

Stroke Recovery: If a patient falls in the woods...?

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Financial Disclosure

- No relevant financial conflicts of interest

Learning Objectives

- Overview of stroke recovery timeline
- Discuss selected post-stroke symptoms
- Post-stroke care
- Review Health-Related QOL in stroke

Case Presentation

- 72 yo M with recent stroke in last 3 months and received IV-alteplase. Completed inpatient rehabilitation. Residual deficits include mild L sided weakness-fine finger movements and mild foot drop. He walks without assistance.



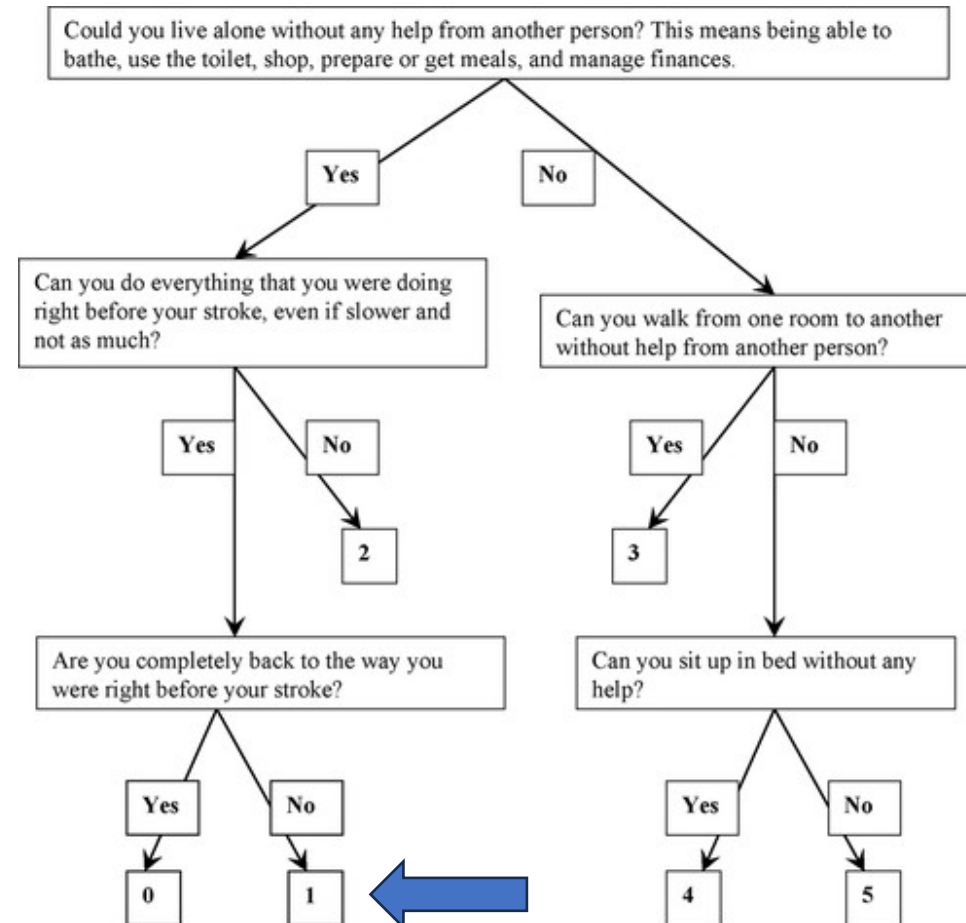




Measure ID#	Measure Short Name	Measure Description
CSTK-10	Modified Rankin Score (mRS) at 90 Days: Favorable Outcome <ul style="list-style-type: none">• IV t-PA Only – Independent• IV t-PA Only – Dependent• MER – Independent• MER - Dependent	This measure captures the proportion of ischemic stroke patients treated with intra-venous (IV) alteplase therapy or who undergo mechanical endovascular reperfusion therapy and have a mRS less than or equal to 2 at 90 days (≥ 75 days and ≤ 105 days).

Modified Rankin Score

Bruno, Akinwunta, & Lin. Stroke. 2010.



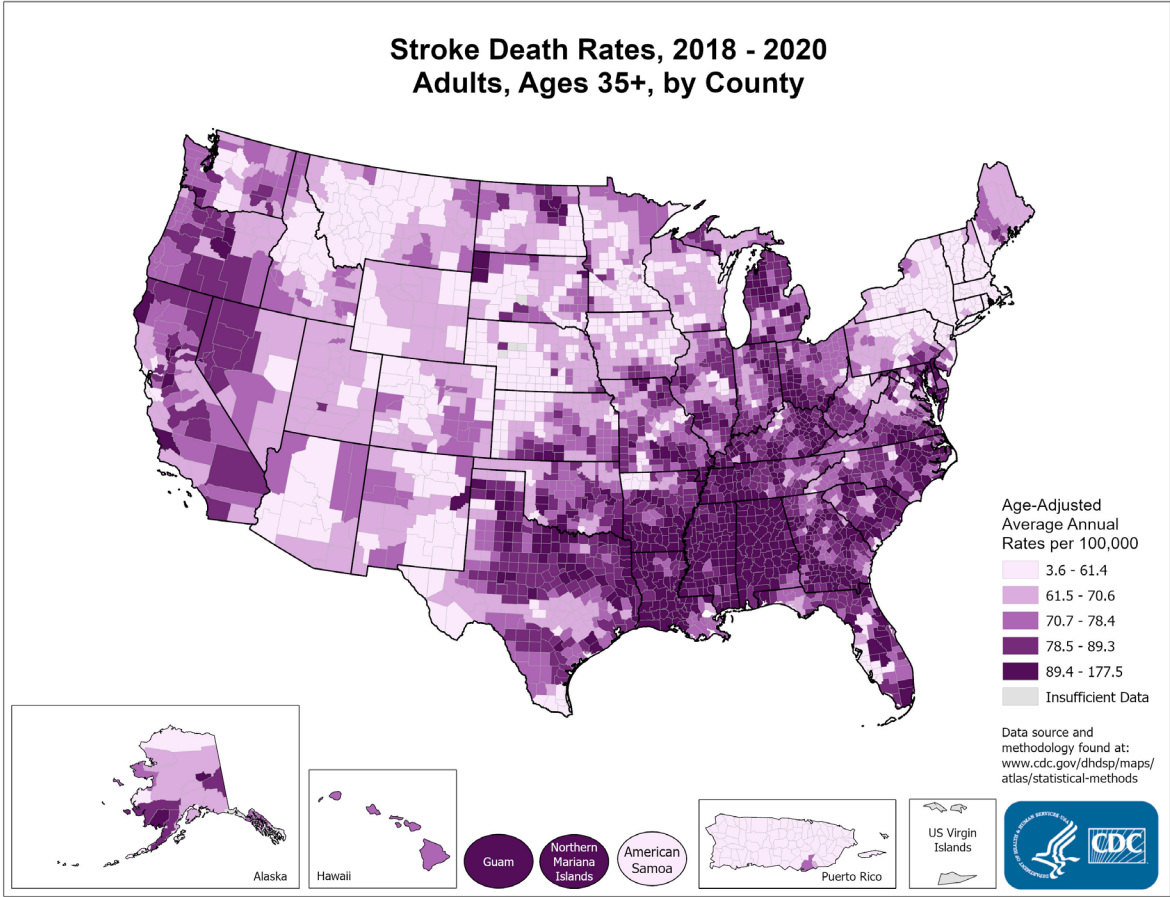
If a patient falls in the woods...

Is it a bad outcome?

