



Predicting home discharge after inpatient rehabilitation of stroke patients with aphasia

Valeria Ginex, Mauro Viganò, Giulia Gilardone, Alessia Monti, Marco Gilardone, Massimo Corbo

► To cite this version:

Valeria Ginex, Mauro Viganò, Giulia Gilardone, Alessia Monti, Marco Gilardone, et al.. Predicting home discharge after inpatient rehabilitation of stroke patients with aphasia. *Neuropsychological Rehabilitation*, 2022, pp.1-16. 10.1080/09602011.2021.2021951 . hal-03961244

HAL Id: hal-03961244

<https://hal.science/hal-03961244>

Submitted on 28 Jan 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Preprint version of the paper:

Ginex, V., Viganò, M., Gilardone, G., Monti, A., Gilardone, M., & Corbo, M. (2022). Predicting home discharge after inpatient rehabilitation of stroke patients with aphasia. *Neuropsychological Rehabilitation*, 1-16.

Published paper available at: <https://doi.org/10.1080/09602011.2021.2021951>

The work is subject to the laws of copyright and intellectual property.

DRAFT

Predicting home discharge after inpatient rehabilitation of stroke patients with aphasia

Valeria Ginex¹, PsyD, Mauro Viganò¹, MA, Giulia Gilardone¹, PsyD, Alessia Monti¹, PhD, Marco Gilardone¹, MD, Massimo Corbo¹, MD

¹Department of Neurorehabilitation Sciences, Casa di Cura del Policlinico, Milan, Italy

Corresponding author:

Mauro Viganò, SLT, MA
Casa di Cura del Policlinico
Department of Neurorehabilitation Sciences
Via Giuseppe Dezza, 48
20144, Milan, Italy
Phone: +39 02 4859 3725
Email: dott.mauro.vigano@gmail.com

Authors' e-mail and ORCID:

Valeria Ginex: v.ginex@ccppdezza.it; 0000-0002-3961-5817
Mauro Viganò: m.vigano@ccppdezza.it; 0000-0003-3447-4792
Giulia Gilardone: g.gilardone@ccppdezza.it; 0000-0003-1482-9891
Alessia Monti: a.monti@ccppdezza.it; 0000-0002-4687-9458
Marco Gilardone: m.gilardone@ccppdezza.it; 0000-0002-3714-2673
Massimo Corbo: m.corbo@ccppdezza.it; 0000-0003-0793-9830

PREDICTING HOME DISCHARGE AFTER INPATIENT REHABILITATION OF STROKE PATIENTS WITH APHASIA

Abstract

The early identification of the discharge setting from Inpatient Rehabilitation Facilities (IRFs) is a primary goal in stroke-related research because of its clinical and socio-economic relevance. Several features have been identified as significant predictors of the discharge setting. Within cognitive deficits, aphasia is known to be a common and disabling condition that could influence rehabilitation outcome. However, it is often set as an exclusion criterion in stroke research.

This study aims to investigate the predictive power of clinical variables, in particular specific language disturbances and nonlinguistic cognitive deficits, for discharge setting in post-acute stroke patients with aphasia after intensive multidisciplinary rehabilitation.

In a sample of 158 patients, demographic, motor, language and nonverbal cognitive data were retrospectively considered for the prediction of the discharge to home versus to other institutional setting. Univariate analysis identified relevant differences between groups and the significant variables were included in a logistic regression model. The results showed that better functional motor status, absence of dysphagia and unimpaired nonlinguistic cognitive profile independently predict the discharge to home. In particular, nonverbal cognitive functioning seemed to be specifically relevant within the aphasic population. The findings could be helpful for setting up the rehabilitation priorities and an adequate discharge arrangement.

Keywords: aphasia, stroke, discharge setting, cognitive deficit, rehabilitation outcome.

Introduction

Stroke is a major cause of disability worldwide and its prevalence is expected to increase¹. After acute care, inpatient rehabilitation facilities (IRFs) admit stroke survivors who require rehabilitation to reduce their degree of disability. The clinical decision for the discharge setting from IRFs is primarily based on the complexity of clinical needs and on the level of independency patients reached during the rehabilitation pathway². The early identification of the discharge setting is a major goal for the clinicians because it allows to set the priorities of the intervention and to plan promptly adequate post-discharge social support systems. Several factors have been investigated as potential predictors of discharge destination after IRF hospitalization of stroke patients. As suggested by previous studies³⁻⁶, younger age seems to be associated with increased odds of being discharged home. Moreover, functional status^{3,7-9} and balance^{10,11} have been reported as clinical determinants for discharge setting after rehabilitation in multiple studies. The presence of dysphagia has been highlighted as an independent factor as well^{4,11}. Other studies have focused on the role of

living arrangement or the premorbid social support, as the civil status, the presence of a caregiver or of a support network^{3-5,7,10,12}. Medicare health insurance or type of healthcare coverage seem to be relevant across countries that do not provide for full national coverage⁴.

Cognitive phenotype is a crucial factor strongly associated with rehabilitation outcome and discharge setting^{4,6,12}. Within cognitive deficits following stroke, aphasia is a common and disabling condition: it affects up to 43%¹³ of older patients and it is associated with higher mortality^{14,15}, inpatient complications¹⁶, higher short- and long-term disability¹⁶⁻¹⁹, longer hospitalization and higher rates of readmission^{14,16,17}. A growing amount of studies highlighted that nonlinguistic cognitive impairments in aphasic patients are frequent and heterogeneous²⁰⁻²². They may worsen aphasia symptoms²² and influence the efficacy of aphasia rehabilitation and language recovery²²⁻²⁵. These results support the importance to detect and evaluate the severity of nonlinguistic cognitive deficits through clinical investigation and specific psychometric tests in patients with aphasia due to stroke.

