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Care-pathway discontinuity after WHO ICOPE screening: a three-year implementation evaluation of 11,827 assessments in Taiwan

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Research Article

Keywords: older adults, intrinsic capacity, integrated care for older people, care pathway, continuity of care, implementation evaluation

Posted Date: October 30th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10941801/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

The World Health Organization Integrated Care for Older People (ICOPE) approach is intended to connect screening for declines in intrinsic capacity with person-centred assessment and care planning. Evidence on whether older people who screen positive reach the next pathway step remains limited. We evaluated downstream-assessment completion, the usefulness of baseline screening profiles for identifying non-completion, and the stability of programme measurements over time.

Methods

We conducted a repeated cross-sectional evaluation of 11,827 routinely collected initial ICOPE assessments among adults aged 65 years and older in a hospital-based programme in Taiwan during 2023–2025. Initial and downstream-assessment records were linked within each calendar year. Among records with at least one abnormal core domain, modified Poisson regression with robust variance estimated adjusted risk ratios (aRRs) for non-completion. Logistic models assessed discrimination and year-by-domain interaction. Domain classifications were independently reconstructed from raw screening items to evaluate measurement stability.

Results

Among 9,517 records with an abnormal screen, 7,174 (75.4%) had no linked downstream assessment; annual non-completion was 76.7%, 72.8%, and 76.6%. Baseline factors showed only small associations with non-completion. Cognitive abnormality was associated with an aRR of 1.04 (95% CI 1.02–1.07; absolute risks 76.3% versus 73.5%), but this association varied by year (interaction P = 0.020). Discrimination was poor (c-statistic 0.550 for the full model versus 0.523 for year alone), providing little support for profile-targeted navigation. Reconstruction reproduced all six domain flags exactly but identified a change in the vision algorithm in 2024 and a marked shift in recorded chair-rise times despite an unchanged threshold.

Conclusions

In routine ICOPE delivery, screening coverage alone did not indicate completion of the intended care pathway: approximately three quarters of positive-screen records lacked a linked downstream assessment. Because baseline intrinsic-capacity profiles did not identify non-completion adequately, programmes should evaluate systematic follow-up for all positive screens and report downstream-assessment completion as an implementation-quality indicator. Longitudinal comparisons also require versioned algorithms and stable measurement procedures.

Introduction

Healthy ageing is defined by the World Health Organization (WHO) as the process of developing and maintaining the functional ability that enables wellbeing in later life [1, 2]. Functional ability is shaped by intrinsic capacity, the composite of a person's physical and mental capacities, which offers a function-centred rather than disease-centred account of health in older people [1, 3]. Impaired intrinsic capacity is associated with frailty, disability, hospital admission and death, and has become a practical organising concept for geriatric care [3, 8, 11].

The Integrated Care for Older People (ICOPE) framework translates this concept into a care pathway: screening across six core domains — cognition, locomotion, vitality, vision, hearing and psychological capacity — followed by comprehensive assessment, an individualised care plan, intervention and review [3, 4, 12]. ICOPE is therefore not a screening instrument but a continuum, and its clinical value depends on the steps that follow a positive screen. Implementation studies have shown that screening is feasible at scale [5, 6, 7], yet what happens after screening is seldom quantified. If older people identified as having reduced intrinsic capacity do not reach comprehensive assessment, the pathway cannot deliver the functional benefit it was designed to produce, and screening becomes case-finding without care.

A second, related problem concerns how programmes are judged. As national ICOPE programmes mature, annual reports increasingly compare the prevalence of intrinsic capacity impairment between years and treat the comparison as evidence about the health of the population or the performance of the service. Such comparisons assume that operational definitions, assessment procedures and recording conventions were stable. That assumption is rarely tested, largely because programme datasets usually distribute system-derived domain flags rather than the underlying screening responses, leaving the definitions opaque.