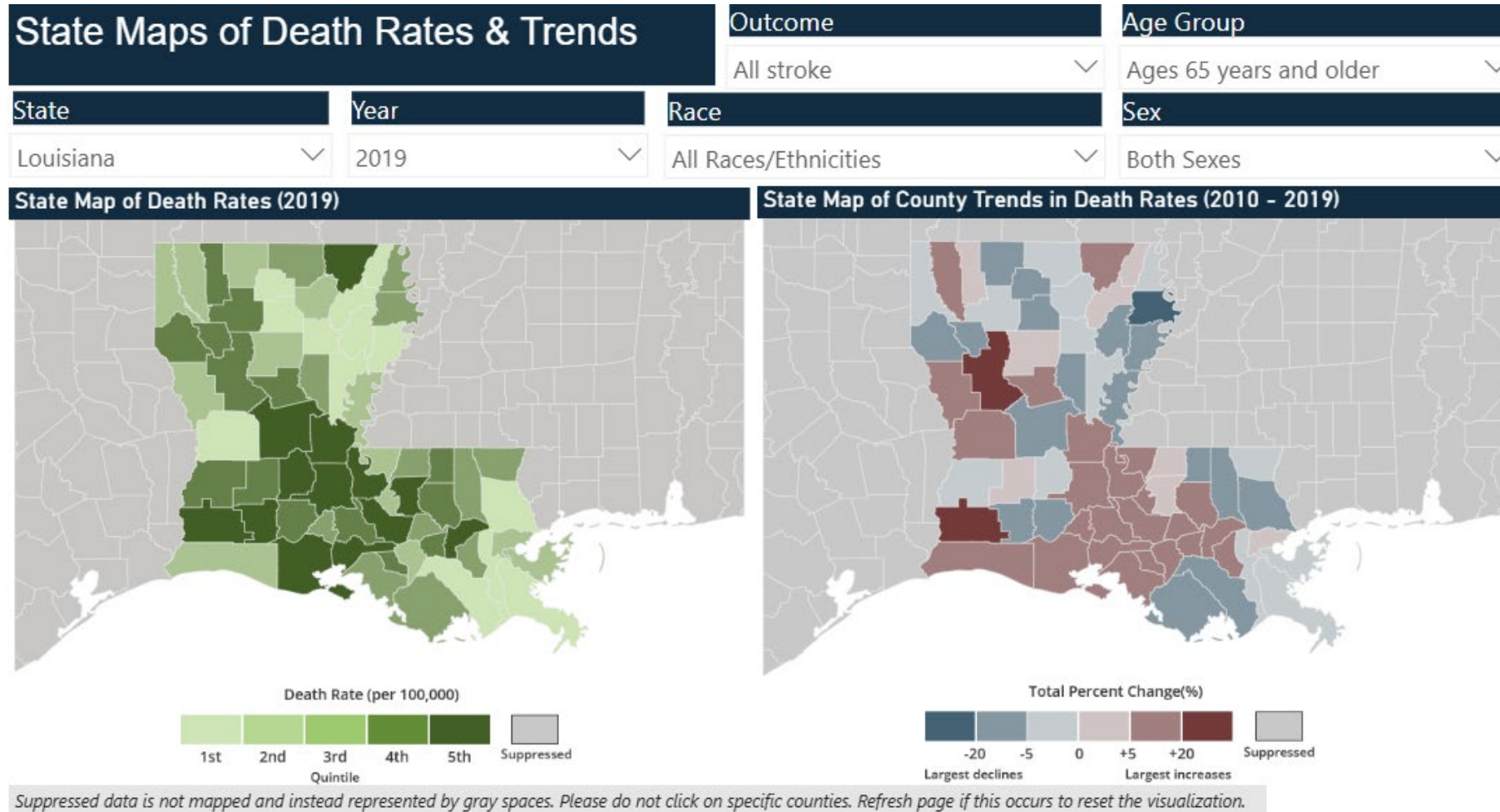
Stroke Statistics

- In the US, 4th leading cause of death (increased from 5th).
- 2nd leading cause of disability worldwide (CDC, 2023)
 - ~800,000 new stroke per year (AHA)
 - ~80% stroke patients will have motor deficits
 - NINDS estimates 9 million stroke survivors
- 45-60% of all stroke patients will need rehabilitation.
- At 6 months, 60% do clinically well but 40% are significantly disabled (Abrams).

