Treatment Dosage in Aphasia Rehabilitation: From Research Efficacy to Real-World Evidence

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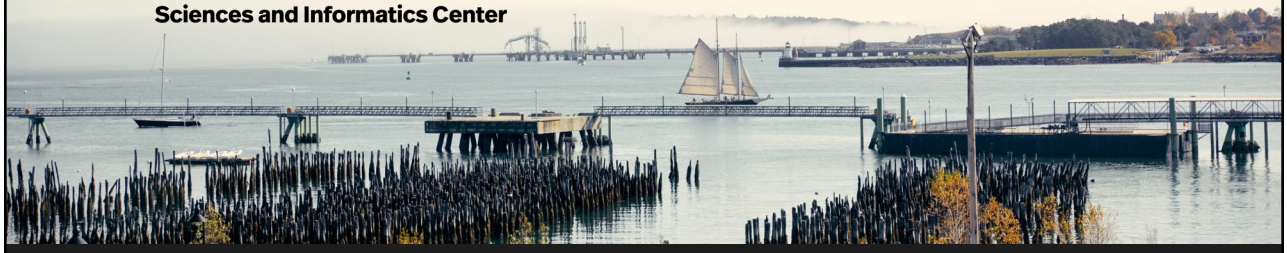

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Disclosures

Rob Cavanaugh

- Employed by Northeastern University
- No relevant non-financial relationships

Brianne Olivieri-Mui

- Employed by Northeastern University
- No relevant non-financial relationships

Louisa Smith

- Employed by Northeastern University
- No relevant non-financial relationships

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Learning Objectives

1. *Describe* the impact of treatment dosage on treatment efficacy and the potential impact of insufficient dosage
2. *Contrast* typical dosage in clinical research versus clinical practice
3. *Identify* three strategies for increasing dosage in clinical practice

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Outline

1. *Operationalizing treatments for aphasia*
2. Conceptualizing dose in aphasia treatment
3. Effects of treatment dose on treatment efficacy
4. Comparing to dosage in 'real-world' clinical practice settings
5. Clinical reflections & future directions

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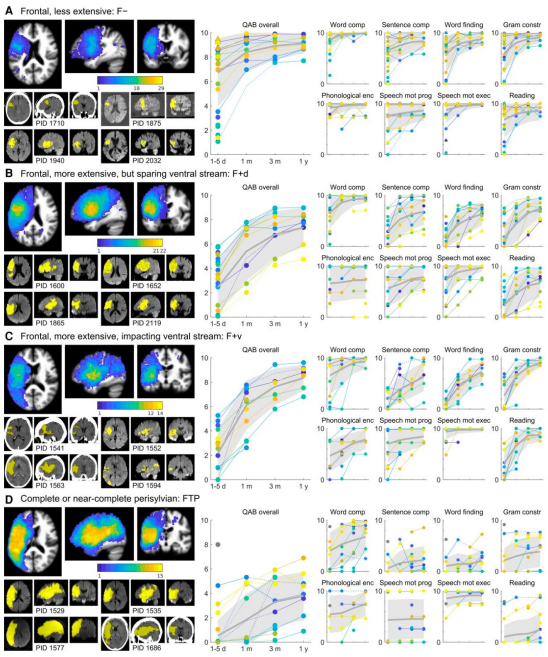
Aphasia

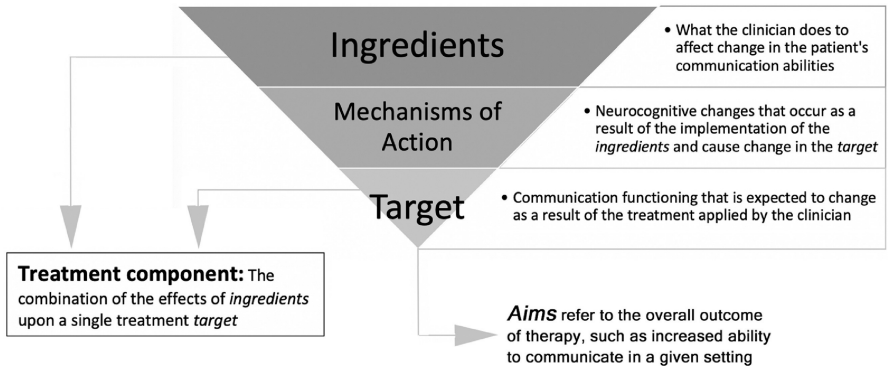
- Language disorder caused by brain that affects any area of language (e.g., talking, understanding others, reading, writing)
- Affects 1/3 of stroke survivors, with more than 180,000 new cases annually (Pedersen et al., 2004)
- Profound impact on health-related quality of life, including greater rates of social isolation and depression compared to stroke survivors without aphasia



Recovery from aphasia in the first year after stroke. Reprinted from Wilson et al., (2023)

