Canadian Stroke Best Practices

CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

Rehabilitation, Recovery and Community Participation Following Stroke

Part One: Stroke Rehabilitation Planning for Optimal Care Delivery Evidence Tables

Initial Stroke Rehabilitation Assessment

Nancy Salbach and Jennifer Yao (Writing Group Chairs)
Michelle Nelson, Jing Shi (Section Leads)
on Behalf of the Canadian Stroke Best Practice Recommendations
Stroke Rehabilitation and Recovery Writing Group

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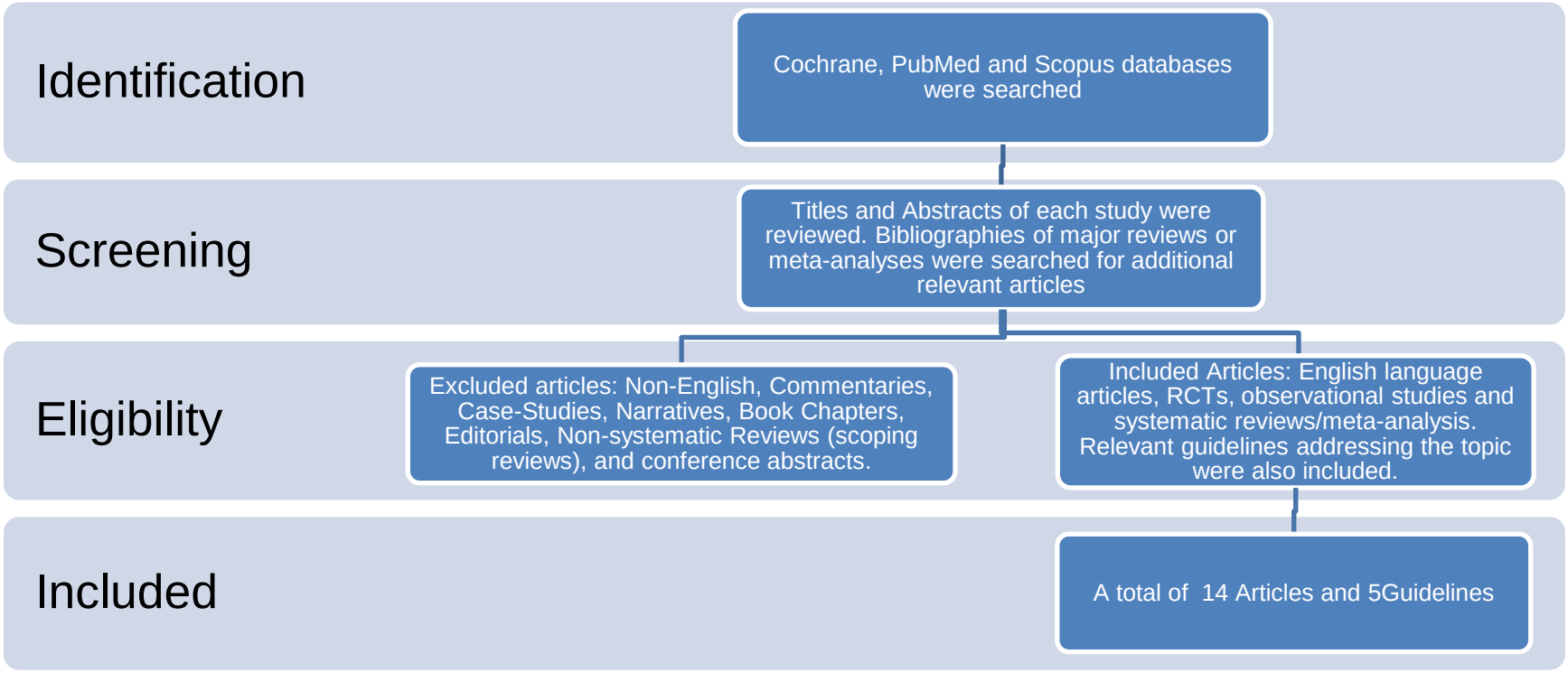
Search Strategy



Cochrane, PubMed and Scopus databases were searched using terms such as Stroke AND Rehabilitation AND (Assessment OR Admission OR Criteria OR Unit). Titles and abstract of each article were reviewed for relevance. Bibliographies were reviewed to find additional relevant articles. Articles were excluded if they were: non-English, commentaries, case-studies, narrative, book chapters, editorials, non-systematic review, or conference abstracts. Additional searches for relevant best practice guidelines were completed and included in a separate section of the review. 14 articles and 5 guidelines were included and were separated into separate categories designed to answer specific questions.