Using three years of routine programme data that retained both derived flags and original item responses, we evaluated ICOPE as an implemented care pathway rather than as a screening instrument alone. We aimed to: (i) quantify completion of downstream assessment after an abnormal screen; (ii) determine whether baseline intrinsic-capacity profiles could identify records at risk of non-completion; and (iii) test whether annual programme indicators rested on stable measurement. By separating a local completion rate from transferable implementation and measurement lessons, the evaluation was designed to inform quality monitoring in other ICOPE delivery settings.

Methods

Design and setting

This was a repeated cross-sectional evaluation of routinely collected records from a hospital-based ICOPE programme in Taiwan, covering initial assessments performed in the calendar years 2023, 2024 and 2025. Taiwan has adopted ICOPE within its national healthy ageing strategy, and the participating network delivered standardised screening in outpatient and community settings. Older people with one

or more abnormal domains were recommended for comprehensive post-screening assessment under routine programme procedures. Reporting follows STROBE (Appendix 1).

Participants

Eligible records were initial ICOPE assessments in adults aged 65 years and over (observed range 65–108). Administrative blank rows and records not classified as initial assessments were excluded, leaving 3 763 records in 2023, 3 820 in 2024 and 4 244 in 2025 (11 827 in total). Age, sex and chronic disease history were complete for every record, so no imputation was needed.

Because no stable personal identifier was available, individuals could not be followed deterministically between calendar years and the assessment record was the unit of analysis. The programme's own first-screening indicator showed that 27.0% of 2024 records and 44.5% of 2025 records were not first screenings. For sensitivity analysis, records were clustered by an approximate cross-year key comprising date of birth, sex and village; records with a missing village were treated as singleton clusters, yielding 8 013 clusters among the 9 517 positive-screen records.

Linkage and outcomes

Post-screening records were linked to initial records within each calendar year using deterministic composite keys built from de-identified administrative fields. Keys were unique for every initial record in all three years, and every post-screening record was matched within its year (668/668, 844/844 and 835/835). Cross-year linkage was not attempted. Full linkage detail is in Appendix 2.

The primary outcome was non-completion of downstream assessment, defined as the absence of a linked post-screening record, among initial records with at least one abnormal core domain. Records with no abnormal domain were excluded because comprehensive assessment was not indicated for them. Residual abnormality among those who returned was examined descriptively only, because follow-up was incomplete and reasons for non-return were not recorded.

Measurement

The programme distributes a derived field listing abnormal domains, but the rules behind it were undocumented. We reconstructed candidate rules from the raw screening responses and tested each against the derived flag in every year. Agreement was complete for all six domains (Appendix 3), which both validated the primary exposure and allowed definitional stability to be tested directly. The hearing item proved to be reverse-coded relative to the supplied data dictionary; analyses used the derived flag and are unaffected, but the correction is needed for reproduction.

Statistical analysis

Because the primary outcome was common (75.4%), odds ratios would materially overstate risk ratios. The primary analysis therefore used modified Poisson regression with robust (sandwich) variance to estimate adjusted risk ratios (aRRs), reported with absolute risks. Logistic models using the same covariates are shown alongside for comparability with earlier work and were used to calculate the c-statistic. The locked primary specification included assessment year, age per five years, sex, chronic condition count and all six domain indicators. Because a quadratic age term improved logistic-model fit (likelihood-ratio χ^2=26.88, 1 df, P < 0.001), age was refitted in five-year categories as a sensitivity analysis; domain estimates and interpretation were materially unchanged (Appendix 4). Effect modification by year was tested by likelihood-ratio tests of year × domain terms, with year-specific estimates reported when supported. Prespecified sensitivity analyses used cluster-robust variance based on the approximate person key, inverse-probability-of-completion weighting for residual abnormality among linked positive-screen records, and an expanded chronic condition count including free-text conditions (Appendix 4). Analyses used Python 3 with NumPy, SciPy and statsmodels. A separate implementation independently rebuilt the analytic dataset from the raw CSV files and refitted the modified Poisson and logistic models by custom iteratively reweighted least squares, including direct calculation of the sandwich covariance. All 54 automated cross-implementation checks passed; the maximum absolute numerical difference was 1.47×10 − 7. Tests were two-sided with P < 0.05 considered statistically significant. No causal effect of ICOPE screening or subsequent care was estimated.