CDC stroke mortality map

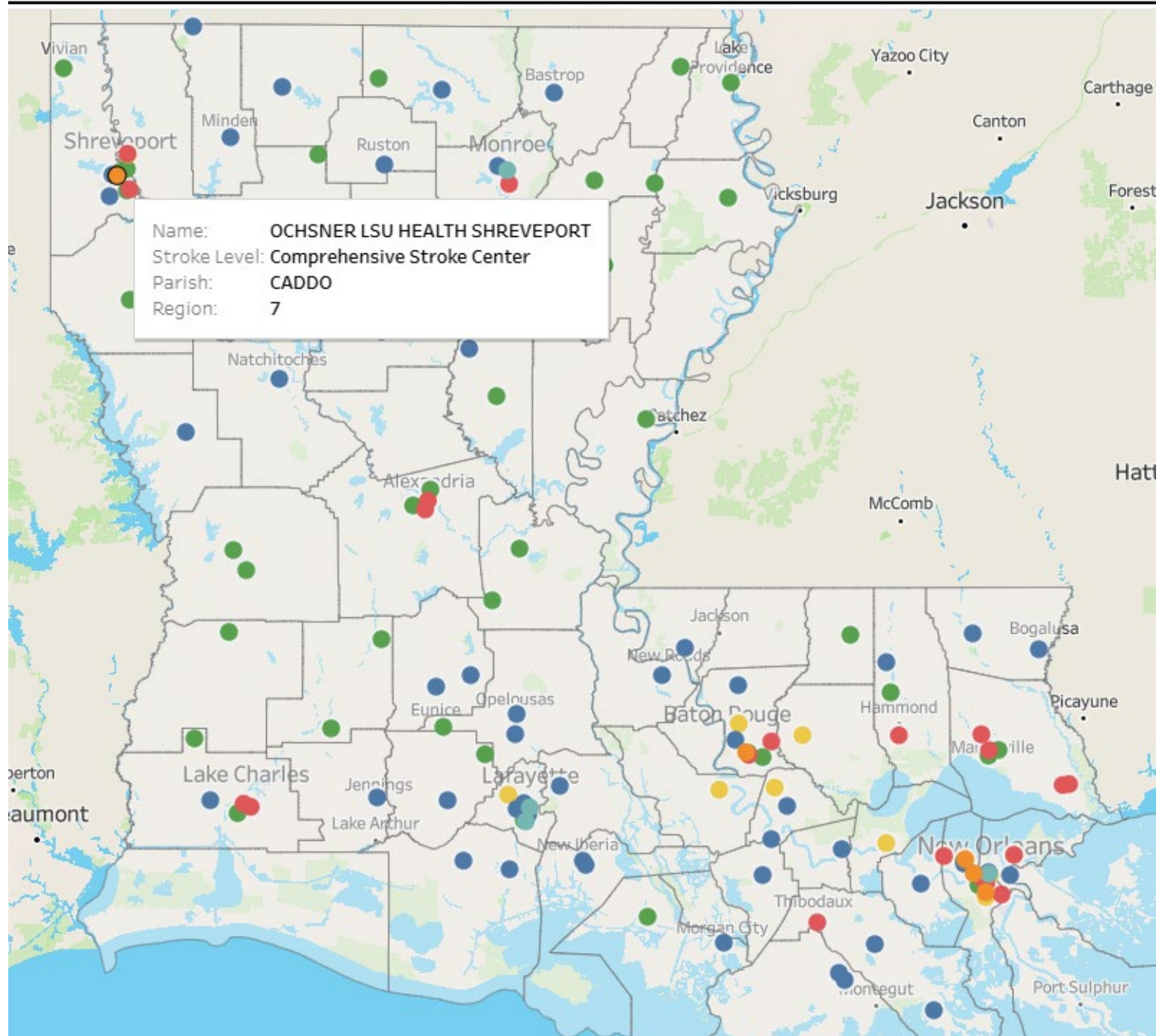


CDC- State Level: Louisiana



<https://www.cdc.gov/dhds/m/aps/hd-stroke-mortality-dashboard.htm>

Hospitals by Stroke Level



Disability Data Dashboard

Navigate Disability Counts data through this interactive interface

Select State/Territories

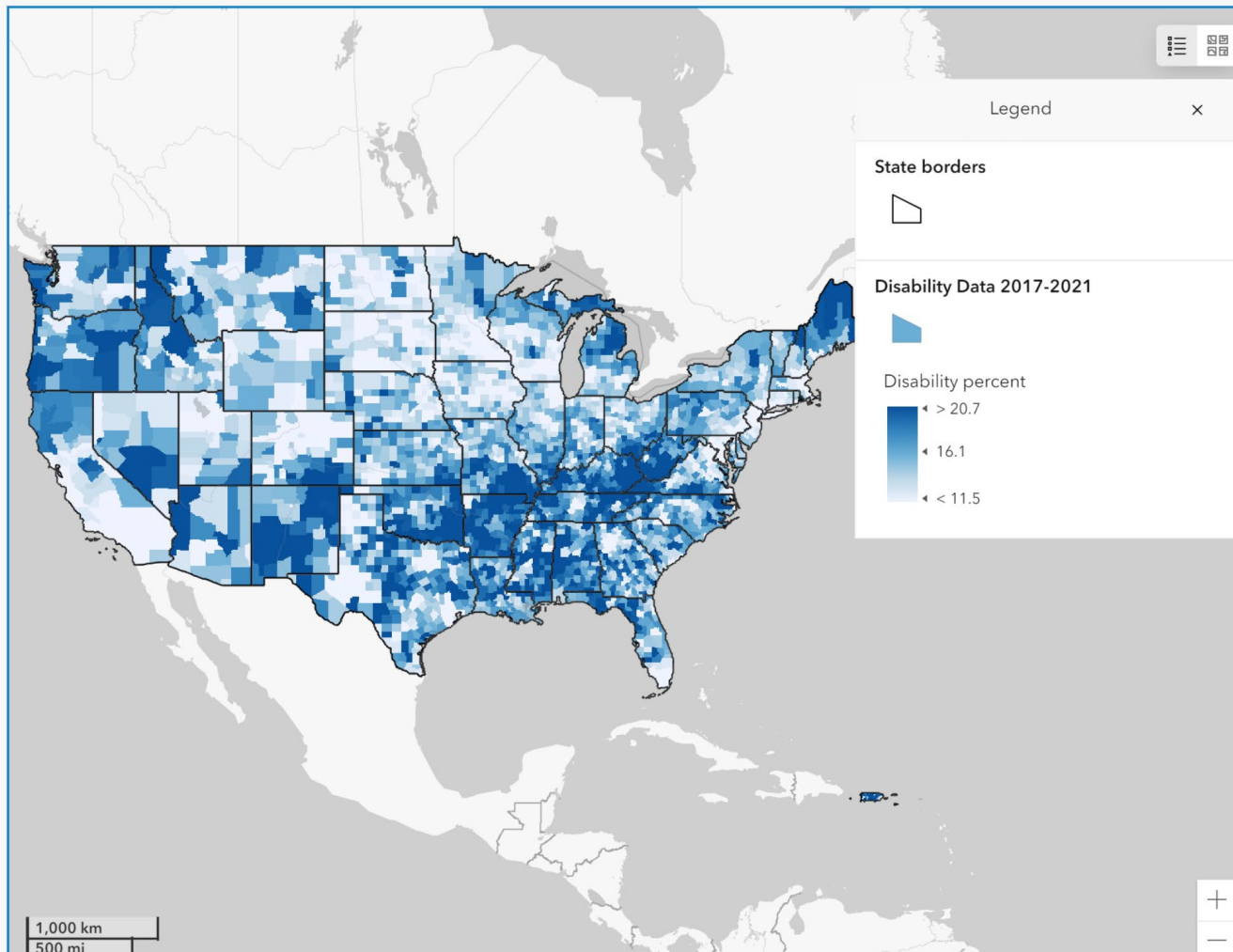
- South Dakota
- Tennessee
- Texas
- Utah
- Vermont
- Virginia
- Washington
- West Virginia
- Wisconsin
- Wyoming

Reset

Select all

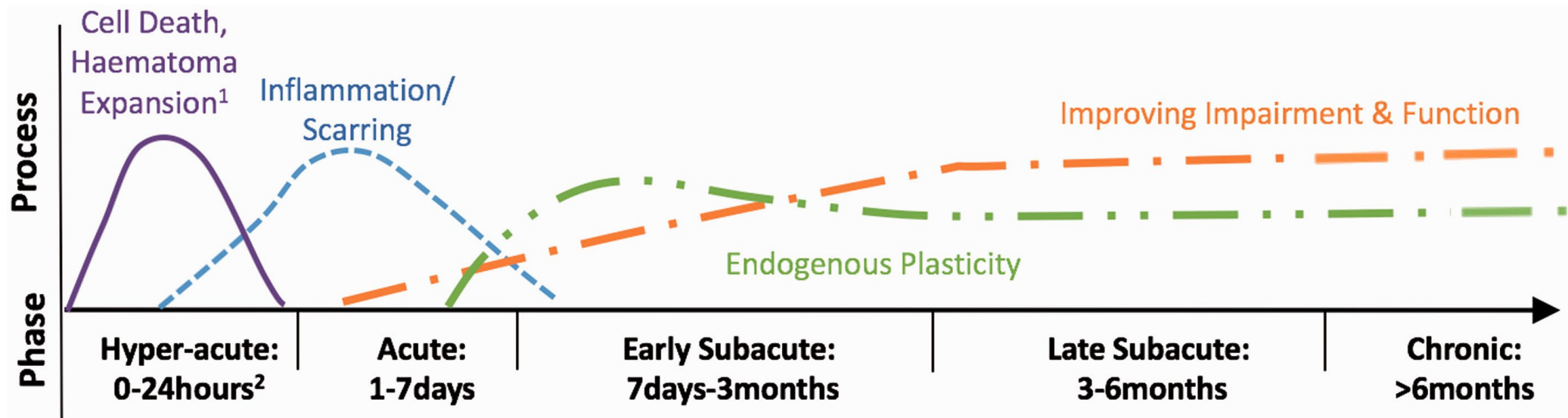
Metropolitan Classification

- Metropolitan
- Mircopolitan
- Noncore

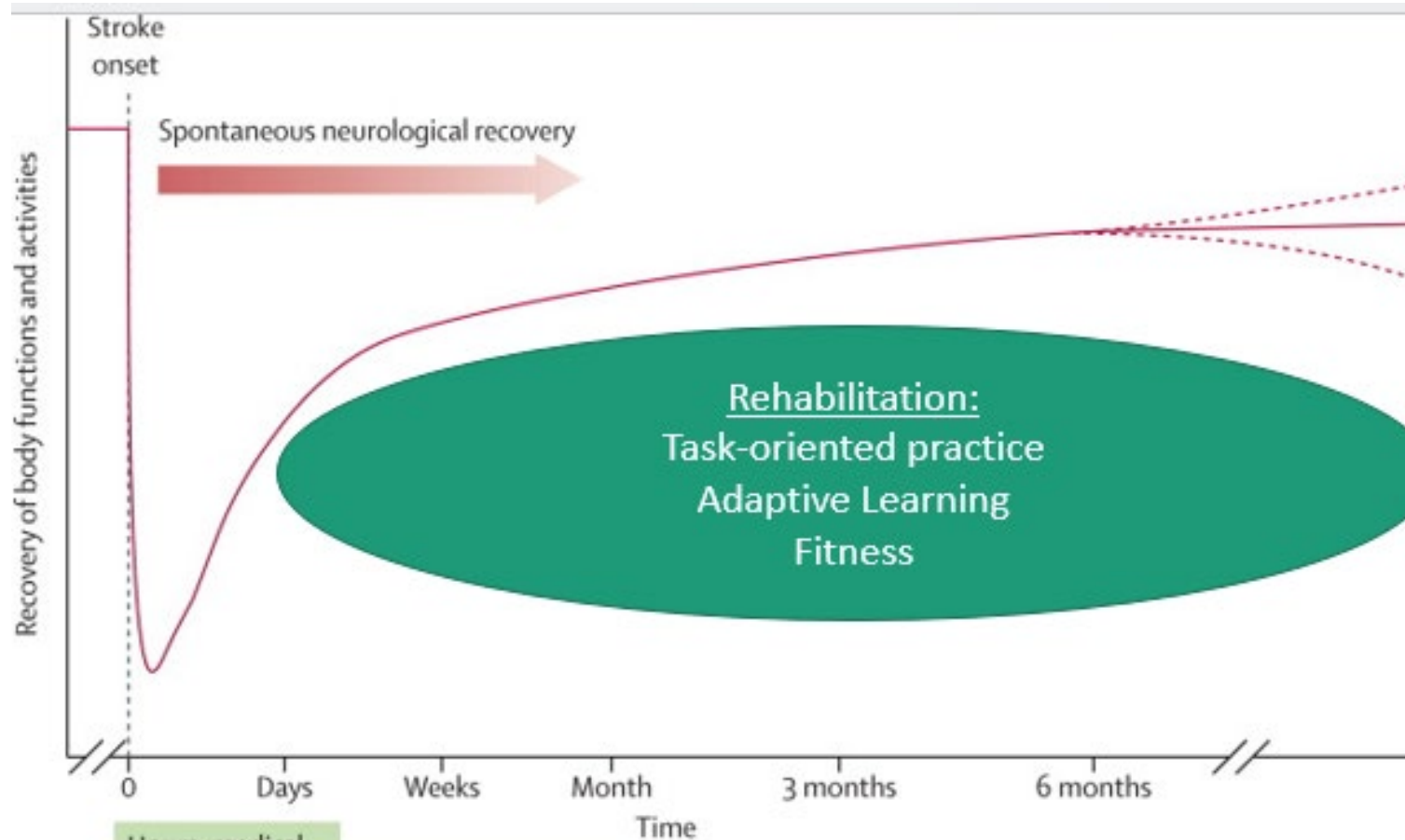


<https://rtc.ruralinstitute.umt.edu/geography/DisabilityCounts.asp>

Neurobiology of motor recovery



¹ Haemorrhagic stroke specific. ² Treatments extend to 24 hours to accommodate options for anterior and posterior circulation, as well as basilar occlusion.