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Published Guidelines

Guideline	Recommendations
Mead GE, Sposato LA, Silva GS, Yperzeele L, Wu S, Kutlubaev MA et al. **Systematic review and synthesis of global stroke guidelines for the World Stroke Organization.** ***Int J Stroke*. 2023 Feb 1:17474930231156753.**	Acute stroke patients admitted to hospital should have an initial assessment by rehabilitation professionals as soon as possible after admission. (Strong recommendation)
National Clinical Guideline for Stroke for the UK and Ireland. London: Intercollegiate Stroke Working Party; 2023 May 4. **Available at:** www.strokeguideline.org**.** **(selected)**	People with stroke should be considered to have the potential to benefit from rehabilitation at any point after their stroke.
Zhang T, Zhao J, Li X, Bai Y, Wang B, Qu Y et al. **Chinese Stroke Association guidelines for clinical management of cerebrovascular disorders: executive summary and 2019 update of clinical management of stroke rehabilitation.** ***Stroke Vasc Neurol*. 2020 Sep;5(3):250-259. (selected)**	2. When stable, patients with acute stroke should be evaluated for individualised and comprehensive rehabilitation (Grade I recommendation, Level A evidence). 3. It is reasonable to apply standard and effective scale for the rehabilitation assessment before developing individualised programme and rehabilitation (Grade IIa, Level B evidence).
Clinical Guidelines for Stroke Management 2017. Melbourne (Australia): National Stroke Foundation. **Chapter 3 of 8: Acute medical and surgical management**	Practice points • Every stroke patient should have their rehabilitation needs assessed within 24–48 hours of admission to the stroke unit by members of the interdisciplinary team, using an appropriate process or tool e.g. the Assessment for Rehabilitation Tool (Australian Stroke Coalition Working Group 2012). • Any stroke patient with identified rehabilitation needs should be referred to a rehabilitation service. • Rehabilitation service providers should document whether a stroke patient has rehabilitation needs and whether appropriate rehabilitation services are available to meet these needs.

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Guideline	Recommendations
Winstein CJ, Stein J, Arena R, Bates B, Cherney LR, Cramer SC et al; on behalf of the American Heart Association Stroke Council, Council on Cardiovascular and Stroke Nursing, Council on Clinical Cardiology, and Council on Quality of Care and Outcomes Research. **Guidelines for adult stroke rehabilitation and recovery: a guideline for healthcare professionals from the American Heart Association/American Stroke Association.** ***Stroke* 2016;47:e98–e169**	It is recommended that all individuals with stroke be provided a formal assessment of their ADLs and IADLs, communication abilities, and functional mobility before discharge from acute care hospitalization and the findings be incorporated into the care transition and the discharge planning process. Class 1; LOE B A functional assessment by a clinician with expertise in rehabilitation is recommended for patients with an acute stroke with residual functional deficits. Class I; LOE C Determination of postacute rehabilitation needs should be based on assessments of residual neurological deficits; activity limitations; cognitive, communicative, and psychological status; swallowing ability; determination of previous functional ability and medical comorbidities; level of family/caregiver support; capacity of family/caregiver to meet the care needs of the stroke survivor; likelihood of returning to community living; and ability to participate in rehabilitation Class 1; LOE C The routine administration of standardized measures can be useful to document the severity of stroke and resulting disability, starting in the acute phase and progressing over the course of recovery and rehabilitation. Class IIa; LOE C A standardized measure of balance and gait speed (for those who can walk) may be considered for planning postacute rehabilitation care and for safety counseling with the patient and family. Class IIb LOE B