The study was approved by the Institutional Review Board of Kuang Tien General Hospital (KTGH IRB No. KTGH 11529; approved 30 July 2026). The requirement for informed consent was waived because the study used de-identified routinely collected data and posed minimal risk. Generative artificial intelligence assisted with language editing, manuscript formatting and development of the separate computational verification workflow; the authors reviewed the code and aggregate outputs and retained responsibility for all scientific content, results and interpretations.

Declaration of Sources of Funding: this work received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Results

Population and recorded profiles

Across the three years 11 827 initial assessments were analysed. Mean age was 74.0, 74.5 and 74.2 years and about 55% of records were for women. At least one abnormal core domain was recorded in 2 853 (75.8%), 3 102 (81.2%) and 3 562 (83.9%) records (Table 1). Recorded locomotion abnormality fell from 70.5% to 37.3%, while cognitive abnormality rose from 45.0% to 55.8% and vision abnormality from 17.0% to 38.9%. For reasons given below, these annual differences are reported as recorded programme profiles and not as population trends.

Table 1
Characteristics and recorded core-domain abnormalities at initial ICOPE assessment, by year.

Initial assessments, n	**2023**	**2024**	**2025**	**All years**
	3 763	**3 820**	**4 244**	**11 827**
Mean age, years	74.0	74.5	74.2	74.2
Women, %	55.1	54.7	54.8	54.9
Any core-domain abnormality, n (%)	2 853 (75.8)	3 102 (81.2)	3 562 (83.9)	9 517 (80.5)
One abnormal domain, n (%)	884 (23.5)	1 495 (39.1)	1 717 (40.5)	4 096 (34.6)
Two abnormal domains, n (%)	1 179 (31.3)	902 (23.6)	1 039 (24.5)	3 120 (26.4)
Three or more, n (%)	790 (21.0)	705 (18.5)	806 (19.0)	2 301 (19.5)
Cognition, n (%)	1 694 (45.0)	2 250 (58.9)	2 369 (55.8)	6 313 (53.4)
Locomotion, n (%)	2 654 (70.5)	1 241 (32.5)	1 584 (37.3)	5 479 (46.3)
Vitality/nutrition, n (%)	322 (8.6)	340 (8.9)	152 (3.6)	814 (6.9)
Vision, as recorded, n (%)	641 (17.0)	1 257 (32.9)	1 650 (38.9)	3 548 (30.0)
Vision, harmonised to 2024 rule, %	25.2	32.9	38.9	—
Hearing, n (%)	318 (8.5)	528 (13.8)	691 (16.3)	1 537 (13.0)
Psychological (depressive symptoms), n (%)	293 (7.8)	204 (5.3)	97 (2.3)	594 (5.0)

*Annual differences are recorded programme profiles and should not be read as within-person trajectories. Vision is shown as recorded and harmonised to the 2024–25 rule, because the vision algorithm changed in 2024 (*Fig. 2b; *Appendix 3).*

Care continuity

Of the 9 517 records with an abnormal screen, 7 174 (75.4%) had no linked downstream assessment. Annual non-completion was 76.7% (2 189/2 853) in 2023, 72.8% (2 258/3 102) in 2024 and 76.6% (2 727/3 562) in 2025 (Table 2, Fig. 1). Thus, fewer than one in four positive-screen records were followed by a linked downstream assessment. Among linked completers, residual abnormality was documented in 88.8%, 61.0% and 58.7%, respectively; these figures describe a selected subgroup and should not be interpreted as changes in the assessed population.

Table 2
Care continuity after abnormal ICOPE screening, by year.

Year	Initial assessments, n	Abnormal screen, n	Completed downstream assessment, n (%)	Did not complete, n (%)
2023	3 763	2 853	664 (23.3)	2 189 (76.7)
2024	3 820	3 102	844 (27.2)	2 258 (72.8)
2025	4 244	3 562	835 (23.4)	2 727 (76.6)
All years	11 827	9 517	2 343 (24.6)	7 174 (75.4)

Percentages for completion and non-completion use records with an abnormal screen as the denominator. Four additional records in 2023 were linked despite having no abnormal core domain and are excluded here (Appendix 2).