Hours: medical

Hours-days: early mobilisation

Days-weeks: restoring impairments in order to regain activities

Days-months: task-oriented practice with adaptive learning and compensation strategies

Days-months: specific rehabilitation interventions (including physical fitness) to improve extended activities of daily living and social interaction

Weeks-months: environmental adaptations and services at home

Months-years: maintenance of physical condition and monitoring quality of life

Langhorne, P. Stroke Rehabilitation. Lancet Neurology, 2011.

Is rehab important?

- Meta-analysis of 10 trials: 1586 pts randomized to multidisciplinary team rehab vs general medicine care:
 - 28% reduction in mortality at 4 month
 - 21% reduction in mortality at 1 year
 - Less need for SNF, fewer deaths, and less disability
- An extra 5 patients return home independent for every 100 patients receiving stroke rehab.

Inpatient Rehabilitation



ORIGINAL RESEARCH

Functional Measures Upon Admission to Acute Inpatient Rehabilitation Predict Quality of Life After Ischemic Stroke

Chen Lin, MD,^a Mansi Katkar, BS,^b Jungwha Lee, PhD,^c Elliot Roth, MD,^d Richard L. Harvey, MD,^d Shyam Prabhakaran, MD, MS^e



WILEY
PM&R

Transcranial doppler ultrasonography can predict inpatient rehabilitation functional outcome in patients with stroke.
DOI: 10.1002/pmrj.13161



NEUROLOGICAL RESEARCH
2023, VOL. 45, NO. 6, 578-582
<https://doi.org/10.1080/01616412.2023.2167534>



Check for updates

Association of inpatient rehabilitation with functional outcome in patients with stroke receiving mechanical thrombectomy

Chen Lin^a, Andrea Arevalo^a and Hely D. Nanavati^{b,c}

ORIGINAL RESEARCH ARTICLE



African Americans and Women Have Lower Functional Gains During Acute Inpatient Rehabilitation After Hemorrhagic Stroke

Sana Somani, MD, Hely Nanavati, MBBS, MPH, Xiaohua Zhou, MD, and Chen Lin, MD



3. High-dose, very early mobilization within 24 hours of stroke onset should not be performed because it can reduce the odds of a favorable outcome at 3 months.

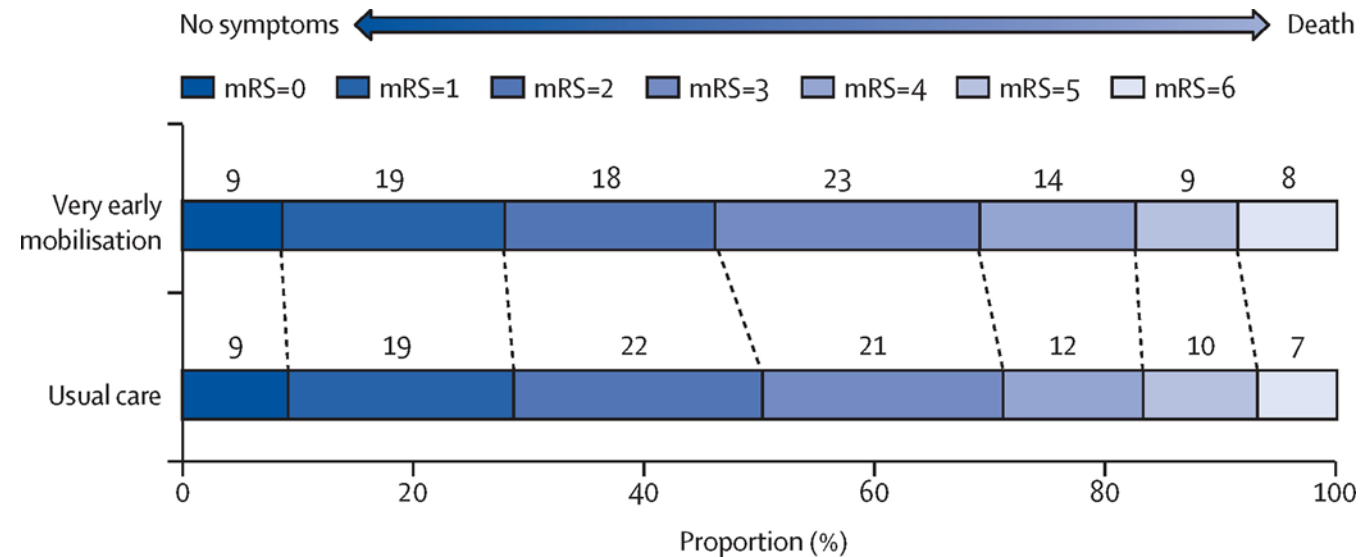
III: Harm

B-R

AVERT: A Very Early Rehabilitation Trial

- Phase 3, Parallel-group, single-blind, RCT at 56 acute stroke units in five countries
- 2104 pts between 7/2006-10/2014
- Compared high-dose, very early mobilization with standard-of-care
- High-dose mobilization protocol: Mobilization was begun within 24 hours of stroke onset, focus on out of bed activities, and at least 3 additional out-of-bed sessions.
- Primary outcome: favorable mRS 0-2 at 3 months

Primary Outcome



46% VEM vs 50% UC in favorable (mRS 0-2) outcome (adjusted odds ratio 0.73, 95% CI 0.59–0.90; $p=0.004$).

8% VEM vs 7% (OR 1.34, 95% CI 0.93–1.93, $p=0.113$) death

Table 2: Intervention Summary

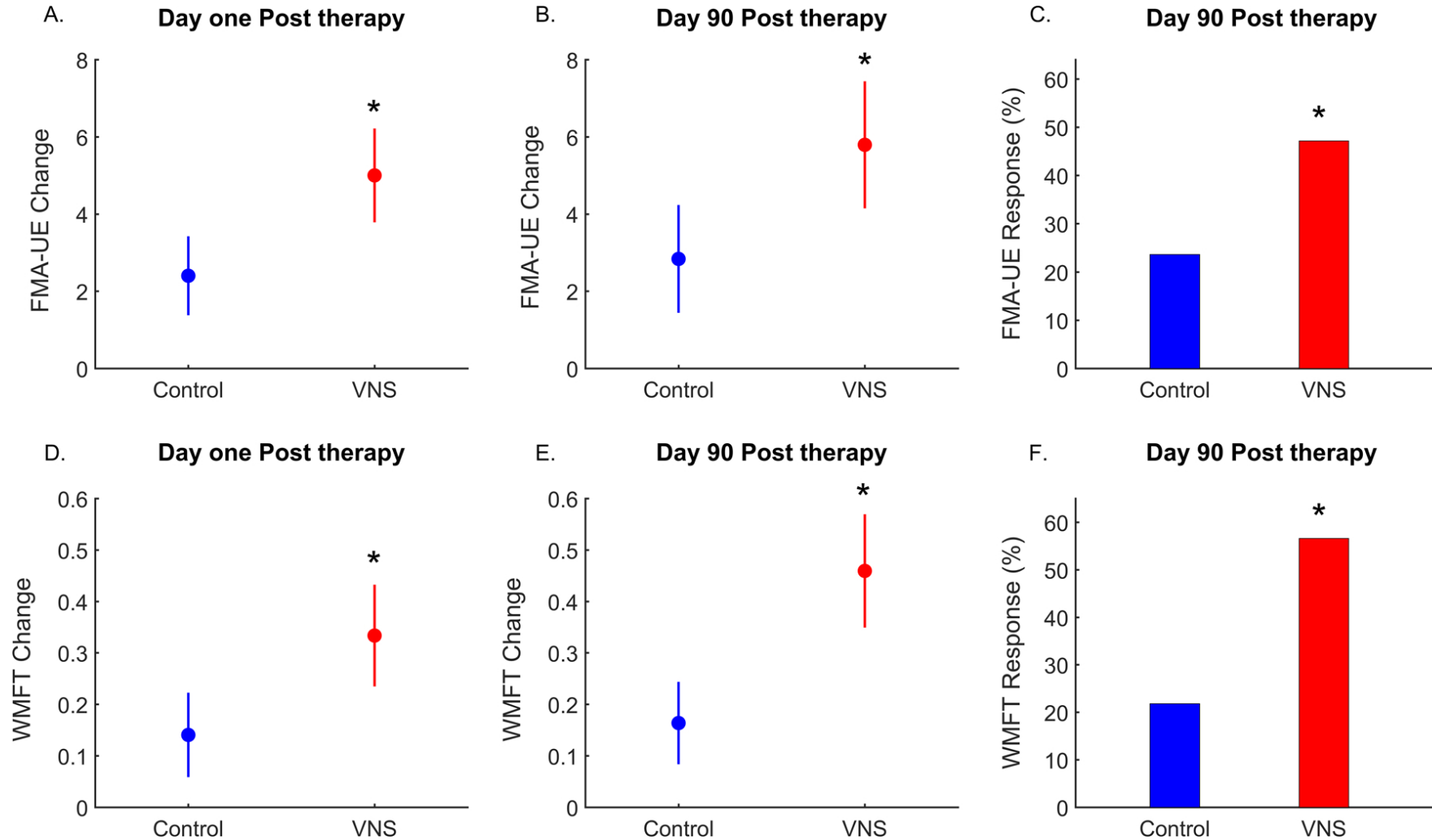
	Very early mobilisation (n=1054)	Usual care (n=1050)	p value	Median shift (95% CI)
Time to first mobilisation (h)	18.5 (12.8–22.3; n=1042*)	22.4 (16.5–29.3; n=1036*)	<0.0001	4.8 (4.1–5.7)
Frequency per person†	6.5 (4.0–9.5)	3 (2.0–4.5)	<0.0001	3 (3–3.5)
Daily amount per person (min)‡	31 (16.5–50.5)	10 (0–18)	<0.0001	21.0 (20–22.5)
Total amount per person (min)§	201.5 (108–340)	70 (32–130)	<0.0001	117 (107–128)