Breaking down aphasia treatment

Research Treatment Specification System



Fridriksson, 2023

Example:
Semantic Feature Analysis Treatment (SFA)

- Interleaved, effortful retrieval of target words and semantic features across several semantic categories (ingredients)

1. Name the item
2. Generate semantic features
3. Name the item again
4. Repeat with a new item

- Steps 1-3 = 1 "treatment trial"

GROUP	DESCRIPTION	FUNCTION
Transportation	4 wheels	Skating
	Brake	Lace them up
	Buckle	Buy

CONTEXT	OTHER/PERSONAL	
Skate Park	sore bum	rollerblade
Park		I laced up the rollerblades *
Dick's (Sporting Goods)		

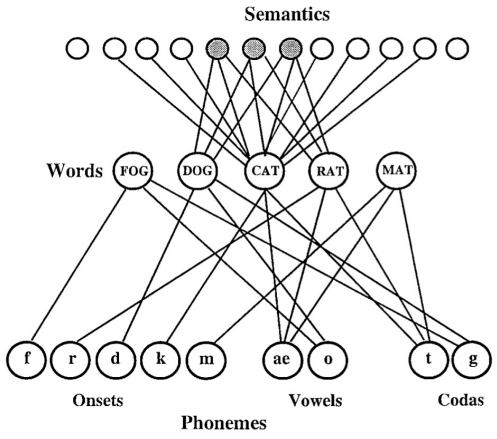
```
Rollerblade
Naming: Incorrect
Group: Transportation (PG)
Description: 4 wheels (PG), Brake (PG), Buckle
Function: Skating (PG), Lace them up (PG), Buy
Context: Skate Park (PG), Park (PG), Dick's (Sporting Goods) (PG)
Other/Personal: sore bum (PG)
Free Text: rollerblade

I laced up the rollerblades *
```


Gravier, 2018

Example #1
SFA Restorative Mechanism

- Elicitation and production of semantic features spreads activation of the features within the semantic network to their associated concepts and ultimately to associated lexical items.
- Repeated production of target words and semantic features strengthens the connections between conceptual and lexical representations (figure)
- Alternatively, repeated feature generation and naming of target items may improve the resting activation for both the target item and other items within a semantic category.

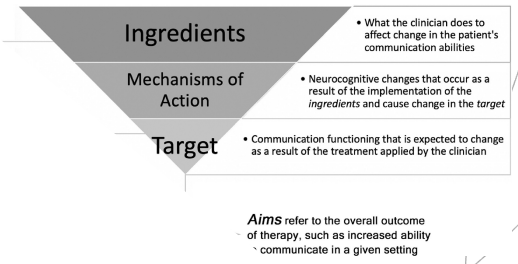


Foygel & Dell 2002

Operationalizing aphasia treatment

Research Treatment Specification System

- **Ingredients:** Semantic feature generation, naming practice, feedback, cueing hierarchy
- **Mechanism:** Spreading activation
- **Target:** Naming ability
- **Aim:** Improved word finding in conversation



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Example #2
SFA Compensatory Mechanism

- SFA "promotes habituation of semantic self-cueing and semantically appropriate circumlocution, strategies that facilitate communication even if specific lexical retrieval fails" Antonucci (2009)
- Retrieval of semantically related content may also help individuals with aphasia navigate to their intended lexical item (i.e., self-cueing)

@nathanwpyle Strange Planet

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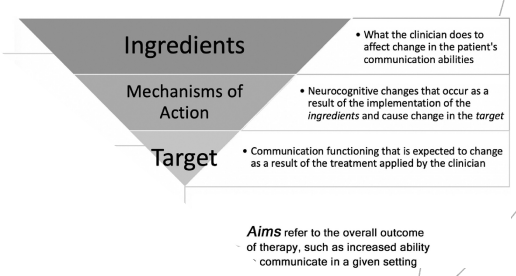
Operationalizing aphasia treatment

Research Treatment Specification System

- **Ingredients:** Semantic feature generation, naming practice, feedback, cueing hierarchy
- **Mechanism:** Habituation of circumlocution or self-cueing facilitates word finding during anomia
- **Target:** Naming ability
- **Aim:** Improved word finding in conversation



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5. Clinical reflections & future directions

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Defining Dose

DOSE FORM = Activity or task in which a teaching episode occurs. Teaching episodes contain the active ingredients of intervention, either therapeutic inputs or client acts.