Baseline profiles and non-completion

Associations between baseline domains and non-completion were detectable but small (Table 3). Cognitive abnormality carried an aRR of 1.04 (95% CI 1.02–1.07), corresponding to 76.3% versus 73.5% — an absolute difference of 2.8 percentage points. Locomotion (aRR 0.95, 0.92–0.98), vitality/nutrition (0.93, 0.88–0.98) and hearing abnormality (0.95, 0.91–0.98) were associated with slightly better completion. The corresponding logistic estimate for cognition (odds ratio 1.18, 1.07–1.31) overstates the risk ratio roughly fourfold in this common outcome.

Table 3
Associations with non-completion of downstream assessment among 9 517 records with an abnormal screen.

Cognition abnormality	Non-completion, %	Adjusted risk ratio (95% CI)*	Adjusted odds ratio (95% CI)†	P
	76.3 v 73.5	**1.04 (1.02–1.07)**	**1.18 (1.07–1.31)**	**0.002**
Locomotion abnormality	74.5 v 76.6	0.95 (0.92–0.98)	0.82 (0.73–0.91)	< 0.001
Vitality/nutrition abnormality	69.7 v 75.9	0.93 (0.88–0.98)	0.76 (0.65–0.90)	0.004
Vision abnormality	75.3 v 75.5	1.01 (0.98–1.03)	1.04 (0.94–1.15)	0.465
Hearing abnormality	71.7 v 76.1	0.95 (0.91–0.98)	0.81 (0.71–0.91)	0.002
Psychological abnormality	73.9 v 75.5	1.01 (0.96–1.07)	1.05 (0.86–1.28)	0.655
Chronic conditions, per condition	—	0.98 (0.97–0.99)	0.94 (0.90–0.98)	0.002
Age, per 5 years	—	1.00 (1.00–1.01)	1.02 (0.98–1.06)	0.336
Women	—	1.00 (0.97–1.02)	0.99 (0.90–1.09)	0.848
Year 2024 v 2023	72.8 v 76.7	0.92 (0.89–0.95)	0.72 (0.63–0.82)	< 0.001
Year 2025 v 2023	76.6 v 76.7	0.97 (0.94–1.00)	0.89 (0.78–1.02)	0.081

**Modified Poisson regression with robust (sandwich) variance (primary analysis). †Logistic regression with the same covariates, shown for comparability with earlier literature; with a 75.4% outcome, odds ratios can materially exaggerate risk-ratio departures from the null. Both models adjusted for assessment year, age per five years, sex, chronic condition count and all six domains. The c-statistic from the logistic model was 0.550 (0.523 for year alone). Five-year age categories were examined in a sensitivity analysis and did not materially change the domain estimates (Appendix A4.3). The cognition association was modified by year (interaction P = 0.020; Appendix A4.2).*

Discrimination was poor: the c-statistic was 0.550 for the full model and 0.523 for a model containing assessment year alone, so all measured covariates together added little discrimination beyond year. Non-completion varied non-monotonically with age (77.2% at 65–69 years, 72.4% at 75–79 years and 78.4% at 85 years and over); modelling age in five-year categories did not materially change the domain estimates (Appendix A4.3). The cognitive association was modified by year (interaction P = 0.020) and was confined to 2023 (odds ratio 1.40, 95% CI 1.16–1.69) rather than 2024 (1.07, 0.89–1.30) or 2025 (1.12, 0.94–1.33); the pooled cognition estimate is therefore not treated as a principal finding.

Measurement stability

All six domain classifications were reproduced exactly from the raw items in every year. Four domains used identical rules throughout. Two did not. The 2023 vision flag corresponded exactly to the screening item alone, although 3 123 records had a documented confirmatory vision test that year; from 2024 the

flag corresponded exactly to the screening item or a failed confirmatory test. Applying the 2024 rule to 2023 raises vision abnormality from 17.0% to 25.2%, so roughly 8 of the 22 percentage points of the apparent increase are definitional (Fig. 2b).