- Most Usual Care still within 24 hours
- No difference in complication rates
- Did not record LVOs (Used Oxfordshire class system)
- Focus on intensive out of bed therapy, and very early initiation
- We know intensive therapy trials have not been successful

Approaches to therapy

- Constraint- Induced Movement Therapy (CIMT)- started in 1993 but used in multiple therapy trials including EXCITE by Wolf et al (IIa, A).
- Robotics- generally Class II recommendations. Shown to have some benefit. Largest US study VA Robotics Trial did not show significant difference with therapy (IIa, A).
- Neuromodulation: neuromuscular E-stim, sensory stimulation, VNS, and tDCS (IIa-III).

Vagus nerve stimulation paired with rehabilitation for upper limb motor function after ischaemic stroke (VNS-REHAB): a randomised, blinded, pivotal, device trial



What does a 3 Point Change on Fugl-Meyer mean? Severe-Moderate Impairment



Severe:

Lift paretic arm to
wash axilla

Fugl-Meyer 11 to 14



Place arm into
sleeve

Fugl-Meyer 19 to 22

Moderate:

Tuck shirt, hike pants
Fugl-Meyer 25 to 28



FDA Approves First-of-Its-Kind Stroke Rehabilitation System

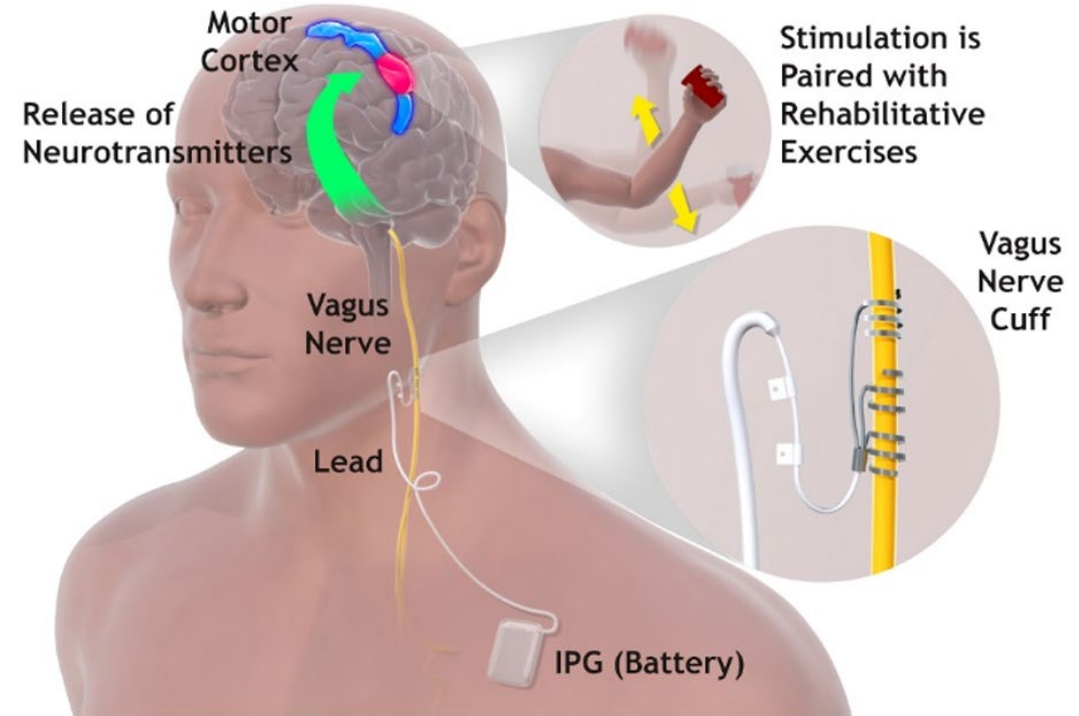


For Immediate Release: August 27, 2021

Español

The U.S. Food and Drug Administration today approved the MicroTransponder Vivistim Paired VNS System (Vivistim System), a first-of-its-kind, drug-free rehabilitation system intended to treat moderate to severe upper extremity motor deficits associated with chronic ischemic stroke—a stroke caused by a blockage of blood flow to the brain with long-lasting symptoms—using vagus nerve stimulation (VNS).

“People who have lost mobility in their hands and arms due to ischemic stroke are often limited in their treatment options for regaining motor function” said Christopher M. Loftus, M.D., acting director of the FDA’s Center for Devices and Radiological Health’s Office of Neurological and Physical Medicine Devices. **“Today’s approval of the Vivistim Paired VNS System offers the first stroke rehabilitation option using vagus nerve stimulation. Used alongside rehabilitative exercise, this device may offer benefit to those who have lost function in their upper limbs due to ischemic stroke.”**



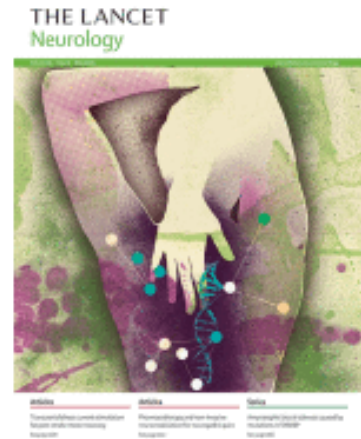
FULL TEXT ARTICLE



Safety and efficacy of transcranial direct current stimulation in addition to constraint-induced movement therapy for post-stroke motor recovery (TRANSPORT2): a phase 2, multicentre, randomised, sham-controlled triple-blind trial