DOSE = number of therapeutic inputs, or, client acts per session

25 50 75 100 125 150 175 200+

SESSION DURATION in minutes

LESS 10 20 30 40 50 60 70 80 90 MORE

SESSION FREQUENCY times per week

1 2 3 4 5 6 7 8 9

TOTAL INTERVENTION DURATION in time (weeks or months)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

CUMULATIVE INTERVENTION INTENSITY
= product of dose x dose frequency x total duration *(e.g., 100 production practice trials 3 x week for 12 weeks = 3600 productions of a targeted speech skill).*

Baker 2012, Warren 2007

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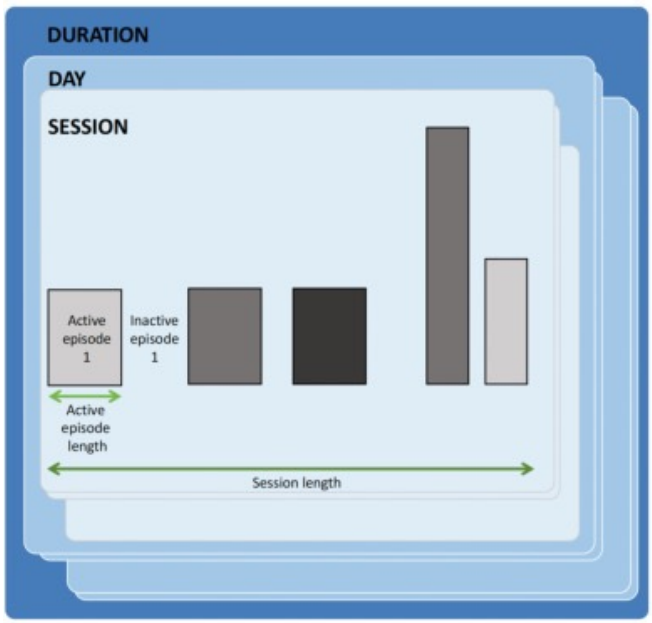
Defining Dose

Multidimension Dose Articulation Framework

Harvey, 2023



Dose Dimensions:

Duration, length of the intervention.

Days of intervention, can vary in number and spacing.

Sessions, can vary per day in number and spacing.

Session length, total time in intervention environment.

*A session includes **episodes** that can be active (time on task) or inactive (time off task).*

Session density, proportion of time spent active compared to inactive.

Episodes are defined by:

Length, how long is the task performed in units of time.

Difficulty, how hard is the task performed (intrinsic to the type of task).
Low Med High

Intensity, how much of the task is performed (work) per episode or unit of time (rate).

Multidimensional Dose Articulation Framework (copyright Wolters Kluwer Health, Inc)

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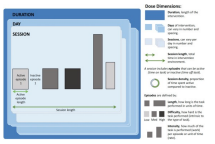
Key dosage variables



Therapeutic Element

- The basic unit of therapy; either a therapeutic input or a client act

Session Dose

- The amount of therapeutic content provided in a session, in minutes or therapeutic elements.

Session Frequency

- E.g., The number of therapy sessions per week..

Session Duration

- How long the treatment lasts (e.g., 10 weeks)

Total Dose

- Amount of therapy provided or received over an intervention period, in time or therapeutic inputs, e.g., total hours, total number of therapeutic elements

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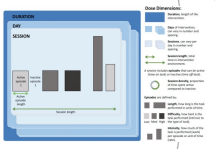
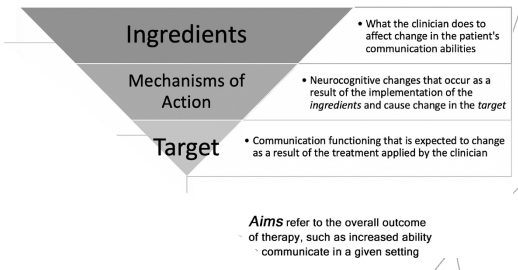
Operationalizing aphasia treatment

Research Treatment Specification System



- Therapeutic Elements

  Semantic feature generation, naming practice, feedback, cueing hierarchy



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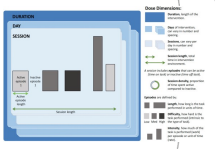
Operationalizing aphasia treatment

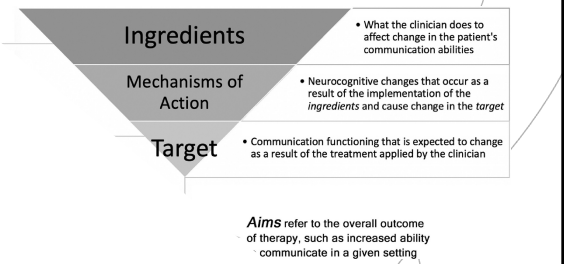
Research Treatment Specification System



- Therapeutic Elements

  Semantic feature generation, naming practice, feedback, cueing hierarchy

- **Session dose**: Number of SFA treatment trials in a single session (e.g., 15 trials/session)
- **Session intensity**: Rate at which treatment trials are given (E.g., 20 trials/hour over the course of treatment)
- **Session frequency**: The number of therapy sessions per week.
- **Total dose:** 15 trials/session * 2 sessions/week * 5 weeks = 150 trials



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Reporting dose in the research literature
(Harvey 2020)

