prescriptions within the assessment window for ATC N06A (antidepressants), N05B (anxiolytics), N05C (hypnotics and sedatives) or N05A (antipsychotics)	Pharmacy database (rank 2)
Mental health	Free-text keywords	Chinese-language free-text terms corresponding to depression; anxiety; psychosis or psychotic features	Admission records, nursing assessments, discharge summaries (rank 3)
Cognitive/functional	Diagnosis codes	ICD-10 F01-F03 (dementia); G30 (Alzheimer disease)	Structured diagnosis fields (rank 1)

Cognitive/functional	Free-text keywords	Chinese-language free-text terms corresponding to dementia; cognitive impairment; disorientation; dependence in basic activities of daily living	Nursing and admission notes (rank 3; no pharmacy criterion for this domain)
Social/economic	Structured fields	Marital status widowed or divorced; living alone or no accompanying caregiver recorded at admission; registered minimum living allowance status or social assistance beneficiary	Demographic and administrative fields (rank 1)
Social/economic	Free-text keywords	Chinese-language free-text terms corresponding to living alone; widowhood; divorce; absence of a caregiver; social assistance	Admission records, discharge summaries (rank 3)

The assessment window comprised the 365 days preceding discharge from the index admission, including documentation generated during the index admission itself. A domain was scored once any criterion was met, following the prespecified hierarchy (structured codes or fields, then pharmacy records, then free text). Free-text keyword hits were processed with a negation rule: A keyword preceded within the same clause by a Chinese-language negation expression meaning no, denies, not observed, or excluded was not counted. Every keyword hit was verified against the source record by one investigator, and a random sample of 60 records (15.0% of the cohort) was independently re-reviewed by two investigators blinded to outcome status (overall kappa = 0.86; Supplementary Table 2). The pharmacy criterion for the mental health domain required at least two outpatient prescriptions; because anatomical therapeutic chemical classification N05C agents (hypnotics and sedatives) are frequently prescribed for insomnia in cardiac patients, a sensitivity analysis excluding them is

reported in Supplementary Table 3. The Electronic medical record-derived psychosocial vulnerability index total score ranges 0-3; high Electronic medical record-derived psychosocial vulnerability index was defined as a score ≥ 2. Definitions were intentionally inclusive and represent electronic-record signals of possible vulnerability rather than clinical diagnoses. ATC: Anatomical therapeutic chemical classification; EMR: Electronic medical record; EVI: Electronic medical record-derived psychosocial vulnerability index; ICD-10: International Classification of Diseases, 10th revision.

Supplementary Table 5 Consistency of the association between high electronic medical record-derived psychosocial vulnerability index and 90-day unplanned readmission across analytic approaches and covariate sets

Analysis	**Population**	**Covariate set**	**High *vs* low EVI**	**Effect estimate (95%CI)**	***P* value**	**Balance and model diagnostics**	**E-value, point (CI bound)**
Unadjusted	Full cohort, *n* = 400	None	39/102 (38.2) *vs* 64/298 (21.5)	OR 2.26 (1.39-3.68)	< 0.001	Maximum absolute SMD 0.71	-

Propensity score matching, conditional logistic regression (primary analysis)	Matched cohort, n = 200	Core set (5 variables)	38/100 (38.0) *vs* 25/100 (25.0)	Conditional OR 1.87 (1.01-3.46)	0.047 (score); 0.051 (Wald)	PS model c-statistic 0.72; 2 of 102 high-EVI patients unmatched within caliper; maximum absolute SMD 0.05 across 19 covariates; 28 *vs* 15 discordant pairs	2.1 (1.1)
IPTW (ATT), weighted logistic regression	Full cohort, n = 400	Core set (5 variables)	38.2% *vs* 26.6% (weighted)	OR 1.71 (1.07-2.72)	0.02	Stabilised weights truncated at 1st and 99th percentiles, range 0.31-3.92; maximum absolute SMD 0.06	1.9 (1.2)

IPTW (ATT), weighted logistic regression	Full cohort, *n* = 400	Expanded set (11 variables)	37.9% *vs* 27.3% (weighted)	OR 1.63 (0.99-2.68)	0.054	PS model c-statistic 0.77; propensity score overlap covered all 102 high-EVI patients; stabilised weights truncated at 1st and 99th percentiles, range 0.28-4.10; maximum absolute SMD 0.08	1.9 (1.0)
Multivariable logistic regression	Full cohort, *n* = 400	Expanded set (11 variables)	39/102 (38.2) *vs* 64/298 (21.5)	Adjusted OR 1.72 (1.03-2.87)	0.04	103 events for 12 model parameters (8.6 events per parameter)	1.9 (1.1)

The core covariate set comprised age, left ventricular ejection fraction, chronic kidney disease, prior hospitalisation within 12 months and diabetes mellitus; the expanded set added female sex, hypertension, atrial fibrillation, anaemia, multivessel percutaneous coronary intervention and percutaneous coronary intervention indication (three categories). Matching used 1:1 nearest-neighbour matching without replacement and a caliper of 0.2 SD of the logit of the propensity score. Inverse probability of treatment weighting targeted the average treatment effect in the treated,

retaining high-electronic medical record-derived psychosocial vulnerability index (EVI) patients at unit weight and weighting low-EVI patients by the odds of the propensity score; standard errors were robust sandwich estimates. Propensity score overlap, weight distributions and balance for the expanded model are shown in Supplementary Figure 2. Matching with the expanded set was not pursued because more than 10% of high-EVI patients could not be matched within the caliper; the expanded set was therefore carried by weighting and regression in the full cohort. *E*-values give the minimum strength of association, on the risk ratio scale, that an unmeasured confounder would need with both EVI and readmission to fully explain the observed estimate (point) or to move the confidence bound to the null (CI bound); odds ratios were converted to approximate risk ratios by the square-root transformation because the outcome was common, and a value of 1.0 indicates that the confidence interval already includes the null. ATT: Average treatment effect in the treated; CI: Confidence interval; EVI: Electronic medical record-derived psychosocial vulnerability index; IPTW: Inverse probability of treatment weighting; OR: Odds ratio; PS: Propensity score; SMD: Standardised mean difference.