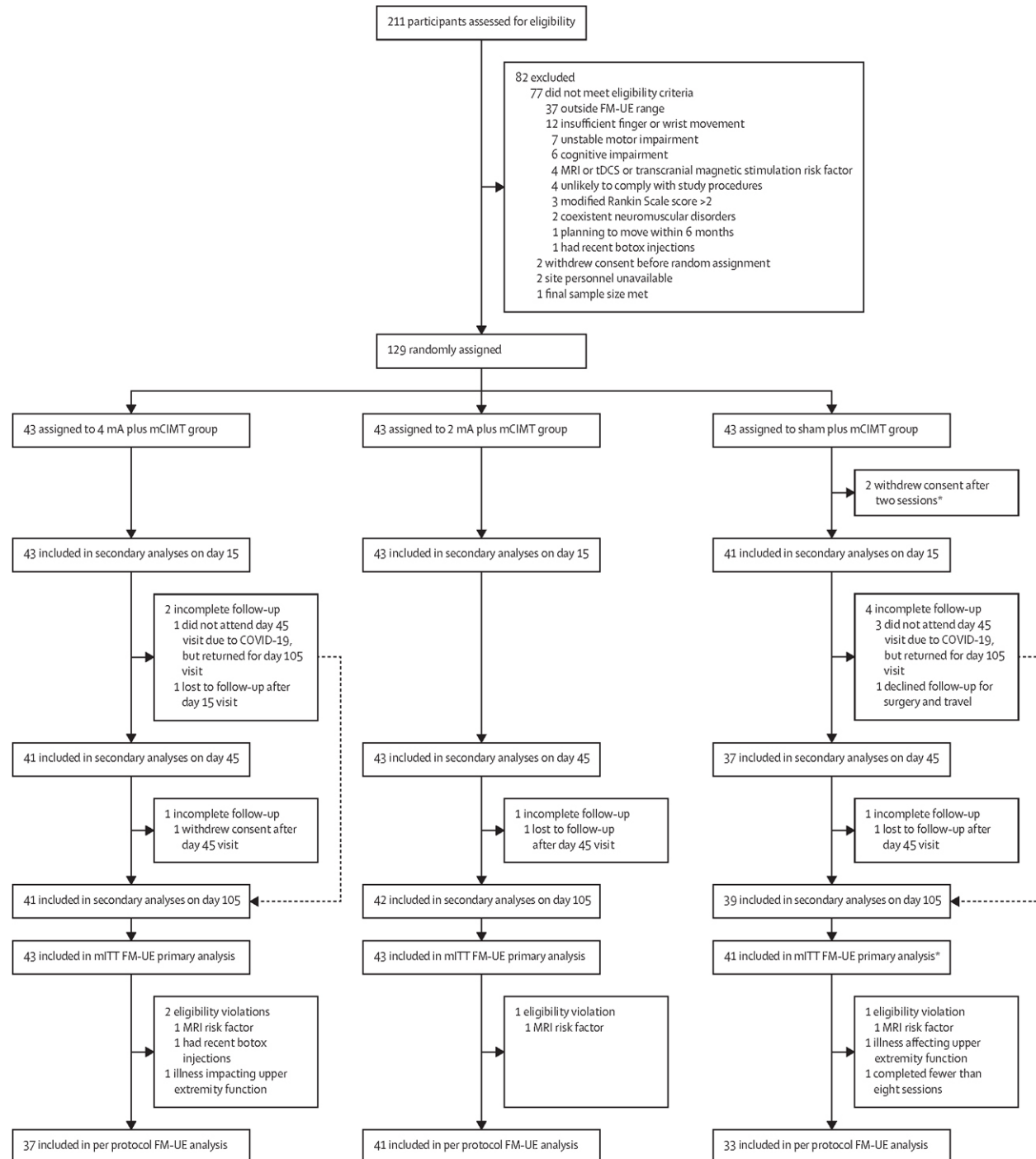
Gottfried Schlaug Prof, Christy Cassarly PhD, Jody A Feld PhD, Steve L Wolf Prof, Veronica T Rowe PhD, Stacy Fritz Prof, Pratik Y Chhatbar PhD, Anant Shinde PhD, Zemin Su MAS, Joseph P Broderick Prof, Richard Zorowitz Prof, Oluwole Awosika MD, Dylan Edwards Prof, Chen Lin MD, Gerard E Franciso Prof, George F Wittenberg Prof, Svetlana Pundik Prof, Christopher Gregory Prof, Michael R Borich PhD, Viswanathan Ramakrishnan Prof and Wuwei Feng Prof
Lancet Neurology, The, 2025-05-01, Volume 24, Issue 5, Pages 400-412, Copyright © 2025 Elsevier Ltd