- Most treatment studies report dosage in terms of therapy minutes / hours
  ~25% report dosage in terms of therapeutic elements delivered
- Many studies report the prescribed schedule but not the amount of treatment participants actually receive
- Home practice time rarely included or tracked

Most discussions of dose in aphasia treatment focus on **the distribution of in-person treatment *time* as a proxy for the total treatment dose**

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Effects of dose
Bhogal, 2003

- Meta-analysis of 10 controlled trials that investigated SLT for aphasia after stroke published between 1/1975 and 5/2002 (**864 total participants**)
- Target outcome measures were the Token Test, PICA, and FCP
- "**Studies that demonstrated a significant treatment effect provided 8.8 hours of therapy per week for 11.2 weeks versus the negative studies that only provided ≈2 hours per week for 22.9 weeks**"
- Shorter, more intense treatments were correlated with greater improvements
- More treatment hours correlated with greater improvements


Stroke
Volume 34, Issue 4, 1 April 2003; Pages 987-993
https://doi.org/10.1161/01.STR.0000062343.64383.D0

ORIGINAL CONTRIBUTIONS

Intensity of Aphasia Therapy, Impact on Recovery

Sanjit K. Bhogal, BA (Hon), Robert Teasell, MD, and Mark Speechley, PhD

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Effects of dose
Breitenstein, 2017

- RCT (n = 156) comparing **16 hours per week for 3 weeks** versus **6 hours per week for 8 weeks**
- "intervention was based on best-practice guidelines, combining linguistic and communicative-pragmatic approaches individualised to the baseline profile of each patient"
- Target outcome measures: Amsterdam-Nijmegen Everyday Language Test
- **Participants who received over 5 weeks therapy showed about 30% improvement in primary outcome compared to initial 3 weeks of therapy.**

Intensive speech and language therapy in patients with chronic aphasia after stroke: a randomised, open-label, blinded-endpoint, controlled trial in a health-care setting

Caterina Breitenstein, Tanja Grewe, Agnes Flöel, Wolfram Ziegler, Luise Springer*, Peter Martus, Walter Huber, Klaus Willmes, E Bernd Ringelstein, Karl Georg Haeusler, Stefanie Abel, Ralf Glindemann, Frank Domahs, Frank Regenbrecht, Klaus-Jürgen Schlenck, Marion Thomas, Hellmuth Obrig, Ernst de Langen, Roman Rocker, Franziska Wigbers, Christina Rühmkorf, Indra Hempen, Jonathan List, Annette Baumgaertner, for the FCET2EC study group†

Summary

Lancet 2017; 389: 1528–38 Background Treatment guidelines for aphasia recommend intensive speech and language therapy for chronic

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Effects of dose
Stahl, 2018

- RCT (n = 30) comparing two outpatient groups who engaged in either highly-intensive practice (**Group I: 4 hours daily**) or moderately-intensive practice (**Group II: 2 hours daily**) of **Intensive Language-Action Therapy**
- Target outcome measures: Aachen Aphasia Test
- "**no added value of treatment intensity over and above 2 hours of daily practice within 4 weeks**"
- "even a small 2-week increase in treatment duration contributes to recovery from chronic post- stroke aphasia"

Cognitive neurology

OPEN ACCESS

RESEARCH PAPER

Efficacy of intensive aphasia therapy in patients with chronic stroke: a randomised controlled trial

Benjamin Stahl,[1,2,3,4] Bettina Mohr,[5] Verena Büscher,[6] Felix R Dreyer,[6] Guglielmo Lucchese,[2,6] Friedemann Pulvermüller[6,7]

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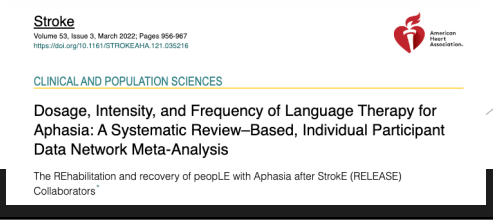
Effects of dose

RELEASE Collaborators, 2021

- "Systematic review-based, individual participant data network meta-analysis"
- Published, unpublished, and emerging trials including SLT and ≥10 individual participant data on aphasia, language outcomes, and time post-onset (**n = 959 over 25 studies**)
- "Controlling for age, sex, aphasia severity, and time poststroke at baseline, the **greatest overall language and functional communication gains** were associated with interventions that were **mixed expressive-receptive approaches, delivered over 5 days weekly for up to 50 hours in total**."
- "Generally, language gains observed were the greatest when associated with interventions tailored by **functional relevance and augmented by prescribed home practice tasks**."



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Is there a research practice dosage gap in aphasia rehabilitation?

Q: What can happen when real-world clinical practice differs from the research evidence base?

A: Voltage Drop
Reduced treatment fidelity in clinical settings ⟶ Poorer treatment effectiveness/outcomes in clinical practice

National Center for Advancing Translational Sciences of the National Institutes of Health Award TL1TR001858.