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Evidence Tables

Rehabilitation Admission Criteria

Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
Hakkennes et al. 2013 **USA** **Prospective Study**	14 clinicians responsible for assessing the suitability of patients for inpatient rehabilitation at 5 acute stroke units. Assessors were rehabilitation consultants (43%), rehabilitation registrars (36%) and geriatricians (21%). The number of years' experience ranged from <1 to >10 years. 69% of the assessors conducted > 5 assessments per week.	A questionnaire was administered to assess factors that were used to assess a patient's suitability for rehabilitation, and included 15 patient-related factors (e.g. age, pre-morbid mobility) and 2 organization factors (bed availability and funding source). 75 patients referred for inpatient rehabilitation following a severe stroke were assessed at day 3 post stroke, using the above-stated criteria. Factors that were associated with acceptance for admission vs. not accepted, were compared.	**Primary Outcome:** Factors associated with selection of admission to inpatient stroke rehabilitation	Based on responses from the questionnaire, the 3 most importance items influencing the decision to accept a patient for inpatient rehabilitation were pre-morbid cognition, pre-morbid mobility and pre-morbid communication. 61/75 (81.3%) patients were accepted for impatient rehabilitation. Patients accepted for rehabilitation were significantly younger (median age 73 vs. 83.5 years, p=0.004). A higher percentage were independent prior to stroke (mRS 0-2: 93.3 vs. 71.4%, p=0.037), lived at home with support prior to stroke (83.6 vs. 57.1%, p=0.041), and were employed pre-stroke (26.2 vs. 0%, p=0.03).
Stineman et al. 2013 **USA** **Retrospective study**	8,783 Veterans admitted to a Veterans Affairs Medical Center with a primary diagnosis of stroke from 2006-2008. Mean age was 68.7 years, 97.3% were men.	All patients were assessed early following stroke to determine their eligibility for 2 types of rehabilitation: a) Consultation-level rehabilitation (medical focus) or b) comprehensive-level rehabilitation (focus on restoration of function), based on physical grades and cognitive stages of independence (Grade I=total dependence; Grade VII=total	**Primary outcome:** Independent factors associated with admission for comprehensive-level rehabilitation.	983 (11.2%) veterans were selected for comprehensive-level rehabilitation. Patients at the lowest grades of physical independence (I, II, III, IV) and the middle cognitive stages (III, IV, V) had higher odds of admission to a comprehensive rehabilitation unit. (p<0.0001). Other independent factors associated with higher odds of admission for comprehensive rehabilitation: <70 years, married, living at home pre-stroke and the presence of a comprehensive rehabilitation unit at admitting hospital.

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Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
		independence), demographics, stroke type, comorbidities, and facility-level variables.		Independent factors associated with lower odds of admission for comprehensive rehabilitation: non-ischemic strokes (e.g. ICH, SAH), and ≥1 comorbidity
Hakkennes et. al 2011 **Australia** **Systematic Review**	79 studies, including i) 26 systematic reviews of prognostic indicators for stroke rehabilitation, ii) 48 studies examining discharge prediction from the acute care setting and iii) 6 studies of rehabilitation admission criteria.	Narrative synthesis	**Primary outcome:** Variables associated with, or predictive of, functional level, discharge disposition stroke rehabilitation admission criteria	**Prognostic indicators:** Age, functional level poststroke, urinary incontinence, and poststroke cognition were the factors most consistently associated with functional status at the end of the study period and final discharge disposition. Initial level of severity of weakness/ impairment and conscious level were also associated with functional level at the end of the study period. Older age, lower functional level poststroke, urinary incontinence, lower levels of poststroke cognition, and increased severity of weakness and impairment were associated with a negative outcome. **Discharge disposition:** The factors most frequently found to be associated with acute hospital discharge disposition included age, severity of impairment, presence of hemiparesis, cognition, and functional level after stroke. **Predictors of admission to stroke inpatient rehabilitation:** The most common predictors of admission to inpatient rehabilitation were age, functional level pre-stroke, and functional level post stroke. 3 of the 5 studies citing age, indicated age <70 was associated with greater likelihood of rehab admission. Premorbid functional impairment was associated