Despite those evidences, the role of nonlinguistic cognitive deficit in aphasic patients on functional recovery has been poorly investigated, since, possibly, the language impairment challenges the feasibility and the reliability of the other cognitive domain's assessment. Aphasic patients are often unable to undergo a complete evaluation, as many neuropsychological tests used to identify possible cognitive impairments require verbal comprehension and/or oral production abilities²⁶. As a result, people with aphasia are often excluded from stroke research²⁷. Only one study²⁸ on a sample of aphasic patients investigated the role of nonlinguistic cognitive impairments of aphasic patients on functional outcome after rehabilitation: results indicated a clear association between cognitive impairment and poor functional outcome. To the best of our knowledge, the role of nonlinguistic cognitive impairments of aphasic patients on discharge setting after rehabilitation has not yet been explored within a population of aphasic patients. A recent systematic review investigating the results of non-invasive brain stimulation, such as transcranial Direct Current Stimulation (tDCS), suggested that further study should be undertaken on the relationship between language/aphasia and cognition, and improved cognitive assessments for patients with aphasia may be developed²⁹.

The aim of this study is to investigate the role of clinical variables, in particular specific language disturbances and nonlinguistic cognitive deficits, in the prediction of discharge setting from IRF in a large cohort of post-acute left-hemispheric stroke patients with aphasia who underwent an intensive and multidisciplinary rehabilitation treatment.

Patients and Methods

Performing a text search in the electronic data system of our IRF, a sample of 158 patients, who were consecutively admitted from January 2010 to December 2018, was identified. Inclusion criteria were: (a) presence of aphasia, (b) post-acute phase (Time Post Onset, TPO between 3 and 180 days), (c) native Italian speaker and (d) right-handed. Patients with a history of dementia and/or psychiatric illness, severe sensory deficits, consciousness disorders and clinical conditions not allowing the assessment or the rehabilitation

1 treatment were excluded. The study was conducted in accordance with the Declaration of Helsinki and was
2 approved by the Local Ethics Committee (Milano Area B: Resolution 378_2018, ID 68101).

3 Demographic and clinical data of our sample were collected and included age (years), gender, education
4 (according to Italian school system), premorbid functional independence (Y/N), premorbid living
5 arrangement (alone/family/attendant), first ever stroke (Y/N), type of stroke (ischemic/hemorrhagic), TPO
6 (days) and presence of dysphagia (Y/N). The presence of dysphagia was tested at admission and discharge
7 by a qualified speech therapist through Clinical Swallowing Evaluation (CSE)³⁰, i.e., oral movement
8 evaluation and swallowing tests with different consistencies. According to CSE, the patients in need of tube
9 feeding or semisolid diet were qualified as dysphagic. Functional status was assessed by a physiatrist at
10 admission and discharge through the Functional Independence Measure (FIM)³¹, a 18-items clinician-
11 reported scale. The score for global functional independence (total FIM, T-FIM) ranges from 18 to 126,
12 while the score for motor impairment (motor FIM, M-FIM) ranges from 13 to 91; a higher score corresponds
13 to a higher independence level. The amount of rehabilitation treatment was calculated in terms of total
14 number of one-to-one sessions for each type of intervention. Physiotherapy (PhT) was usually undertaken
15 twice a day, while speech and language therapy (SpT) and occupational therapy (OcT) were administered
16 according to medical prescription, usually 2 to 5 times per week. Each session lasted 45 minutes in average.
17 The total length of stay (LOS, days) in the IRF was also calculated. The standard LOS according to the
18 regional diagnosis-related group (DRG) based hospitalization system is set at 60 days for this specific
19 population.

20 Regarding cognitive assessment, three domains were analyzed: language, nonverbal reasoning, and spatial
21 cognition. An in-depth assessment of language was performed through Aachen Aphasia Test (AAT)^{32,33}
22 both at admission and discharge. AAT consists of five subtests specific for different linguistic abilities: i)
23 Token test, including comprehension of verbal commands; ii) repetition of phonemes, words and sentences;
24 iii) written language, including reading and writing; iv) naming of objects, colors and pictures' description
25 and v) comprehension of oral and written words and sentences. All data were reported in normalized scores.
26 For each AAT subtest, a score between 20 and 42 indicates a severe impairment, between 43 and 52 a
27 moderate and from 53 and 80 a mild one. The analysis of the normalized scores in the five subtests provided
28 an average level of linguistic performance (H-index); a greater H-index score corresponds to a better
29 performance and, consequently, to a less severe language impairment.

30 Colored Raven's Matrices Test (CPM)³⁴ was administered to evaluate pure nonverbal reasoning abilities.
31 This culture-free test is particularly appropriate for aphasic patients, since it evaluates abstract reasoning
32 through visual items requiring neither language involvement nor declarative knowledge. Past research
33 consistently revealed good psychometric properties for this test³⁵.

34 The assessment of unilateral spatial neglect (USN) was performed using lines³⁶ and bells³⁷ cancellation tests.
35 The omission in the contralesional space of ≥ 2 lines or ≥ 5 bells was considered as indicative of the presence
36 of right-USN.

Discharge setting was set as the outcome measure. All patients had a clear discharge location, therefore they were classified in two groups, defined as home vs. institutional setting (IS).