AJSLP
Research Article
Is There a Research–Practice Dosage Gap in Aphasia Rehabilitation?
Robert Cavanaugh,[a] Christina Kravetz,[b] Lillian Jarold,[a,c] Yina Quique,[d] Rose Turner,[a] and William S. Evans[a]

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Research Practice dosage Gap

Cavanaugh, 2021

What is the **typical treatment dose** administered to people with aphasia in **contemporary clinical aphasia studies**?

What is the **typical treatment dose** received by people with post-stroke aphasia in an episode of care in **outpatient rehabilitation** clinical settings?

To what extent is the dosage in contemporary aphasia treatment research **aligned** with current outpatient clinical practice settings?

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Dosage in the treatment literature

303 studies 2009 - 2019

Scoping review dosage statistics averaged across studies (top) and weighted by study sample size (bottom)

Variable	Mean	Median	Minimum	Q25	Q75	Maximum
Total sessions	10.1	15	1	10	23.8	137
Total hours	25.1	20	1	12	30	151.3
Hours per session	1.3	1	0.2	0.9	1.5	4
Hours per week	4.7	3	0.5	2	5	22.9
Sessions per week	3.6	3	0.6	2	5	20
Total weeks	7	6	1	4	8	63.6

Dosage in the treatment literature

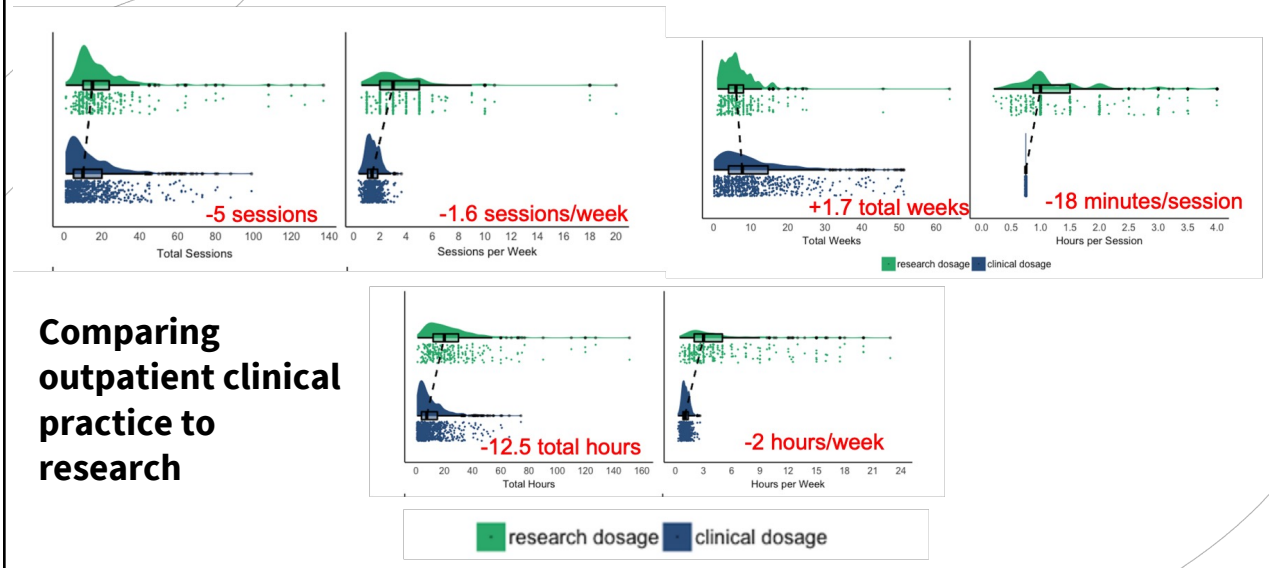
303 studies 2009 - 2019

Outpatient dosage statistics from 2014-2019 for episodes of care with ICD diagnosis of stroke and aphasia at the Centers for Rehabilitation Services in Western Pennsylvania, US

Variable	Mean	Median	Minimum	Q25	Q75	Maximum
Total sessions	14.50	10.00	1.00	5.00	20.00	99.00
Total hours	10.90	7.50	0.80	3.80	15.00	74.30
Hours per week	1.10	1.10	0.30	0.80	1.40	2.60
Sessions per week	1.50	1.40	0.40	1.10	1.80	3.60
Total weeks	10.60	7.70	0.10	4.00	14.60	51.30

Note. Dosage variables are calculated across individual episodes of care. Session duration is 45 minutes per session for all treatment sessions. A total of 683 episodes of care were included in the study, 570 of which had more than 4 sessions and were included in estimates of weekly frequency.