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				with a decreased likelihood of rehabilitation admission, and moderate post stroke impairment was associated with a greater chance of admission. Other factors with weaker evidence of a positive association of admission to inpatient rehab included: social support, higher level of pre-stroke cognition, consciousness level, and the absence of behavioral problems.
Putman et al. 2007 **CERISE study** **Belgium** **Prospective study**	532 patients, aged 40-85 years, admitted to one of 6 stroke rehabilitation units (SRU) in 4 European countries, following first-ever stroke. Admission criteria included score ≤ 11 on the Gross Motor function of the Rivermead Motor Assessment (RMA-GF) and/or a score on Leg and Trunk function (RMA-LT) ≤ 8 and/or a score on Arm function (RMA-AR) ≤ 12 on admission to the rehabilitation centre.	All patients underwent comprehensive assessments within 2 days of admission. The medical consultants (MCs) were surveyed by questionnaire, to document the impact of clinical and non-clinical factors on the admission of patients after stroke to the SRU. The questionnaire was composed of 25 patient-related and 12 institutional context factors and were rated by the MCs on a scale of 1 to 4 (1=no effect, 4=very high effect)	**Primary outcome:** Differences in patient characteristics and decision making among the 6 SRUs	Mean age at admission ranged from 58.1 to 75.6 years. Median Barthel Index score on admission ranged from 35 to 75. Median NIHSS scores at admission ranged from 4-10. There was wide variability in admission criteria among the different SRUs. Age had no or low effect on admission decision making in 5/6 units. The presence of pre-morbid cognitive disability, depression and severe behavioral problems were identified by ≥2 SRUs as having a high or very high effect (i.e. not likely to be admitted)

Prognostic Factors Associated with Achievement of Functional Gains

Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
Predictors of Gains made during inpatient rehabilitation				
Scrutinio et al. 2017	Derivation cohort: 717 patients admitted to a stroke rehabilitation unit within 90 days of stroke onset, from 2002-2011,	2 prediction models were developed. Candidate variables included age,	**Primary outcome:** Predictors of a motor FIM score of >61 points at	Median admission and discharge FIM scores for both cohorts were 40 and 70, respectively.

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Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
Italy **Retrospective study**	with an admission FIM score of <80. Mean age was 72 years, 57.2% were men. Validation cohort: 875 patients (same criteria as validation cohort), admitted from 2011-2016. Mean age was 70 years, 55% were men.	sex, marital and employment status, hypertension, diabetes, chronic obstructive pulmonary disease, coronary heart disease, atrial fibrillation, time from stroke occurrence to rehabilitation admission, type of stroke (ischemic or hemorrhagic), side of impairment, aphasia, unilateral neglect, M-FIM score, cognitive FIM score, blood urea nitrogen, estimated glomerular filtration rate, and hemoglobin. The 2 final models were validated using a second cohort of patients.	discharge (Model 1) **Secondary outcome:** Predictors of Functional Independence Staging (FIS) grade ≥5 at discharge (Model 2)	Significant, independent predictors of the primary outcome included decreasing age (OR=0.97, 95% CI 0.95–0.98), decreasing time from stroke to admission to stroke rehabilitation (OR=0.97, 95% CI 0.96–0.98), unilateral neglect (OR=0.28, 95% CI 0.11–0.70), and increasing admission motor and cognitive FIM scores (OR=1.15, 95% CI 1.12–1.18 and OR=1.05, 95% CI 1.02–1.08, respectively). The AUC for Model 1 was 0.883, 95% CI, 0.858–0.910). Significant, independent predictors of the secondary outcome included decreasing age (OR= 0.96, 95% CI 0.93–0.98, decreasing time from stroke to admission to stroke rehabilitation (OR=0.96, 95% CI 0.95–0.98), male sex (OR=1.92, 95% CI 1.08-3.43), and increasing admission motor and cognitive FIM scores (OR=1.16, 95% CI 1.13–1.19 and OR=1.05, 95% CI 1.01–1.08, respectively). The AUC for Model 2 was 0.913, 95% CIs, 0.884–0.942. In the validation cohorts the AUCs for Models 1 and 2 were 0.866, 95% CI 0.840–0.892 and 0.850, 95% CI 0.815–0.885, respectively.
Scrutinio et al. 2015 **Italy** **Retrospective study**	722 patients admitted to a stroke rehabilitation unit within 90 days of stroke onset, from 2002-2011, with an admission FIM score of <80. Mean age was 72 years, 57.1% were men.	Multivariable linear regression analysis was used to assess the association between baseline variables and FIM gain	**Primary outcome:** FIM gain	Mean admission and discharge FIM scores were 41.6 and 71.3 points, respectively. Mean FIM gain was 29.7 points. Each 10-year decrement in age was a significant independent predictor of FIM gain. Earlier admission to inpatient rehabilitation, being married, presence of aphasia and lower admission NIHSS scores were also significant predictors of FIM gain.
Meyer et al.	63 multivariable models derived from 27	Candidate variables were	**Primary outcome:**	FIM (or FIM gain or FIM efficiency) was used an