Statistical analyses

IBM SPSS Statistics® software (version 25.0) was used to perform all statistical analyses. Descriptive data were displayed as mean and SD or absolute number and frequency. Possible associations among the continuous variables were investigated with the Pearson correlation coefficient. In order to identify significant differences between home and IS groups, the Pearson's χ^2 test was used for categorical variables, while Student's t test was adopted for continuous variables. The predictive power of the independent variables associated with a higher probability to be discharged home was investigated with a logistic regression model. The potentially predictive variables in the logistic model were selected considering clinical plausibility, significant differences highlighted by univariate analysis, and after verifying linearity and multicollinearity assumptions. Adjusted odds ratios (OR) and 95% confidence intervals (CI 95%) were used as measures of effect. The statistical significance was set at $p < 0.05$.

Results

Overall, 158 aphasic patients (80 male and 78 female) took part in the study. Patients had a mean age of 73.2 ± 10.9 years and an average number of years of formal education of 9.7 ± 4.4 . They were admitted to the IRF between 4 and 178 days after stroke and the mean length of hospitalization was 57.5 ± 18.6 days. Most of the subjects have experienced a first-ever stroke at the time of the enrollment (77.2%) and were functionally independent before the event (78.4%). Fifty-one patients (32.3%) presented with dysphagia at admission. Initial mean M-FIM score was 40.7 ± 20.5 while mean T-FIM score was 61.1 ± 26.0 . Regarding language, admission mean AAT scores were 45.5 ± 12.8 for Token test, 50.3 ± 14.3 for repetition, 49.3 ± 12.1 for written language, 49.9 ± 13.6 for naming and 45.7 ± 13.0 for comprehension. Fifty-one (32.3%) patients showed impaired pure nonverbal reasoning abilities and nine (5.7%) had right-sided USN. Considering the overall sample no significant correlation was found between age and other continuous variables ($p > 0.05$). A moderate negative correlation was identified between LOS and M-FIM ($r = -0.445$, $p < 0.01$); while a weak negative correlations were found between LOS and AAT subtests scores ($-0.306 < r < -0.212$, $p < 0.01$). M-FIM showed weak to moderate positive correlations with AAT subtest scores ($0.207 < r < 0.430$, $p < 0.01$). Finally among AAT subtests scores moderate to strong correlation were identified ($0.593 < r < 0.743$, $p < 0.01$).

Discharged home vs. to IS: univariate analysis at admission evaluation

Table 1 shows demographic, clinical and functional characteristics of the two groups of patients (home vs. IS). Within the sample, 92 patients (58.2%) were discharged home while 66 (41.8%) to an institutional setting. Univariate analysis showed that age, gender, education, premorbid autonomy, first ever stroke, ictus type and TPO did not differ within groups. Otherwise, M-FIM and T-FIM mean scores at admission were significantly higher (both $p < 0.001$) in patients who were discharged home than those of patients who were discharged to other institutions. Moreover, there were significantly more patients with dysphagia ($p < 0.001$)

1 within the IS group (57.6%) compared to the discharged home group (14.1%). Patients who were discharged
2 to IS were hospitalized for a longer period than those discharged home, and consequently they underwent a
3 greater number of sessions of physical and speech and language therapy (all $p<0.001$). Average LOS for
4 home discharged group was in line with standard DRG-based hospitalization time while patients discharged
5 to other institutions presented a longer stay in the IRF. Regarding cognitive domain (**Table 2**), in the IS
6 group the aphasic disorder at admission was significantly more severe (H index; $p=0.003$) corresponding to
7 worse performances in all AAT subtests (i.e., Token test: $p=0.007$; repetition: $p=0.015$; written language:
8 $p=0.003$; naming: $p=0.003$; comprehension: $p<0.001$). Moreover, CPM differed significantly among groups
9 ($p<0.001$): there were more patients with unimpaired pure nonverbal reasoning abilities within the
10 discharged home group (78.3%) compared to the IS one (53.0%). No significant differences regarding the
11 presence of right-sided USN ($p=0.867$) were found between the two groups.

13 *Longitudinal analysis and evaluations at discharge point*

14 Analyzing longitudinally data at admission and at discharge it can be noted that both IS and home groups
15 showed a significant improvement in M-FIM, T-FIM, H-index and AAT subtests scores and regarding the
16 prevalence of dysphagia (all $p<0.001$). However, comparing performances at discharge point (**Table 3**), it
17 can be underlined that scores in all the above-mentioned tests were significantly higher in the discharged
18 home group than in the IS one (all $p<0.001$). Regarding dysphagia, in the discharged home group, the
19 prevalence of this impairment was significantly lower when compared with the IS group ($p<0.001$).
20 Furthermore, just four patients of our sample were discharged with a tube-feeding device, all of them were
21 sent to an IS, none at home. Information concerning USN and CPM were not available due to missing data at
22 discharge point for this area of assessment.

24 *Predictors of the discharge home setting*

25 Two logistic regression models were performed to analyze the predictive power of the independent variables
26 classified as clinically relevant and statistically significant in the univariate analysis. LOS was not included
27 in both models due to the violation of the linearity assumption. Motor FIM, dysphagia, CPM and language
28 assessment were included as potential predictors, while age and gender ~~and LOS~~ were considered as
29 adjustment covariates. H-index and AAT subtests were not included in the same predictive model to avoid
30 the collinearity bias, since the first measure is derived from the others. No collinearity among the other
31 continue variables has been found (tolerance >0.1 ; VIF <10). In the first regression model the global severity
32 of aphasia (i.e., H-index, data not presented) was considered, while in the second one all AAT subtests were
33 included (data presented in **Table 4**). Outcomes between the two models were largely comparable: admission
34 M-FIM, dysphagia and pure nonverbal reasoning abilities independently predicted discharge setting in both
35 models. Aphasia general severity and specific linguistic performances were not found to be predictive for
36 discharge setting, either considering the mean degree of impairment (H-index) or single language abilities
37 (AAT subtests) independently.