Comparing outpatient clinical practice to research



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Consistent with sparse data through the literature

- Katz et al. (2000) surveyed 175 clinicians in four countries: clinicians in the U.S. private sector reported providing the most outpatient sessions, between one and 20, with a mean of nine sessions.
- Stroke survivors who are Medicare beneficiaries receive an average of 8 total hours of outpatient speech-language pathology services within the first year after stroke (Skolarus et al., 2017).
- Stroke survivors in the STRONG study reported an average of 8 SLP visits within the first year after stroke across the continuum of care (with wide variability, SD of 20). 60% of stroke survivors reported never receiving SLP services. (Young et al.,, 2023)

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Dose in aphasia clinical settings
2023 update

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OHDSI
OBSERVATIONAL HEALTH DATA SCIENCES AND INFORMATICS

- *The Observational Health Data Sciences and Informatics (OHDSI)* program is an international, multi-stakeholder, interdisciplinary collaborative to bring out the value of health data through large-scale analytics.
- Northeastern University's OHDSI Center maintains a network of standardized clinical data covering nearly 10% of the world's population. We support research collaborations among academia, industries, and governments across disciplines and around the globe.
- OHDSI real-world evidence generation uses the Observational Medical Outcomes Partnership (OMOP) Common Data Model (Sherman, 2016)

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Dose in aphasia clinical settings
2023 update

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The PharMetrics Plus database for Academics (IQVIA) is a private, commercial adjudicated claims database with health information for 34 million enrollees

The data include enrollee age, prescription drug information (drug name, dose, day supply), and physician diagnosis according to ICD10, standardized to the OMOP CDM.

Northeastern has licensed access to this database from January 1, 2017, to December 31, 2021, that included >16 million enrollees with at least 1 year of enrollment.

Fact Sheet

IQVIA

IQVIA PharMetrics® Plus for Academics
Enhanced with Mortality Data

Real-world data on commercially insured patients enhanced with the most complete source of mortality data on the market

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Dose in aphasia clinical settings
2023 update

Defining a post-stroke aphasia cohort

- > 18 years of age or older
- >= 1 diagnosis of stroke during an inpatient visit
- >= 2 diagnosis codes of aphasia
- >= 6 months of observation prior to index date (first CVA code) without any stroke codes
- >= 1 year of continuous observation following CVA

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Fact Sheet

IQVIA

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Dose in aphasia clinical settings
2023 update

Cohort statistics

- 6,560 patients/enrollees
- ~ 30% of patients had an OP SLP eval + tx
- 49% female
- mean age: 70.8 years (median: 74; middle 50%: 66-80)

Provider plans:

- 45% Medicare Supplement (i.e., Mediare FFS + medigap)
- 28% Medicare Advantage
- 27% Commercial
- 1% managed Medicaid

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Results

2023 update

	Clinical Practice		Clinical Research	
	PMTx+	UPMC CRS	Scoping Review	RELEASE
Total Visits	15 (10)	14.5 (10)	10 (15)	
Total Hours		10.9 (7.5)	25.1 (20)	50
Total Weeks	9.5 (7.5)	10.6 (7.7)	7 (6)	
Sessions per week	1.7 (1.5)	1.5	3.6 (3)	5

Note: Mean (Median). Scoping review refers to Cavanaugh, 2021. RELEASE refers to dosage associated with greatest overall outcomes.

- ~6% of patients received more than 50 visits per episode of care
- 14 patients (0.6%) received >100 visits and >3 visits per week.

Replicates 2021 results at a national scale using closed commercial claims data

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On average, cumulative dosage (total hours) in the clinic is only 40% of dosage delivered in clinical aphasia research…

…and only 20% of treatment dose associated with the greatest overall language and communication outcomes in aphasia treatment (RELEASE, 2021)

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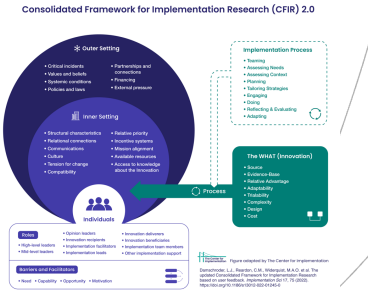
Factors that might influence real-world dose

Patient Factors:
- Financial costs (e.g., copays, coinsurance)
- Transportation
- Family support / reliance on others
- Comorbidities
- Motivation

Clinician Factors
- Experience
- Awareness & fidelity to dosage
- Differences in d/c criteria
- Cultural bias/sensitivity

System Factors:
- insurance coverage
- provider availability



CFIR 2.0

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Clinical Reflections & Recommendations

1. How familiar are you with the "**evidence-based dose**" of your go-to aphasia treatments?
   - How does it **compare to your daily practice** using those treatments?
   - What is your typical "***session density***"?
   - (in research its probably > 90%)
2. Consider & address **patient-specific barriers** to achieving sufficient dose
3. Implement the "active ingredients" in a **home treatment program**?