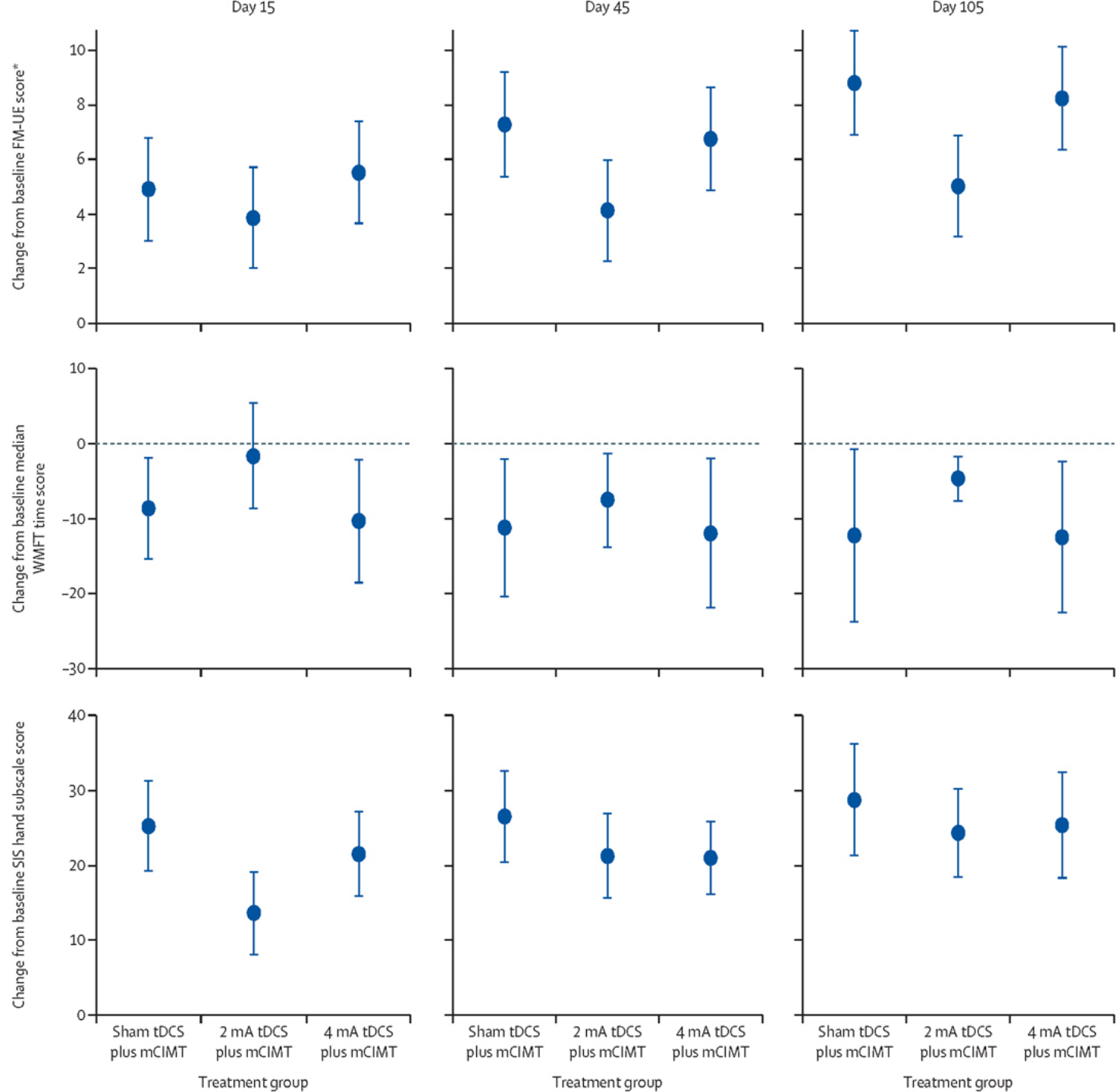


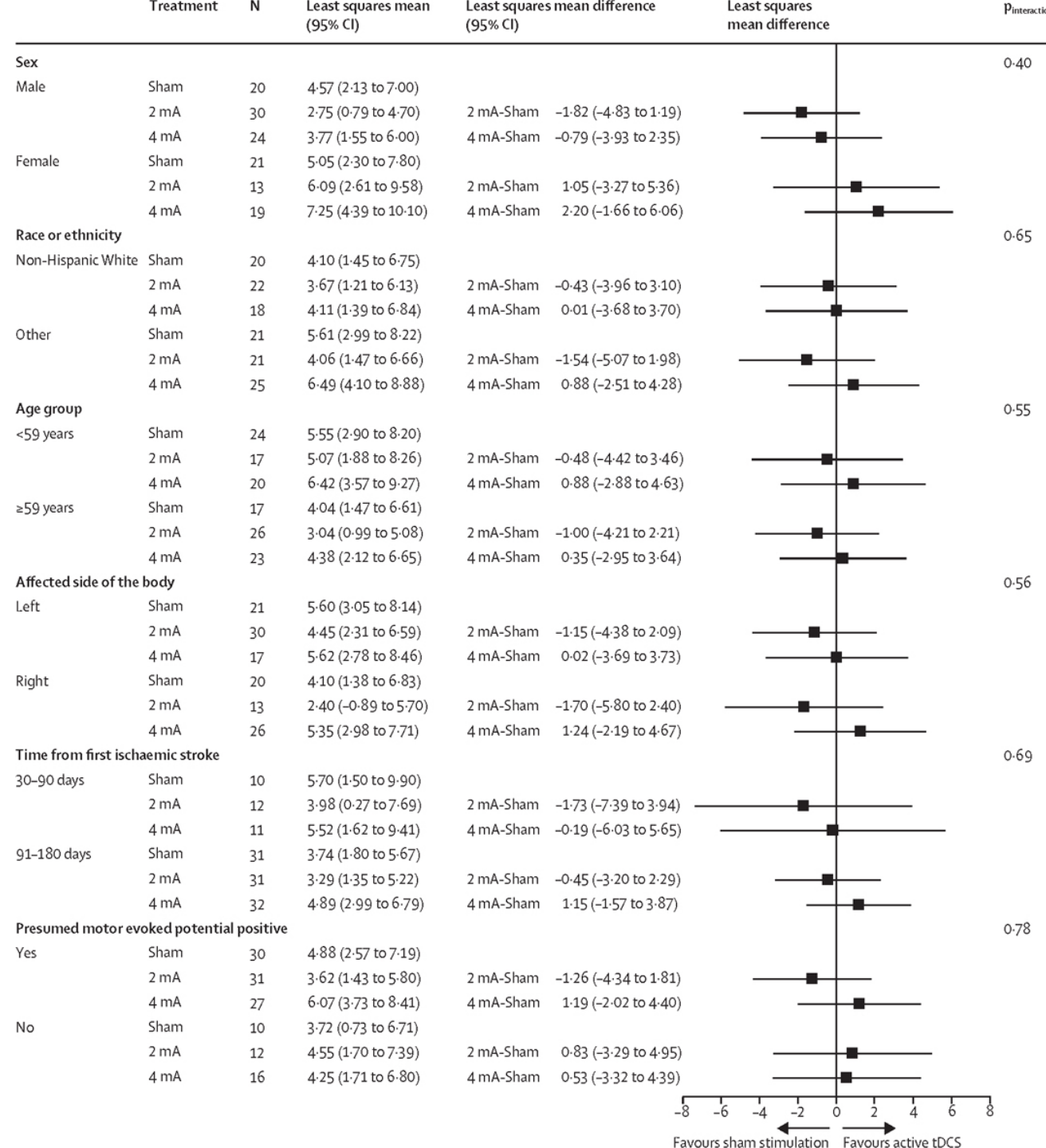
Lancet Neurology, The
Volume 24, Issue 5

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Post-stroke care

Recommendations: Organization of Poststroke Rehabilitation Care (Levels of Care)	Class	Level of Evidence
It is recommended that stroke patients who are candidates for postacute rehabilitation receive organized, coordinated, interprofessional care.	I	A
It is recommended that stroke survivors who qualify for and have access to IRF care receive treatment in an IRF in preference to a SNF.	I	B
Organized community-based and coordinated interprofessional rehabilitation care is recommended in the outpatient or home-based settings.	I	C
ESD services may be reasonable for people with mild to moderate disability.	IIb	B

Multidisciplinary Clinics

HEALTH SYSTEMS
2020, VOL. 9, NO. 2, 95–118
<https://doi.org/10.1080/20476965.2018.1436909>



REVIEW ARTICLE

OPEN ACCESS

Multi-disciplinary planning in health care: a review

A. G. Leefink^a, I. A. Bikker^{a,b}, I. M. H. Vliegen^c and R. J. Boucherie^a

^aCenter for Healthcare Operations Improvement and Research, University of Twente, Enschede, Netherlands; ^bDepartment of Healthcare Logistics, Sint Maartenskliniek, Nijmegen, Netherlands; ^cDepartment of Industrial Engineering & Innovation Sciences, Eindhoven University of Technology, Eindhoven, Netherlands

- Benefits:
 - Standardization
 - Teamwork
 - Communication
 - Access
 - Satisfaction
 - Outcomes/QOL
 - Cost-effectiveness

Open Access

Research

BMJ Open Elements of integrated care approaches for older people: a review of reviews

Andrew M Briggs,^{1,2} Pim P Valentijn,^{3,4,5} Jotheeswaran A Thiyagarajan,¹
Islene Araujo de Carvalho¹

Stroke Multidisciplinary Care

Journal of Multidisciplinary Healthcare

Dovepress

open access to scientific and medical research

 Open Access Full Text Article

ORIGINAL RESEARCH

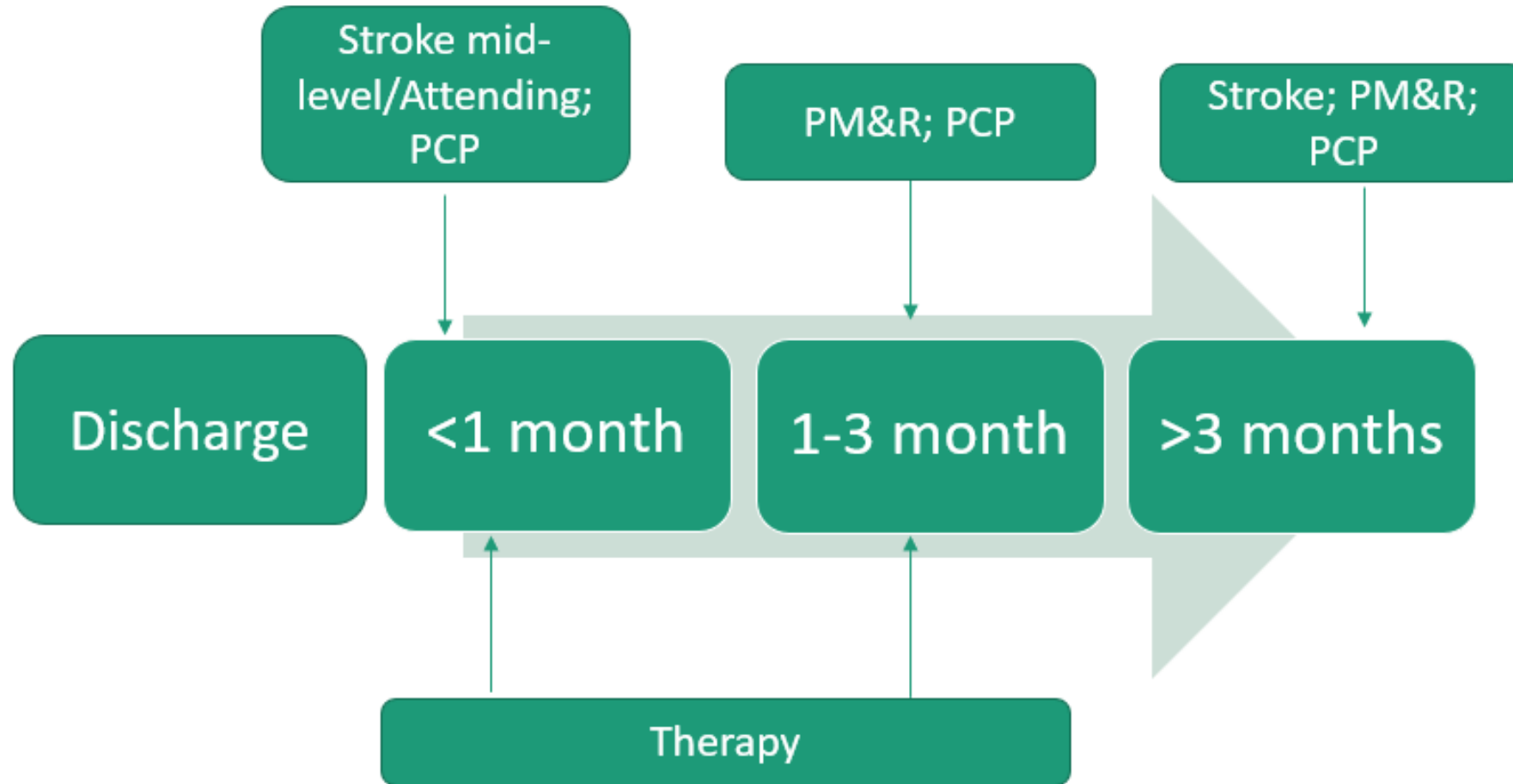
A multidisciplinary stroke clinic for outpatient care of veterans with cerebrovascular disease

