CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

Rehabilitation and Recovery following Stroke Evidence Tables

Inpatient Rehabilitation Admission Criteria

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on Behalf of the Canadian Stroke Best Practice Recommendations
Rehabilitation and Recovery following Stroke Writing Group

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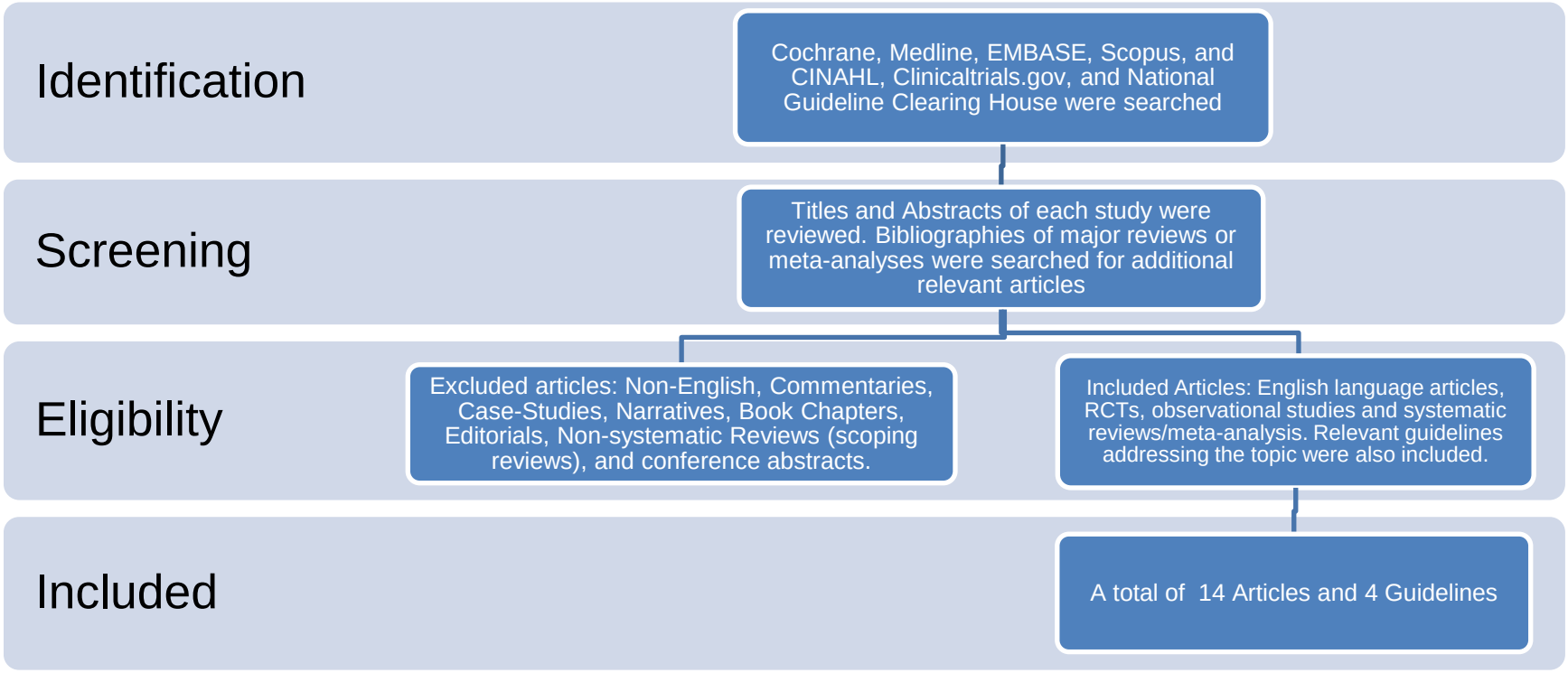
Search Strategy



Cochrane, Medline, and CINAHL, Clinicaltrials.gov, EMBASE, and Scopus were searched using the keywords: 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 4 guidelines were included and were separated into separate categories designed to answer specific questions.

Published Guidelines

Guideline	Recommendations
Intercollegiate Stroke Working Party. National clinical guideline for stroke, 5th Edition. London: Royal College of Physicians, 2016. Section 5 Rehabilitation	No Broad statements included
Winstein CJ, Stein J, Arena R, Bates B, Cherney LR, Cramer SC, Deruyter F, Eng JJ, Fisher B, Harvey RL, Lang CE, MacKay-Lyons M, Ottenbacher KJ, Pugh S, Reeves MJ, Richards LG, Stiers W, Zorowitz RD; 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
National Clinical guidelines for stroke" 5th Edition 2016; Intercollegiate Stroke Working Party. Royal College of Physicians	**2.9.1 Recommendations** **A** Assessment measures used in stroke rehabilitation should meet the following criteria as far as possible: – they should collect relevant data across the required range (i.e. they are valid and fulfil a need); – they should have sufficient sensitivity to detect change within a person and differences between people; – their reliability should be known when used by different people on different occasions and in different settings; – they should be simple to use under a variety of circumstances; – they should provide scores that are easily understood. **B** A stroke service should agree on a standard set of assessment measures that should be collected and recorded routinely. **C** A stroke service should have protocols for determining the routine collection and use of data