For locomotion, the threshold was unchanged: 'chair-rise time greater than 12 s, or unable' reproduced the flag exactly in all three years. The recorded measurements nevertheless differed substantially. Median chair-rise time was 19 s in 2023, 10 s in 2024 and 11 s in 2025 ($P < 0.001$), and the 2023 distribution was heaped at 12, 25 and 30 s whereas later distributions were smoother (Fig. 2a). The abrupt shift and digit heaping raise concern about changes in administration or recording and preclude interpreting the annual prevalence difference as a population trend.

Sensitivity analyses did not alter any conclusion (Appendix 4). With missing-village records treated as singleton clusters, cluster-robust standard errors differed from model-based standard errors by at most 5.5%. The programme's repeat-participation indicator was not associated with non-completion (odds ratio 0.95, 95% CI 0.85–1.07; $P = 0.41$). Inverse-probability weighting among the 2 343 linked positive-screen records left the residual-abnormality estimates essentially unchanged, and expanding the chronic disease count altered no domain estimate.

Discussion

Principal findings

This three-year evaluation identified two implementation problems that are relevant to ICOPE programmes beyond the study setting. First, approximately three quarters of records with a positive screen had no linked downstream assessment, with little improvement over time. Second, the information collected at screening did not discriminate adequately between completion and non-completion. The care gap was therefore large, persistent, and not readily solved by targeting follow-up according to intrinsic-capacity profiles. In parallel, reconstruction of the programme rules showed that two of six annual domain indicators were not measured comparably across years.

These findings shift the interpretation of ICOPE programme performance from screening reach to pathway completion. Screening is an entry point rather than the intervention itself; without person-centred assessment, identification of potentially modifiable decline cannot reliably lead to a care plan, intervention, or review. The primary result should therefore be read as an implementation signal: high screening volume can coexist with substantial discontinuity at the next care-pathway step.

Implications for geriatric care and ICOPE implementation

For clinicians and programme managers, the immediate question is not only which domains are abnormal but whether every positive result produces an accountable next action. The six baseline domains added little discrimination beyond calendar year, and observed associations were too small and inconsistent to justify selective navigation. A systematic approach—such as scheduling the next

assessment before the screening encounter ends, assigning responsibility for recall, documenting referral destination, and recording the reason for non-completion—may be more defensible than restricting follow-up to selected domain profiles. These strategies require prospective evaluation; the present observational data do not establish their effectiveness.

The absence of a linked record cannot be equated with patient refusal or failure to attend. Assessment elsewhere, administrative delay, relocation, death, and incomplete data capture remain possible. This uncertainty is itself a programme-design finding. If reasons for pathway discontinuity are not captured, services cannot distinguish access barriers from documentation failures or identify where corrective action is needed.

Transferability beyond Taiwan

The absolute non-completion rate is specific to the organisation, referral arrangements, and data infrastructure of this hospital-based programme and should not be exported to other settings. The transferable finding is the method and the implementation question. Any health system adopting ICOPE must connect case-finding to assessment and care planning, define who owns the hand-off, and measure whether that hand-off occurs. These requirements apply whether delivery is organised through primary care, community services, hospitals, or integrated health and social-care networks.

Accordingly, programmes should report a small cascade of denominators: people screened, positive screens, completed person-centred assessments, initiated care plans, and reassessments. Completion should be accompanied by time-to-assessment and reasons for non-completion where available. Cross-setting comparison should focus initially on these explicitly defined process measures rather than assuming that the Taiwan rate represents an international benchmark.