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Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
2015 **Canada** **Systematic review**	studies, examining predictors of either FIM or Barthel Index (BI) scores at inpatient rehabilitation discharge, following admission for stroke.	identified and pooled to quantify the number of times they were explored, the proportion of times they were identified as a significant predictor of outcome, and the direction of effect (+ predictor variable associated with higher FIM or BI score, - predictor variable has inverse association with FIM or BI score)	Variables consistently associated with FIM or BI at inpatient rehabilitation discharge	outcome in 56 of the models, and BI or BI efficiency in 7 models. 126 candidate variables were explored in the identified models, of which 50% were found to be a significant predictor at least once. Variables that were found to be significant predictors of outcome in ≥50% of models included admission BI score (+/-), NIHSS score (-), admission FIM score (+/-), impulsivity (+), dysphasia (+), neglect (-), previous stroke (-), and age (-)
Ng et al. 2013 **Singapore** **Prospective study**	1,332 patients, ≥15 years admitted to an inpatient rehabilitation unit over 5 years. Mean age was 64.1 years, 58.9% were men.	Data collection included demographics, social and cultural characteristics, stroke type and diagnostic details, cerebrovascular risk factors, medical complications, and functional outcomes (FIM). 2 models were developed to identify independent predictors of discharge FIM and FIM change	**Primary outcome:** Factors associated with discharge FIM score and FIM gains during inpatient rehabilitation	Mean admission and discharge FIM scores were 67.9±23.0 and 83.2±23.5. Mean FIM change was 15.4±12.3. Higher discharge FIM scores were associated with higher admission motor and cognitive FIM scores, younger age, male gender, employment at admission, non-married, presence of a caregiver, haemorrhagic stroke, absence of urinary tract infection or depression, right-sided motor impairments, and a longer LOS. Greater FIM gains were associated with lower admission motor FIM scores, higher admission cognitive FIM scores, younger age, male gender, employment at admission, non-married, presence of a caregiver, haemorrhagic stroke, right-sided motor impairments, and a longer LOS.
Kohler et. al. 2011 **Australia** **Retrospective study**	1,154 patients admitted to a stroke rehabilitation unit from 1997-2007 who remained there for ≥3 days. Mean age was 69.9 years, 55.4% were men.	Oxfordshire classification subgroup, sociodemographic and functional data were collected for patients and used to predict functional improvements during inpatient rehabilitation.	**Primary outcome:** Independent predictors of FIM gain	Mean admission FIM score and FIM gains were 75.9 and 21.5, respectively. Admission motor FIM was the best predictor of FIM gain (37.4% of variance, which increased to 40.5% when age was added).

