Generalizability of models predicting independent gait after stroke

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Every year 43.000 people experience a stroke

67% of stroke survivors is not able to walk independently at baseline

Recovery of independent gait is predictable

Patient information ↑

Goal setting & Discharge planning ↑

Length of stay & health care costs ↓

Limited generalizability of the models

Safety of using a prediction model

0 Externally validated

Methods

Model selection

Systematic literature search (Pubmed and Cinahl):
Cut-off independent gait: with or without walking aid.
Quality assessment (PROBAST[1])

Validation data

Stroke cohort data (n = 853)
Hammel Neurorehabilitation Research Centre discharge data matched to Danish Stroke Registry admission data

Analysis

Proxy selection
Model evaluation on validation dataset (Area Under the Curve, calibration curves)
Model updates (AUC < 0,7)

Table 1: Variable selection, included models: EPOS [2] and Kwah et al [3].

Model variables	Validation cohort variables
F. Ambulation Classification ≥ 4	F. Independence Measure locomotion ≥ 6
Motor Assessment Scale walk ≥ 3	F. Independence Measure locomotion ≥ 6
Age per year	Age per year
~~Motricity Index-leg ≥ 25~~	~~Scandinavian Stroke Scale Leg~~ ✗
Trunk Control Test- item 3 = 25	Scandinavian Stroke Scale Gait ≥ 3
NIH Stroke Scale (total)	Scandinavian Stroke Scale (total)

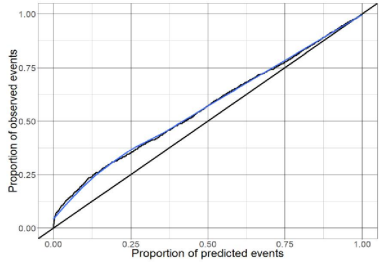
Table 2: model discrimination and updates

Model (Kwah. et al, 2013)	AUC (95% CI)
Original (6)	0.681 (0.648-0.715)
Update- A Intercept	0.686 (0.653-0.719)
Update- B Intercept, regression coefficient age	0.684 (0.651-0.718)
Update- C Intercept, regression coefficient proxyNIHSS	0.669 (0.636-0.703)
Update- D Intercept, regression coefficients age and proxyNIHSS	0.679 (0.646-0.712)
Update- E Intercept, all regression coefficients + SSS Leg	0.805 (0.774-0.836) 0.788*

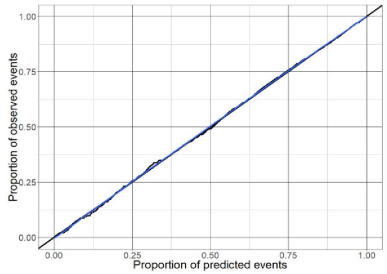
*AUC corrected for overfitting by bootstrapping

Figure 1: Calibration curves

Original model



Updated (final) model



Conclusion

Awareness of the external validity of a clinical prediction model is important to clinicians and patients.

This research showed reduced model performance in geographical validation, therefore the model was updated.

Selection

Cut-off outcome
Standardized moment of baseline measures
Follow-up at discharge

Case mix

Unknown functional status prior to stroke

Proxies

SSS and NIHSS?
FIM and MRS?

Common in geographical validation

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1: Moons, K. G., Wolff, R. F., Riley, R. D., Whiting, P. F., Westwood, M., Collins, G. S., ... & Mallett, S. (2019). PROBAST: a tool to assess risk of bias and applicability of prediction model studies: explanation and elaboration. Annals of Internal Medicine, 170(1), W1-W33.
2: Veerbeek JM, Van Wegen EE, Harmeling-Van der Wel BC, Kwakkel G, Investigators E. Is accurate prediction of gait in nonambulatory stroke patients possible within 72 hours poststroke? The EPOS study. Neurorehabilitation and neural repair. 2011;25(3):268-74.
3: Kwah LK, Harvey LA, Diong J, Herbert RD. Models containing age and NIHSS predict recovery of ambulation and upper limb function six months after stroke: an observational study. Journal of Physiotherapy. 2013;59(3):189-97.