Measurement and reporting implications

Programme monitoring also depends on stable measurement. Approximately eight percentage points of the apparent increase in recorded vision abnormality arose from a change in the derived rule, while the large fall in locomotion abnormality coincided with an abrupt shift and digit heaping in chair-rise times despite an unchanged threshold. These findings support three safeguards: retain raw item-level data alongside derived flags; version and date-stamp algorithms and data dictionaries; and inspect raw distributions before interpreting annual prevalence changes. Without these safeguards, documentation or implementation changes may be mistaken for changes in population health.

For multicentre and international ICOPE learning, a common minimum dataset should therefore include pathway-stage timestamps, referral disposition, reasons for discontinuity, operational definitions for every derived indicator, and version metadata. Such information would make implementation outcomes interpretable across sites while preserving local adaptation of service delivery.

Strengths and limitations

Strengths include the large three-year sample; complete reconstruction of all six domain classifications from raw items; use of risk ratios and absolute risks for a common outcome; formal evaluation of year-specific heterogeneity; and independent computational reproduction of the primary-model estimates. The combination of pathway evaluation and measurement audit allowed us to distinguish a service-continuity problem from changes in recorded programme profiles.

Several limitations constrain interpretation. This was an observational, hospital-based evaluation in one region of Taiwan and cannot estimate the causal effect of screening or subsequent care. Records rather than unique people were the unit of analysis because no stable cross-year identifier was available. Approximate clustering did not materially change estimates, but residual dependence and linkage error remain possible. The outcome was absence of a linked downstream record, not verified non-attendance; assessments outside the captured system and administrative delay could not be identified. Social, economic, caregiver, transport, digital-access, and service-capacity variables were unavailable and probably explain more of non-completion than the screening domains. Finally, reasons for non-completion were not recorded, so proposed implementation responses require prospective testing.

Conclusions

Across 11,827 routine ICOPE assessments, approximately three quarters of positive-screen records lacked a linked downstream assessment, and baseline screening profiles did not identify non-completion well enough to support selective navigation. The generalisable lesson is not the Taiwan-specific rate but the need to measure and manage the transition from screening to person-centred assessment. ICOPE programmes should report pathway completion alongside screening coverage, document reasons for discontinuity, and preserve versioned measurement rules before interpreting annual changes.

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board of Kuang Tien General Hospital (KTGH IRB No. KTGH 11529; approved 30 July 2026). The requirement for informed consent was waived because the study used de-identified routinely collected data and posed minimal risk.

Consent for publication

Not applicable. The manuscript contains no identifiable individual-level information.

Availability of data and materials

The individual-level dataset is not publicly available and cannot be shared because it contains sensitive health and administrative information governed by institutional ethics and data-protection requirements. Aggregate data supporting the findings are provided in the article and its additional files.

Competing interests

The authors declare that they have no competing interests.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Authors' contributions

M-LH: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, and Visualization. H-WY, P-HL, and Y-SH: Supervision and Project administration. All authors read and approved the final manuscript.

Acknowledgements

Not applicable.