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Generating more features is associated with better outcomes in SFA

Treatment-specific dose-response relationship

Gravier et al., (2018), Evans et al., (2020)

…the greatest overall language and functional communication gains were associated with interventions that were mixed expressive-receptive approaches, delivered over 5 days weekly for up to 50 hours in total

Utilization-level dose-response relationship

RELEASE Collaborators, 2021

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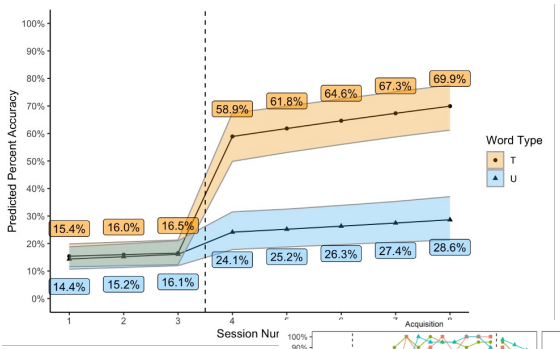
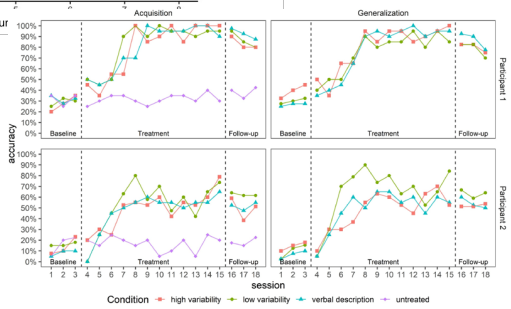
The relationship between treatment-specific dose and outcomes is most likely non-linear!



Goldberg et al., 2022



Quique et al., 2021

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Recommendations for clinical research

1. **Thoughtful selection** of dose in research (think ahead to implementation)
2. More granular **reporting** in research (use the MDAF!)
3. If treatments are more effective at higher dosages, **researchers must provide easily accessible materials** for home practice
4. Evaluate real-world treatment effectiveness **(is there a voltage drop?)**
5. Continue to develop **technology**-based treatment approaches

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Ways forward for aphasia rehabilitation

Strengthening the case for more comprehensive aphasia services

Strengthen the web of evidence around dose to align clinical reimbursement with the evidence base and what we believe individuals with aphasia should receive.

Tie clinical services to key outcomes (patient-reported outcomes, quality of life, readmissions, total cost, medication adherence, return to work, long-term disability)

Build the case for reimbursable chronic-care models for aphasia (Advocacy!)

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Roadmap for RWE in Aphasia, CSD, and Rehabilitation

- **Validate phenotypes** for communication disorders such as aphasia to increase confidence in diagnosis codes (Rao, 2023)
- **Develop rehabilitation-specific standardized vocabularies** for real-world evidence generation in rehabilitation
- **Increase uptake of data** from rehabilitation provider notes, imaging data, through the data vendors and into national databases

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Roux Institute OHDSI Center team, Fall 2023

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Pittsburgh Translational Aphasia Research Initiative
PTARI

Pitt SHRS
Communication Science and Disorders

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References

- Breitenstein, C., Grewe, T., Flöel, A., Ziegler, W., Springer, L., Martus, P., ... & Bamborschke, S. (2017). Intensive speech and language therapy in patients with chronic aphasia after stroke: a randomised, open-label, blinded-endpoint, controlled trial in a health-care setting. The Lancet, 389(10078), 1528-1538.
- Cavanaugh, R., Gravier, M. L., Autenreith, A. M., Doyle, P. J., Hula, W. D., & Dickey, M. W. (2021). Effects of Semantic Feature Type, Diversity, and Quantity on Semantic Feature Analysis Treatment Outcomes in Aphasia. American Journal of Speech-Language Pathology, 30(1S), 344–358. https://doi.org/10.1044/2020_AJSLP-19-00112
- Cavanaugh, R., Kravetz, C., Jarold, L., Quique, Y., Turner, R., & Evans, W. S. (2021). Is There a Research–Practice Dosage Gap in Aphasia Rehabilitation? American Journal of Speech- Language Pathology, 30(5), 2115–2129. https://doi.org/10.1044/2021_AJSLP-20-00257
- Dignam, J., Copland, D., McKinnon, E., Burfein, P., O'Brien, K., Farrell, A., & Rodriguez, A. D. (2015). Intensive versus distributed aphasia therapy: a nonrandomized, parallel-group, dosage-controlled study. Stroke, 46(8), 2206-2211.
- Evans, W. S., Cavanaugh, R., Gravier, M. L., Autenreith, A. S., Doyle, P. J., Hula, W. D., Dickey Michael, W., & Dickey, M. W. (2021). Effects of Semantic Feature Type, Diversity, and Quantity on Semantic Feature Analysis Treatment Outcomes in Aphasia. American Journal of Speech-Language Pathology. https://doi.org/10.1044/2020_AJSLP 19 00112
- Fridriksson, J., Basilakos, A., Boyle, M., Cherney, L. R., DeDe, G., Gordon, J. K., ... & Martin, N. (2022). Demystifying the complexity of aphasia treatment: application of the rehabilitation treatment specification systemx. Archives of physical medicine and rehabilitation, 103(3), 574-580. Baker, E. (2012).
- Goldberg, E., Dickey, M., Hula, W., Cavanaugh, R., Swiderski, A., & Autenreith, A. (2022). Cognitive Functions Supporting Learning Over Time in Naming Treatment for Aphasia. Paper presented at the American Speech-Language-Hearing Association Annual Convention. Friday, November 18, 2022, New Orleans, Louisiana.
- Gravier, M. L., Dickey, M. W., Hula, W. D., Evans, W. S., Owens, R. L., Winans-Mitrik, R. L., & Doyle, P. J. (2018). What matters in semantic feature analysis: Practice-related predictors of treatment response in aphasia. American Journal of Speech-Language Pathology, 27(1S), 438-453.
- Harvey, S., Carragher, M., Dickey, M. W., Pierce, J. E., & Rose, M. L. (2020a). Dose effects in behavioural treatment of post-stroke aphasia: A systematic review and meta-analysis. Disability and Rehabilitation, 1–12.
- Harvey, S., Carragher, M., Dickey, M. W., Pierce, J. E., & Rose, M. L. (2020b). Treatment dose in post-stroke aphasia: A systematic scoping review. Neuropsychological Rehabilitation, 1–32. https://doi.org/10.1080/09602011.2020.1786412
- Harvey, S., Rose, M. L., Brogan, E., Pierce, J. E., Godecke, E., Brownsett, S. L., ... & Hayward, K. S. (2023). Examining dose frameworks to improve aphasia rehabilitation research. Archives of Physical Medicine and Rehabilitation, 104(5), 830-838.