Guideline	Recommendations
	that: – specify the reason for and proposed use of each assessment measure; – provide individual clinicians with a choice of assessment measures where no measure is obviously superior; – review the utility of each assessment measure regularly.
Stroke Rehabilitation. Long-term rehabilitation after stroke. Issued: June 2013. National Institute for Health and Care Excellence.	**Screening and assessment** 1.2.1 On admission to hospital, to ensure the immediate safety and comfort of the person with stroke, screen them for the following and, if problems are identified, start management as soon as possible: • Orientation, positioning, moving and handling, swallowing, transfers (for example, from bed to chair), pressure area risk, continence, communication, including the ability to understand and follow instructions and to convey needs and wishes and nutritional status and hydration 1.2.2 Perform a full medical assessment of the person with stroke, including cognition (attention, memory, spatial awareness, apraxia, perception), vision, hearing, tone, strength, sensation and balance. 1.2.3 A comprehensive assessment of a person with stroke should take into account: • their previous functional abilities, impairment of psychological functioning (cognitive, emotional and communication), impairment of body functions, including pain, activity limitations and participation restrictions and environmental factors (social, physical and cultural). 1.2.4 Information collected routinely from people with stroke using valid, reliable and responsive tools should include the following on admission and discharge: • National Institutes of Health Stroke Scale • Barthel Index. 1.2.5 Information collected from people with stroke using valid, reliable and responsive tools should be fed back to the multidisciplinary team regularly.
Management of Stroke Rehabilitation Working Group. VA/DoD clinical practice guideline for the management of stroke rehabilitation. Washington (DC): Veterans Health Administration, Department of Defense; 2010. p.p.70-72	**Determining Need for Rehabilitation:** • Once the patient is medically stable, the primary physician should consult with rehabilitation services (i.e., physical therapy, occupational therapy, speech and language pathology, kinesiotherapy, and Physical Medicine) to assess the patient's impairments as well as activity and participation deficiencies to establish the patient's rehabilitation needs and goals. • A multidisciplinary assessment should be undertaken and documented for all patients. [A] • Patients with no residual disability post-acute stroke who do not need rehabilitation services may be discharged back to home.

Guideline	Recommendations
	• Strongly recommend that patients with mild to moderate disability in need of rehabilitation services have access to a setting with a coordinated and organized rehabilitation care team that is experienced in providing stroke services. [A] • Post-acute stroke care should be delivered in a setting where rehabilitation care is formally coordinated and organized. • If an organized rehabilitation team is not available in the facility, patients with moderate or severe disability should be offered a referral to a facility with such a team. Alternately, a physician or rehabilitation specialist with some experience in stroke should be involved in the patient's care. • Post-acute stroke care should be delivered by a variety of treatment disciplines which are experienced in providing post-stroke care, to ensure consistency and reduce the risk of complications. • The multidisciplinary team may consist of a physician, nurse, physical therapist, occupational therapist, kinesiotherapist, speech and language pathologist, psychologist, recreational therapist, social worker, patient, and family/caregivers. • Patients who are severely disabled and for whom prognosis for recovery is poor may not benefit from rehabilitation services and may be discharged to home or nursing home in coordination with family/care giver. **Determining Setting:** • The medical team, including the patient and family, must analyze the patient's medical and functional status, as well as expected prognosis in order to establish the most appropriate rehab setting. [I] • The severity of the patient's impairment, the rehabilitation needs, the availability of family/social support and resources, the patient/family goals and preferences and the availability of community resources will determine the optimal environment for care. [I]

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 independence), demographics, stroke type,	**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. Independent factors associated with lower odds of

Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
		comorbidities, and facility-level variables.		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 with a decreased likelihood of rehabilitation admission, and moderate post stroke impairment was associated with a greater chance of admission.

Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
				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)	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 **Italy** **Retrospective study**	Derivation cohort: 717 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, 57.2% were men. Validation cohort: 875 patients (same criteria as validation cohort), admitted from 2011-2016. Mean age was 70	2 prediction models were developed. Candidate variables included age, sex, marital and employment status, hypertension, diabetes, chronic obstructive pulmonary disease, coronary heart disease, atrial fibrillation, time from	**Primary outcome:** Predictors of a motor FIM score of >61 points at discharge (Model 1) **Secondary outcome:** Predictors of Functional Independence Staging (FIS) grade ≥5 at discharge (Model 2)	Median admission and discharge FIM scores for both cohorts were 40 and 70, respectively. 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

Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
	years, 55% were men.	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.		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. 2015 **Canada** **Systematic review**	63 multivariable models derived from 27 studies, examining predictors of either FIM or Barthel Index (BI) scores at inpatient rehabilitation discharge, following admission for stroke.	Candidate variables were 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	**Primary outcome:** Variables consistently associated with FIM or BI at inpatient rehabilitation discharge	FIM (or FIM gain or FIM efficiency) was used an 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

Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
		higher FIM or BI score, - predictor variable has inverse association with FIM or BI score)		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).
Predictors of longer-term outcome				
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);	**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.

Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
		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 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).

Study/Type	Sample Description	Method	Outcomes	Key Findings and Recommendations
				The model performed well in the 2 validation cohorts with AUCs of 0.839 and 0.840.

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