Discussion

The presence and the characteristics of cognitive impairment of stroke patients in IRF is clinically relevant for both setting up early rehabilitation and planning discharge destination. Cognitive phenotype following left-hemispheric stroke could be very heterogeneous, especially due to the multifaceted feature of language disorders and to the co-occurrence of nonlinguistic cognitive impairments. It should be highlighted that addressing this topic is problematic since people with aphasia are frequently excluded from stroke research for several reasons²⁸. In particular, the neuropsychological assessment and the patients' participation to structured activities might be limited due to the linguistic impairment. Besides, aphasic patients are limited in express their consent to participate knowingly to research projects. Therefore, the aim of the present study focused on determining the role of different language impairments and nonlinguistic cognitive deficits, alongside other clinical features, in the prediction of discharge setting of post-acute stroke aphasic patients after an intensive and multidisciplinary rehabilitation.

Linguistic impairment

Language assessment revealed that patients discharged home showed a significant less severe aphasia at admission than those discharged to institutional care. This result emerged for all the different language abilities considered and in terms of global severity (i.e., Token test, repetition, written language, naming, comprehension and H index). Nevertheless, from the multivariate analysis, neither general severity nor any specific language features were found to be independent predictors of discharge setting. A possible explanation for this finding could be related to the subtle social impact of aphasia in the post-acute phase, which might reduce the weight of this condition in determining the discharge arrangements. Unlike motor functioning and dysphagia, the disruptive effects of communication disturbances on daily living activities, social participation, interpersonal relationship and psychological well-being tend to be exacerbated in the chronic phase³⁸⁻⁴⁰. Another possible explanation for this finding could be related to the regression model. As a matter of fact, the multivariate analysis considered several independent variables, including pure nonverbal reasoning, that could cover the predictive power of linguistic deficits.

Nonlinguistic cognitive impairment

The results of the present study highlighted that patients with intact nonlinguistic cognitive abilities have a higher probability of being discharged home compared to those who present an impairment in this domain. The role of nonlinguistic cognitive abilities in aphasic patients have been poorly investigated, possibly due to the above-mentioned clinical evaluation²⁸ and research recruitment²⁷ difficulties. For this reason, the possible interaction between aphasia and other cognitive deficits is still debated. In a recent work, Fonseca and colleagues²⁵ identified nonverbal reasoning as the only nonlinguistic cognitive feature able to predict independently aphasia recovery. Furthermore, this cognitive domain was found to be close to statistical

significance for the prediction of motor recovery in a group of aphasic patients after rehabilitation⁴¹. Different explanations for the influence of nonverbal reasoning on discharge setting, aphasia recovery and functional motor outcome could be proposed²⁵. Firstly, nonlinguistic cognitive abilities are necessary for the patient to be involved during training session and to pursue therapy goals, leading to a higher chance to be discharged home. Moreover, these functions could support the use of different strategies to cope with environmental demands and with the completion of daily living activities. Finally, it has been hypothesized that reasoning abilities could be an indirect measure of cognitive reserve. Higher cognitive resources could provide better performances regardless of lesion severity through the activation of alternative functional networks. Notably, reasoning abilities represent only one of the multifaceted cognitive functions that can be selectively impaired following stroke^{21,22}. Further works are needed to investigate whether specific executive abilities (i.e., shifting, inhibition, and updating abilities) affect functional, motor and cognitive outcomes of patients with aphasia due to stroke. In accordance with our findings, some authors^{21,22} stated for an interdependency between general cognitive functioning and linguistic abilities in specific aphasic populations. Conversely, others studies^{42,43} did not support such hypothesis and highlighted the mutual independence between these two domains considering both clinical performances and neuroimaging. As a novelty of this research, it can be supposed that the association between nonlinguistic cognitive impairment and aphasia is a better predictor of discharge setting than aphasia severity itself. Left-sided USN in right-hemisphere stroke patients have been previously identified as a clinical determinant of rehabilitation outcome^{44,45}. In our sample, the prevalence of unilateral spatial neglect did not significantly differ between the two groups considered, suggesting that right-sided USN seems might not to be as relevant as left-sided one. A possible explanation of this finding could be that right-sided USN is usually less severe than left-sided USN⁴⁶. Moreover, it can be supposed that no significant effect of USN could depend on the small number of subjects with this impairment in our population (5.7%).

Motor and swallowing impairment

As highlighted in the results, besides cognitive features, functional motor status and dysphagia were identified as independent predictors of the discharge setting. The role of admission motor/functional status on discharge destination from IRF has been already emphasized by several studies^{3,41,47-49} regarding stroke patients, without a specific focus on aphasia and language disturbances. These studies suggest that patients with a severe functional impairment are less likely to be discharged home especially when in absence of a suitable social support. Our results confirm these findings to be still appropriate within aphasic population. In addition, the longer hospitalization of the patients discharged to IS could be interpreted in light of their more severe condition, which might require prolonged assistance and medical care. Furthermore, the examined literature⁵⁰ identifies dysphagia as a common impairment following stroke. Swallowing problems after stroke rates up to 65% and may induce hydration and nutritional difficulties, a wide range of in-hospital complications and a lower gain from rehabilitation treatments. Arnold and colleagues⁵¹ reported that in a large sample of stroke patients dysphagia was associated with a lower probability to live at home either at

1 discharge from hospital or after three months. The results of the present study agree with the literature, since
2 about one-third of the sample presented dysphagia at admission and this impairment was the most relevant
3 clinical characteristic in predicting the discharge destination. Possible explanations for this finding may
4 include the high risk of clinical complications associated with dysphagia and the difficulties of managing a
5 modified diet or an enteral feeding device at home⁵⁰. The reported results regarding dysphagia evaluation at
6 discharge support this hypothesis. In fact, only 2.2% of the discharged home group showed a persistent
7 dysphagia requiring a modified diet and no subject in the same group manifested the necessity of tube
8 feeding at discharge. Similar findings have been already described in previous studies^{6,52} and seem to be
9 confirmed for aphasic patients too.