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Figures

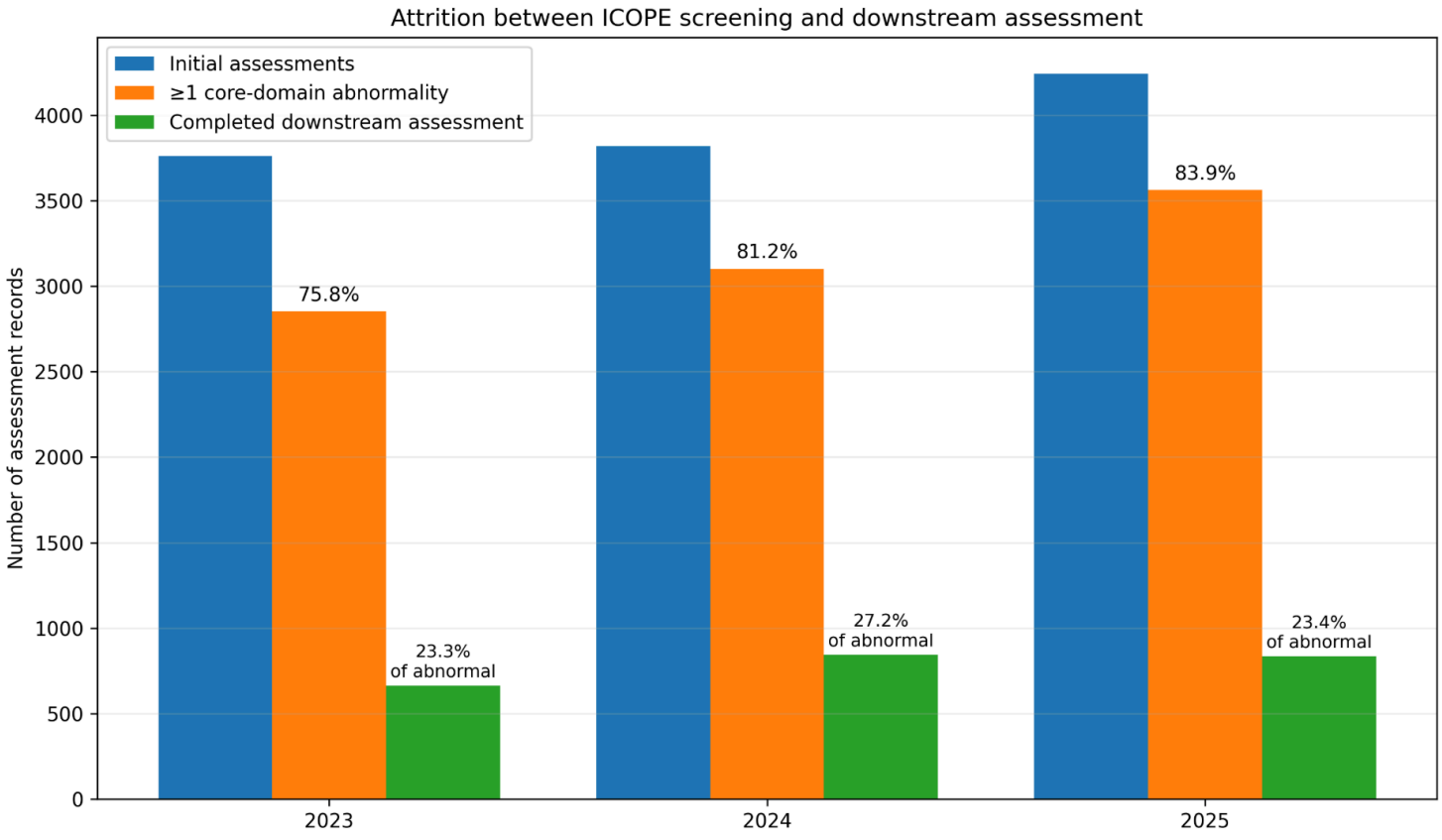


Figure 1

Attrition between ICOPE screening and downstream assessment, by year. Bars show initial assessments, records with at least one abnormal core domain, and records with a linked downstream assessment. Labels give each stage as a percentage of the preceding stage.

Alt text: Grouped bar chart for 2023, 2024 and 2025. Initial assessments number 3 763, 3 820 and 4 244; positive screens number 2 853, 3 102 and 3 562; linked downstream assessments among positive screens number 664, 844 and 835.