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References (continued)

- Katz, R. C., Hallowell, B., Code, C., Armstrong, E., Roberts, P., Pound, C., & Katz, L. (2000). A multinational comparison of aphasia management practices. International Journal of Language & Communication Disorders, 35(2), 303–314. https://doi.org/10.1080/136828200247205
- Optimal intervention intensity. International Journal of Speech-Language Pathology, 14(5), 401-409.
- Pierce, J. E., O'Halloran, R., Menahemi-Falkov, M., Togher, L., & Rose, M. L. (2020). Comparing higher and lower weekly treatment intensity for chronic aphasia: A systematic review and meta-analysis. Neuropsychological Rehabilitation, 1–25. https://doi.org/10.1080/09602011.2020.1768127
- Quique, Y. M., Cavanaugh, R., Lescht, E., & Evans, W. S. (2022). Applying adaptive distributed practice to self-managed computer-based anomia treatment: A single-case experimental design. Journal of Communication Disorders, 99, 106249. https://doi.org/10.1016/j.jcomdis.2022.106249
- Rao, G. (2023). PhenotypeLibrary: The OHDSI Phenotype library.
- REhabilitation and recovery of peopLE with Aphasia after StrokE (RELEASE) Collaborators. (2022). Dosage, intensity, and frequency of language therapy for aphasia: A systematic review–based, individual participant data network meta-analysis. Stroke, 53(3), 956-967.Evans, W. S.,
- Sherman, R. E., Anderson, S. A., Dal Pan, G. J., Gray, G. W., Gross, T., Hunter, N. L., LaVange, L., Marinac-Dabic, D., Marks, P. W., Robb, M. A., & others. (2016). Real-world evidence—What is it and what can it tell us. N Engl J Med, 375(23), 2293–2297.
- Simmons-Mackie, N. (2018). Aphasia in North America. Aphasia Access.
- Skolarus, L. E., Feng, C., & Burke, J. F. (2017). No Racial Difference in Rehabilitation Therapy Across All Post-Acute Care Settings in the Year Following a Stroke. Stroke, 48(12), 3329–3335. https://doi.org/10.1161/STROKEAHA.117.017290
- Stahl, B., Mohr, B., Büscher, V., Dreyer, F. R., Lucchese, G., & Pulvermüller, F. (2018). Efficacy of intensive aphasia therapy in patients with chronic stroke: a randomised controlled trial. Journal of Neurology, Neurosurgery & Psychiatry, 89(6), 586-592.
- Warren, S. F., Fey, M. E., & Yoder, P. J. (2007). Differential treatment intensity research: A missing link to creating optimally effective communication interventions. Mental retardation and developmental disabilities research reviews, 13(1), 70-77.
- Wilson, S. M., Entrup, J. L., Schneck, S. M., Onuscheck, C. F., Levy, D. F., Rahman, M., ... & Kirshner, H. S. (2023). Recovery from aphasia in the first year after stroke. Brain, 146(3), 1021-1039.
- Young, B. M., Holman, E. A., & Cramer, S. C. (2023). Rehabilitation Therapy Doses Are Low After Stroke and Predicted by Clinical Factors. Stroke, 54(3), 831–839.