10
11 This study presents some limitations. Despite the fairly large sample, the study was conducted in a single
12 setting, limiting the generalizability of the results. Moreover, due to the retrospective nature of the study,
13 some variables known to impact IRF discharge were not available for the recruited population (e.g.,
14 comorbidities, index of stroke severity, extent of the lesion, depression, socio-economic condition). For the
15 same reason, in this study only the presence/absence of nonverbal reasoning impairment and USN were
16 considered among nonlinguistic cognitive abilities. Future work should include a thorough evaluation of the
17 cognitive domain, with different tools designed for specific abilities (e.g., attention and executive function),
18 to identify the possible influence of selective impairment on rehabilitation outcome. Furthermore, a
19 comparison between homogeneous populations of aphasic and non-aphasic poststroke patients on this matter
20 could highlight specific findings for people with aphasia. Finally, it would be interesting to analyze, with a
21 long-term follow-up, the evolution of the discharge arrangement in terms of further rehabilitation
22 admissions, relocation in a nursing home or introduction of a home assistant.

23 24 **Conclusions**

25 Interdisciplinary complex stroke rehabilitation is one of the fastest growing fields in stroke research. This
26 study attempts to better characterize the determinants of one crucial rehabilitation outcome (i.e., discharge
27 destination from IRF) in a large cohort of post-acute stroke aphasic patients who are often neglected by
28 researches. The displayed results highlighted the preeminent role of nonlinguistic cognitive deficit in
29 predicting the discharge setting within this specific population. This data account for the importance of an
30 adequate assessment of nonverbal neuropsychological profile of aphasic patients admitted in IRFs.
31 Furthermore, the predictive power of functional motor status and especially dysphagia was confirmed to be
32 significant. These findings could be clinically helpful for an early identification of the discharge destination
33 and for setting up commensurate rehabilitation goals.

34 35 **Statement of Ethics**

All research procedures were conducted ethically in accordance with the World Medical Association Declaration of Helsinki. All research procedures were approved by the Local Ethics Committee (Milan Area B: Resolution 378_2018, ID 68101).

Disclosure Statement

The authors report no conflict of interest.

Funding Sources

The authors received no financial support for the research, authorship, and/or publication of this article.

References

1. Feigin VL, Forouzanfar MH, Krishnamurthi R, Mensah GA, Connor M; Bennett DA, Moran AE, Sacco RL, Anderson L, Truelsen T et al. Group Global and regional burden of stroke during 1990–2010. Findings from the Global Burden of Disease Study 2010. *Lancet* 2014, 383, 245–254.
2. Thorpe ER, Garrett KB, Smith AM, Reneker JC, Phillips RS. Outcome Measure Scores Predict Discharge Destination in Patients With Acute and Subacute Stroke: A Systematic Review and Series of Meta-analyses. *J Neurol Phys Ther*. 2018 Jan;42(1):2-11.
3. Pereira S, Foley N, Salter K, McClure JA, Meyer M, Brown J, Speechley M, Teasell R. Discharge destination of individuals with severe stroke undergoing rehabilitation: a predictive model. *Disabil Rehabil*. 2014;36(9):727-31.
4. Nguyen VQ, PrvuBettger J, Guerrier T, Hirsch MA, Thomas JG, Pugh TM, Rhoads CF 3rd. Factors associated with discharge to home versus discharge to institutional care after inpatient stroke rehabilitation. *Arch Phys Med Rehabil*. 2015 Jul;96(7):1297-303.
5. Agarwal V, McRae MP, Bhardwaj A, Teasell RW. A model to aid in the prediction of discharge location for stroke rehabilitation patients. *Arch Phys Med Rehabil*. 2003 Nov;84(11):1703-9.
6. Massucci M, Perdon L, Agosti M, Celani MG, Righetti E, Recupero E, Todeschini E, Franceschini M; Italian Cooperative Research (ICR2). Prognostic factors of activity limitation and discharge destination after stroke rehabilitation. *Am J Phys Med Rehabil*. 2006 Dec;85(12):963-70.
7. Pinedo S, Erazo P, Tejada P, Lizarraga N, Aycart J, Miranda M, Zaldibar B, Gamio A, Gómez I, Sanmartín V, Bilbao A. Rehabilitation efficiency and destination on discharge after stroke. *Eur J Phys Rehabil Med*. 2014 Jun;50(3):323-33.
8. Tanwir S, Montgomery K, Chari V, Nesathurai S. Stroke rehabilitation: availability of a family member as caregiver and discharge destination. *Eur J Phys Rehabil Med*. 2014 Jun;50(3):355-62.
9. Ouellette DS, Timple C, Kaplan SE, Rosenberg SS, Rosario ER. Predicting discharge destination with admission outcome scores in stroke patients. *NeuroRehabilitation*. 2015;37(2):173-9.
10. Wee JY, Hopman WM. Stroke impairment predictors of discharge function, length of stay, and discharge destination in stroke rehabilitation. *Am J Phys Med Rehabil*. 2005 Aug;84(8):604-12.