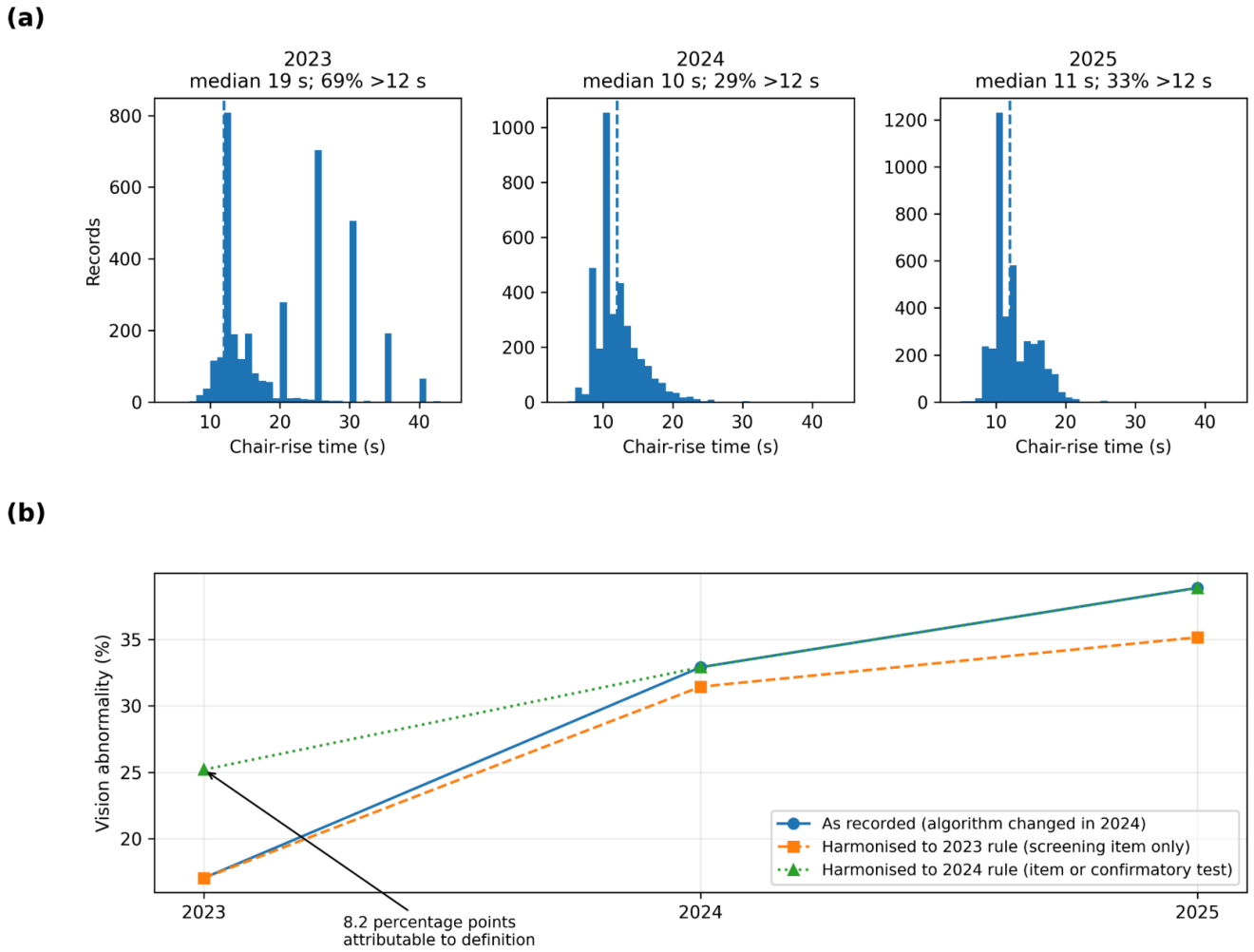


Figure 2

Measurement stability across programme years. (a) Distribution of recorded chair-rise times, with the unchanged >12 s abnormality threshold marked; the 2023 distribution is heaped at 12, 25 and 30 s and its median is nine seconds longer than 2024. Percentages printed above the histograms are calculated among records with an observed chair-rise time; records coded as unable are abnormal under the programme rule but are not represented in the histograms. (b) Vision abnormality as recorded and harmonised to each year's candidate rule; about eight percentage points of the apparent increase is attributable to the algorithm change in 2024.

Alt text: Panel (a) shows chair-rise-time histograms with a dashed threshold at 12 seconds. The 2023 distribution is markedly right-shifted and heaped at 12, 25 and 30 seconds; 2024 and 2025 cluster near 10–

11 seconds. Panel (b) shows recorded and harmonised vision-abnormality percentages; applying the later rule to 2023 raises the estimate from 17.0% to 25.2%.

Supplementary Files

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- BMCGeriatricsAdditionalFile1Appendices.docx