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Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
Predictors of longer-term outcome				
Jampathong et al. 2018 **Thailand** **Systematic review & meta-analysis**	10 studies including elderly persons with moderately severe ischemic stroke, in three high income countries. Mean/median age ranged from 63 to 70 years, the percentage of men ranged from 47% to 60.5%.	The performance of 23 prognostic models developed and/or validated for predicting complete recovery following stroke, was evaluated. The duration of follow-up was 90-100 days in all studies but one, where follow-up was one year. Complete recovery was defined as mRS 0-1, Barthel Index ≥95 or BI (0-20) ≥19, or Glasgow Outcome Scale=1	**Primary outcome:** Discrimination (the model's ability to discriminate between patients with complete recovery vs. non-complete recovery cases), assessed using area under the receiver operating characteristic curve (AUC)	The number of variables in each of the 23 models varied from 1-11. The most common predictors were NIHSS score (included in 17 of all models), age (15), infarct volume (12), diabetes (9), history of stroke (8) and prestroke disability (8). Among the 11 development models, the median AUC was 0.80 (95% CI 0.77 to 0.85). Among the 12 internal validation models, the median AUC was 0.82 (95% CI 0.73 to 0.87). Among the 9 external validation models, the median AUC 0.80 (95% CI 0.76 to 0.82).
Cioncoloni et al. 2013 **Italy** **Retrospective study**	104 stroke patients ≥18 years, previously independent, admitted for inpatient rehabilitation within 48 hours following first-ever stroke. Mean age was 69.7 years, 47.1% were men.	11 variables were assessed at day 10 post stroke (gender, age, side of paresis (left vs. right), NIHSS total score, presence or absence of hemianopsia, sensory loss, extinction or inattention, (NIHSS, items 3, 8, 11); muscle strength of upper and lower limb, (total score of the Motricity Index [MI] upper and lower limb respectively), presence or absence of sitting balance (Trunk Control Tests [TCT], item 3), and ability to perform basic ADL (BI). A model was developed to identify independent predictors of independence at 6 months. Ordinal scales	**Primary outcome:** Independence at 6 months (mRS 0-2)	At 10 days after stroke, the following combination of variables was associated with a 100% probability of independence at 6 months: men, MI-upper limb score ≥75, age ≤70 years and, BI score ≥9. Combinations of 3 out of the same 4 factors were associated with probabilities of 97%-99% of independence at 6 months.

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Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
		were dichotomized according to clinical grounds.		
Verebeek et al. 2011 **The Netherlands** **Systematic review**	48 cohort studies (n=25,843 participants) that 1) identified prognostic studies and combined at least 2 separate variables to predict the future outcome in individuals; and 2) included patients ≥ 18 years who were recruited within 2 weeks after stroke onset and; 3) basic ADL was measured at least 3 months after stroke.	Best evidence synthesis using 4 levels of evidence for a predictor variable were distinguished: (1) strong evidence: generally consistent findings in multiple studies with low risk of bias; (2) moderate evidence: generally consistent findings in 1 study with low risk of bias and ≥1 studies with high risk of bias; (3) limited evidence: only 1 study with low risk of bias; and (4) insufficient or no evidence	**Primary outcome:** Identification of variables predictive, or not predictive of performance on ADL	The most frequency-used measures of ADL included Barthel Index, mRS, Glasgow Outcome Scale, and FIM. There were 6 studies with low risk of bias, and 42 with high risk. There was strong evidence that the following variables were associated with ADL performance ≥3 months post stroke: baseline neurological status, upper limb paresis, and age
Counsell et al. 2002 **UK** **Retrospective study**	530 patients included in the Oxfordshire Community Stroke Project (OCSP), a community-based incidence study (1981–1986) of first-ever stroke of any pathological type or site and who were assessed within 30 days of stroke onset	3 models were developed to predict each outcome and validated using 2 external cohorts. 39 candidate predictor variables were assessed for potential inclusion.	**Primary outcomes:** 30-day survival and independence at 6 months (Oxford Handicap Scale score <3)	The simplest model to predict independence at 6 months included: age (OR= 0.95, 95% CI 0.93-0.97), living alone (OR=0.52, 95% CI 0.31–0.86), independence before stroke (OR=15.55, 95% CI 5.68–42.58, Normal Glasgow Coma Scale verbal score (OR=8.67, 95% CI 3.43–21.91), able to lift arms (OR=8.22, 95% CI 3.25–20.76), and ability to walk (OR=3.71, 95% CI 1.77–7.77). The model performed well in the 2 validation cohorts with AUCs of 0.839 and 0.840.

Abbreviations

ADL: Activity of Daily Living	AUC: area under the curve
CI: Confidence Interval	FIM: Functional Independence Measure
mRS: modified Rankin Scale	NIHSS: National Institutes of Health Stroke Scale
OR: Odds Ratio	

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