11. Arnold M, Liesirova K, Broeg-Morvay A, Meisterernst J, Schlager M, Mono ML, El-Koussy M, Kägi G, Jung S, Sarikaya H. Dysphagia in Acute Stroke: Incidence, Burden and Impact on Clinical Outcome. *PLoS One*. 2016 Feb 10;11(2):e0148424
12. Denti L, Agosti M, Franceschini M Outcome predictors of rehabilitation for first stroke in the elderly. *Eur J Phys Rehabil Med*. 2008 Mar;44(1):3-11
13. Engelter ST, Gostynski M, Papa S, Frei M, Born C, Ajdacic-Gross V, Gutzwiller F, Lyrer PA. Epidemiology of aphasia attributable to first ischemic stroke: incidence, severity, fluency, etiology, and thrombolysis. *Stroke*. 2006 Jun;37(6):1379-84.
14. Laska AC, Hellblom A, Murray V, Kahan T, Von Arbin M. Aphasia in acute stroke and relation to outcome. *J Intern Med*. 2001 May;249(5):413-22.
15. Lazar RM, Boehme AK. Aphasia As a Predictor of Stroke Outcome. *Curr Neurol Neurosci Rep*. 2017 Sep 19;17(11):83.
16. Boehme AK, Martin-Schild S, Marshall RS, Lazar RM. Effect of aphasia on acute stroke outcomes. *Neurology*. 2016 Nov 29;87(22):2348-2354
17. Bersano A, Burgio F, Gattinoni M, Candelise L; PROSIT Study Group. Aphasia burden to hospitalised acute stroke patients: need for an early rehabilitation programme. *Int J Stroke*. 2009 Dec;4(6):443-7.
18. Tsouli S, Kyritsis AP, Tsagalis G, Virvidaki E, Vemmos KN. Significance of aphasia after first-ever acute stroke: impact on early and late outcomes. *Neuroepidemiology*. 2009;33(2):96-102.
19. Haselbach D, Renggli A, Carda S, Croquelois A. Determinants of neurological functional recovery potential after stroke in young adults. *Cerebrovasc Dis Extra*. 2014 Apr 17;4(1):77-83.
20. Helm-Estabrooks N Cognition and aphasia: a discussion and a study. *J Commun Disord*. 2002 Mar-Apr;35(2):171-86.
21. Marinelli CV, Spaccavento S, Craca A, Marangolo P, Angelelli P. Different Cognitive Profiles of Patients with Severe Aphasia. *Behav Neurol*. 2017;2017:3875954.
22. Kalbe E, Reinhold N, Brand M, Markowitsch HJ, Kessler J. A new test battery to assess aphasic disturbances and associated cognitive dysfunctions -- German normative data on the aphasia check list. *J Clin Exp Neuropsychol*.
23. Albert ML. Treatment of aphasia. *Arch Neurol*. 1998 Nov;55(11):1417-9. Review.
24. Goldenberg G, Spatt J. Influence of size and site of cerebral lesions on spontaneous recovery of aphasia and on success of language therapy. *Brain Lang*. 1994 Nov;47(4):684-98
25. Fonseca J, Raposo A, Martins IP. Cognitive performance and aphasia recovery. *Top Stroke Rehabil*. 2018 Mar;25(2):131-136
26. Kalaria RN, Akinyemi R, Ihara M. Stroke injury, cognitive impairment and vascular dementia. *Biochim Biophys Acta*. 2016 May;1862(5):915-25.
27. Brady MC, Fredrick A, Williams B. People with aphasia: 320 capacity to consent, research, participation and intervention inequalities. *Int J Stroke*. 2013 Apr;8(3):193-6.

28. El Hachoui H, Visch-Brink EG, Lingsma HF, van de Sandt-Koenderman MW, Dippel DW, Koudstaal PJ, Middelkoop HA. Nonlinguistic cognitive impairment in poststroke aphasia: a prospective study. *Neurorehabil Neural Repair*. 2014 Mar-Apr;28(3):273-81
29. Elsner, B., Kugler, J., Pohl, M., Mehrholz, J. Transcranial direct current stimulation (tDCS) for improving aphasia in adults with aphasia after stroke. *Cochrane Database of Systematic Reviews* 2019, Issue 5. Art. No.: CD009760. DOI: 10.1002/14651858.CD009760.pub4.
30. McCullough, G. H., Wertz, R. T., Rosenbek, J. C., Mills, R. H., Ross, K. B., & Ashford, J. R. (2000). Inter-and intrajudge reliability of a clinical examination of swallowing in adults. *Dysphagia*, 15(2), 58-67
31. Keith RA, Granger CV, Hamilton BB, Sherwin FS. The functional independence measure: a new tool for rehabilitation *Adv Clin Rehabil*. 1987;1:6-18.
32. Huber, Walter; Klaus Poeck; Dorothea Weniger; Klaus Willmes. *Aachener Aphasia Test*. Göttingen: Hogrefe 1983.
33. Luzzatti C., Willmes K., de Blaser R. (1996). *Aachener Aphasia Test (AAT), versione italiana*, II ed, Organizzazioni speciali, Firenze.
34. Basso A, Capitani E, Laiacina M. Raven's coloured progressive matrices: normative values on 305 adult normal controls. *Funct Neurol*. 1987 Apr-Jun;2(2):189-94.
35. Carpenter PA, Just MA, Shell P. *Psychol Rev*. What one intelligence test measures: a theoretical account of the processing in the Raven Progressive Matrices Test. 1990 Jul;97(3):404-31.
36. Albert, M. L. (1973). A simple test of visual neglect. *Neurology*, 23, 658-664.
37. Gauthier, L., Dehaut, F., & Joanette, Y. (1989). The bell test: a quantitative and qualitative test for visual neglect. *International Journal of Clinical Neuropsychology*, 11, 49-54
38. Dalemans, R. J., De Witte, L. P., Beurskens, A. J., Van Den Heuvel, W. J., & Wade, D. T. (2010). An investigation into the social participation of stroke survivors with aphasia. *Disability and Rehabilitation*, 32(20), 1678-1685.
39. Davidson, B., Howe, T., Worrall, L., Hickson, L., & Togher, L. (2008). Social participation for older people with aphasia: The impact of communication disability on friendships. *Topics in stroke rehabilitation*, 15(4), 325-340.
40. Gainotti, G. (1997). Emotional, psychological and psychosocial problems of aphasic patients: An introduction. *Aphasiology*, 11(7), 635-650.
41. Ginex V, Veronelli L, Vanacore N, Lacorte E, Monti A, Corbo M. Motor recovery in post-stroke patients with aphasia: the role of specific linguistic abilities. *Top Stroke Rehabil*. 2017 Sep;24(6):428-434.
42. Fedorenko E, Varley R. Language and thought are not the same thing: evidence from neuroimaging and neurological patients. *Ann N Y Acad Sci*. 2016 Apr;1369(1):132-53.
43. Seniów J, Litwin M, Leśniak M. The relationship between non-linguistic cognitive deficits and language recovery in patients with aphasia. *J Neurol Sci*. 2009 ug 15;283(1-2):91-4.

- 1 44. Tsujimoto K, Mizuno K, Kobayashi Y, Tanuma A, Liu M. Right as well as left unilateral spatial
2 neglect influences rehabilitation outcomes and its recovery is important for determining discharge
3 destination in subacute stroke patients. *Eur J Phys Rehabil Med*. 2019 May 27.
- 4 45. Di Monaco M1, Schintu S, Dotta M, Barba S, Tappero R, Gindri P. Severity of unilateral spatial
5 neglect is an independent predictor of functional outcome after acute inpatient rehabilitation in
6 individuals with right hemispheric stroke. *Arch Phys Med Rehabil*. 2011 Aug;92(8):1250-6
- 7 46. Ten Brink AF, Verwer JH, Biesbroek JM, Visser-Meily JMA, Nijboer TCW. Differences between
8 left- and right-sided neglect revisited: A large cohort study across multiple domains. *J Clin Exp*
9 *Neuropsychol*. 2017 Sep;39(7):707-723.
- 10 47. Mauthe RW, Haaf DC, Haya P, Krall JM. Predicting discharge destination of stroke patients using a
11 mathematical model based on six items from the Functional Independence Measure. *Arch Phys Med*
12 *Rehabil* 1996;77:10–13.
- 13 48. Lutz BJ. Determinants of discharge destination for stroke patients. *Rehabil Nurs* 2004;29:154–63.
- 14 49. Kongsawasdi S, Klaphajone J, Wivatvongvana P, Watcharasaksilp K. Prognostic Factors of
15 Functional Outcome Assessed by Using the Modified Rankin Scale in Subacute Ischemic Stroke. *J*
16 *Clin Med Res*. 2019 May;11(5):375-382.
- 17 50. Lieber AC, Hong E, Putrino D, Nistal DA, Pan JS, Kellner CP. Nutrition, Energy Expenditure,
18 Dysphagia, and Self-Efficacy in Stroke Rehabilitation: A Review of the Literature. *Brain Sci*. 2018
19 Dec 7;8(12)50
- 20 51. Arnold M, Liesirova K, Broeg-Morvay A, Meisterernst J, Schlager M, Mono ML, El-Koussy M,
21 Kägi G, Jung S, Sarikaya H. Dysphagia in Acute Stroke: Incidence, Burden and Impact on Clinical
22 Outcome. *PLoS One*. 2016 Feb 10;11(2):e0148424.
- 23 52. Di Carlo A1, Lamassa M, Pracucci G, Basile AM, Trefoloni G, Vanni P, Wolfe CD, Tilling K,
24 Ebrahim S, Inzitari D. Stroke in the very old: clinical presentation and determinants of 3-month
25 functional outcome: A European perspective. European BIOMED Study of Stroke Care Group.
26 *Stroke*. 1999 Nov;30(11):2313-9

1 Tables

2

3 **Table 1.** Demographic, clinical and functional characteristics by discharge location (home vs. institutional
4 setting, IS). Continuous variables are reported as mean (SD; range min-max), categorical as N (%).

5

	Home N=92 (58.2%)	IS N=66 (41.8%)	Test
Age	73.8 (±9.5; 48-89)	72.2 (±12.7; 34-91)	t=0.879 p=0.381
Gender			$\chi^2=0.018$ p=0.893
	Male 47 (51.1%)	33 (50.0%)	
	Female 45 (48.9%)	33 (50.0%)	
Education*			$\chi^2=5.214$ p=0.157
	Primary school 24 (28.9%)	23 (39.0%)	
	Middle school 21 (25.3%)	19 (32.2%)	
	High school 35 (42.2%)	14 (23.7%)	
	University 3 (3.6%)	3 (5.1%)	
Premorbid autonomy			$\chi^2=1.714$ p=0.190
	Independent 69 (77.5%)	55 (85.9%)	
	Dependent 20 (22.5%)	9 (14.1%)	
Premorbid living arrangements			$\chi^2=0.127$ p=0.939
	Alone 29 (56.9%)	22 (33.8%)	
	Family 59 (65.6%)	42 (64.6%)	
	Attendant 2 (2.2%)	1 (1.5%)	
First ever stroke			$\chi^2=0.614$ p=0.433
	Yes 69 (75.0%)	53 (80.3%)	
	No 23 (25%)	13 (19.7%)	
Ictus Type			$\chi^2=2.032$ p=0.154
	Ischemic 72 (78.3%)	45 (68.2%)	
	Hemorrhagic 20 (21.7%)	21 (31.8%)	
TPO (days)	23.7 (±31.1; 4-178)	20.4 (±19.9; 4-103)	t=0.741 p=0.460
Dysphagia			$\chi^2=33.183$ p<0.001
	Yes 13 (14.1%)	38 (57.6%)	
	No 79 (85.9%)	28 (42.4%)	
M-FIM	48.1 (±19.4; 15-90)	30.3 (±17.3; 13-85)	t=5.946 p<0.001
T-FIM	70.4 (±24.2; 20-123)	48.0 (±22.7; 18-117)	t=5.895 p<0.001
LOS (days)	53.5 (±14.3; 11-86)	62.9 (±22.3; 12-195)	t=-3.236 p<0.001
PhT (sessions)	90.3 (±26.5; 19-148)	107.5 (±38.2; 22-334)	t=-3.358 p<0.001
SpT (sessions)	32.8 (±18.3; 0-82)	42.8 (±20.1; 0-120)	t=-3.262 p<0.001
OcT (sessions)	17.9 (±14.4; 0-54)	22.2 (±13.5; 0-48)	t=-1.872 p=0.063

6 *Data available on 143 patients. TPO = time post onset; LOS = length of stay; PhT = physical therapy; SpT
7 = speech therapy; OcT = occupational therapy.

1 **Table 2.** Cognitive characteristics at baseline by discharge location (home vs. institutional setting, IS).

2 Continuous variables are reported as mean (SD; range min-max); categorical as N (%).

3

	Home N=92 (58.2%)	IS N=66 (41.8%)	Test
H-index	51.3 (±10.8; 28,6-72.5)	45.8 (±12.3; 25.8-75.6)	t=3.002 p=0.003
Token Test	47.6 (±12.6; 25-72)	24.4 (±12.5; 25-70)	t=2.725 p=0.007
Repetition	52.8 (±12.6; 22-80)	46.7 (±15.8; 22-80)	t=2.467 p=0.015
Written Language	51.2 (±12.1; 31-80)	46.5 (±11.5; 31-74)	t=3.002 p=0.003
Naming abilities	52.6 (±13.4; 31-80)	46.2 (±13.0; 31-80)	t=3.014 p=0.003
Comprehension	48.7 (±11.6; 15-81)	41.5 (±13.7; 15-80)	t=3.571 p<0.001
CPM (pure nonverbal reasoning)			
	<i>Impaired</i> 20 (21.7%)	31 (47.0%)	$\chi^2=11.192$ p<0.001
	<i>Normal</i> 72 (78.3%)	35 (53.0%)	
Right-sided USN			
	<i>Yes</i> 5 (5.4%)	4 (6.1%)	$\chi^2=0.028$ p=0.867
	<i>No</i> 87 (94.6%)	62 (93.9%)	

4 CPM = colored progressive matrices; USN = unilateral spatial neglect.

Table 3. Functional and linguistic characteristics at discharge point, analyzed by discharge location (home vs. institutional setting, IS). Continuous variables are reported as mean (SD; range min-max), categorical as N (%).

	Home N=92 (58.2%)	IS N=66 (41.8%)	Test
M-FIM	70.5 (±18.4; 15-91)	54.2 (±21.7; 15-91)	t=5.069 p<0.001
T-FIM	97.7 (±22.8; 26-126)	77.4 (±27.0; 24-124)	t=5.060 p<0.001
H-index	55.5 (±11.3; 33.5-75.4)	47.8 (±12.0; 25.8-72.8)	t=3.349 p=0.001
Token Test	52.5 (±11.3; 25-74)	45.6 (±11.5; 25-74)	t=3.097 p=0.003
Repetition	55.2 (±12.5; 22-80)	48.1 (±14.1; 22-76)	t=2.747 p=0.007
Written Language	54.9 (±12.9; 31-80)	47.8 (±12.5; 31-80)	t=2.861 p=0.005
Naming abilities	59.6 (±14.2; 31-80)	49.7 (±13.8; 31-80)	t=3.624 p<0.001
Comprehension	52.7 (±10.9; 30-73)	45.2 (±11.5; 15-73)	t=3.491 p=0.001
Dysphagia	Yes 2 (2.2%) No 90 (97.8%)	23 (34.8%) 43 (65.2%)	$\chi^2=30.805$ p<0.001

1 **Table 4.** Logistic Regression Model for home discharge. The model yields a Cox and Snell coefficient that
2 explains the 3233% of the variance.

3

	B	S.E.	Wald	OR	95% CI		p
					lower	upper	
Gender (<i>Male vs Female</i>)	0,400	0,421	0,903	1,492	0,654	3,404	0,342
Age	0,042	0,023	3,286	1,043	0,997	1,091	0,070
M-FIM	0,035	0,014	6,457	1,035	1,008	1,063	0,011
Dysphagia (<i>No vs Yes</i>)	1,932	0,485	15,896	6,902	2,670	17,842	0,000
CPM (<i>Normal vs Impaired</i>)	1,092	0,449	5,903	2,979	1,235	7,188	0,015
Token Test	0,005	0,027	0,036	1,005	0,954	1,059	0,850
Repetition	0,033	0,023	2,051	1,033	0,988	1,080	0,152
Written Language	-0,006	0,031	0,034	0,994	0,935	1,057	0,855
Naming	-0,020	0,027	0,580	0,980	0,929	1,033	0,446
Comprehension	0,008	0,027	0,077	1,008	0,955	1,063	0,782

4 CPM = colored progressive matrices (pure nonverbal reasoning).