Stroke mortality improving; patients living longer with disability and risk of further stroke

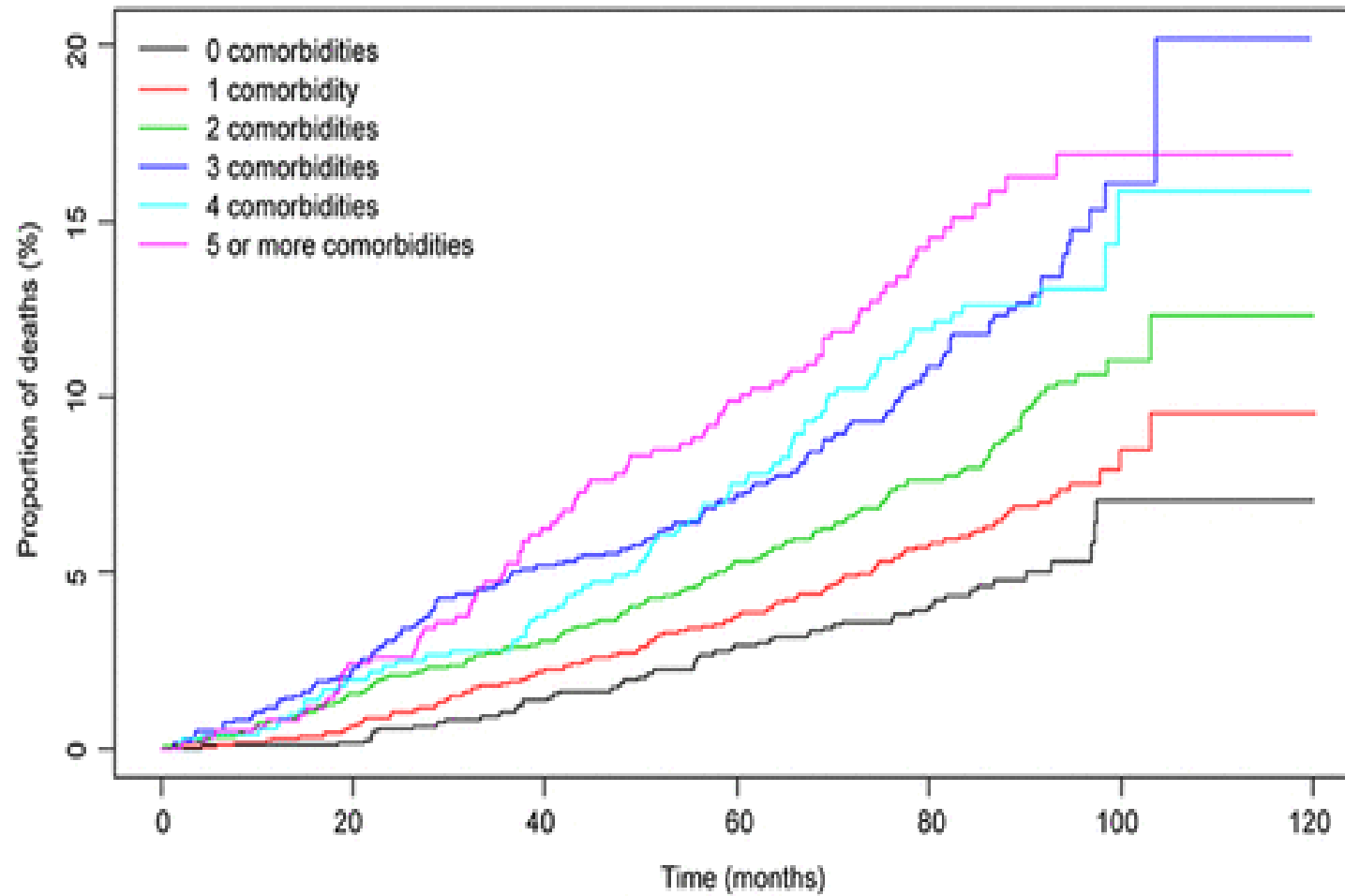
Integrated care in other countries

Pilot clinics in the US i.e. VA

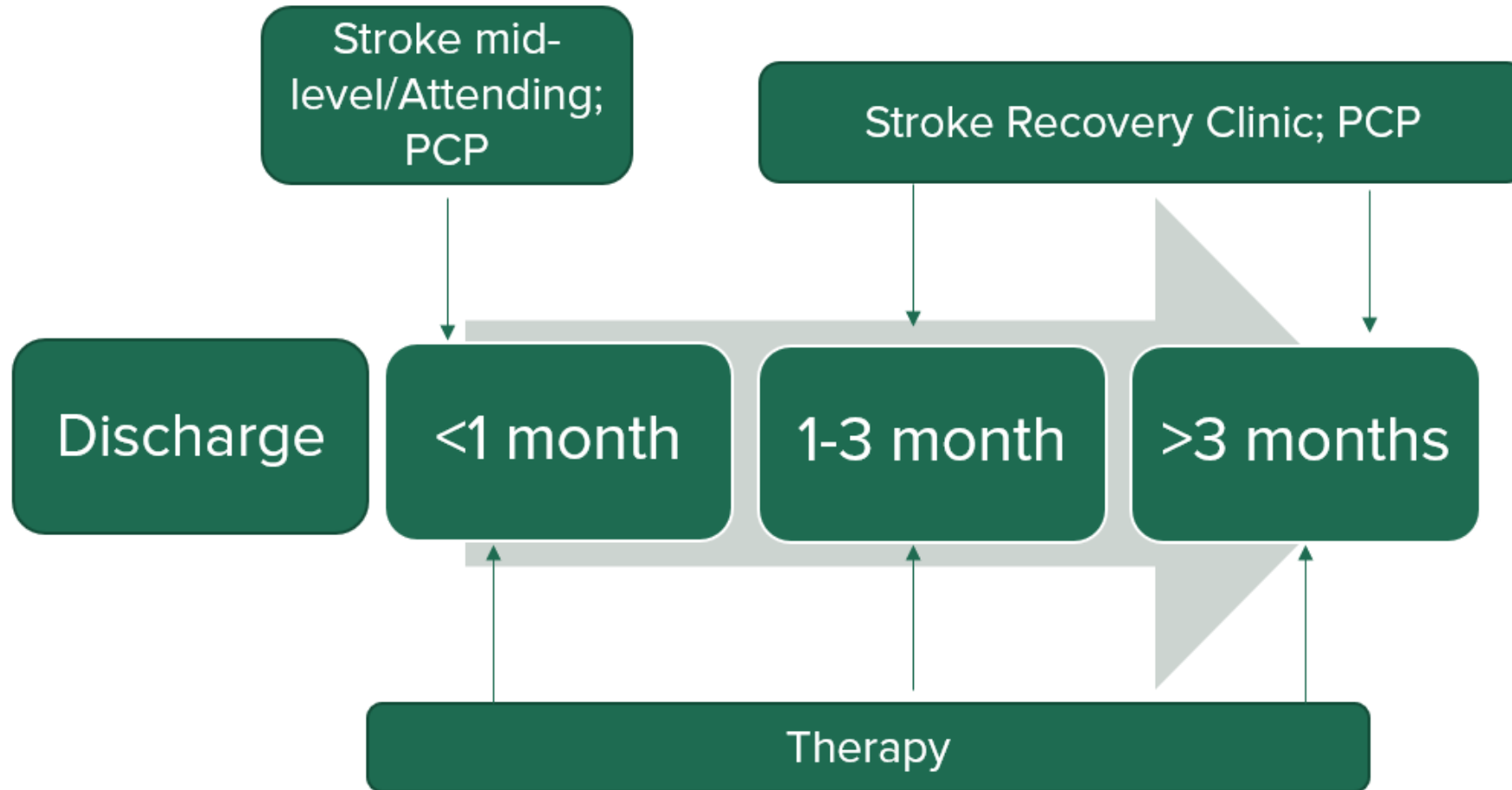
Traditional outpatient models



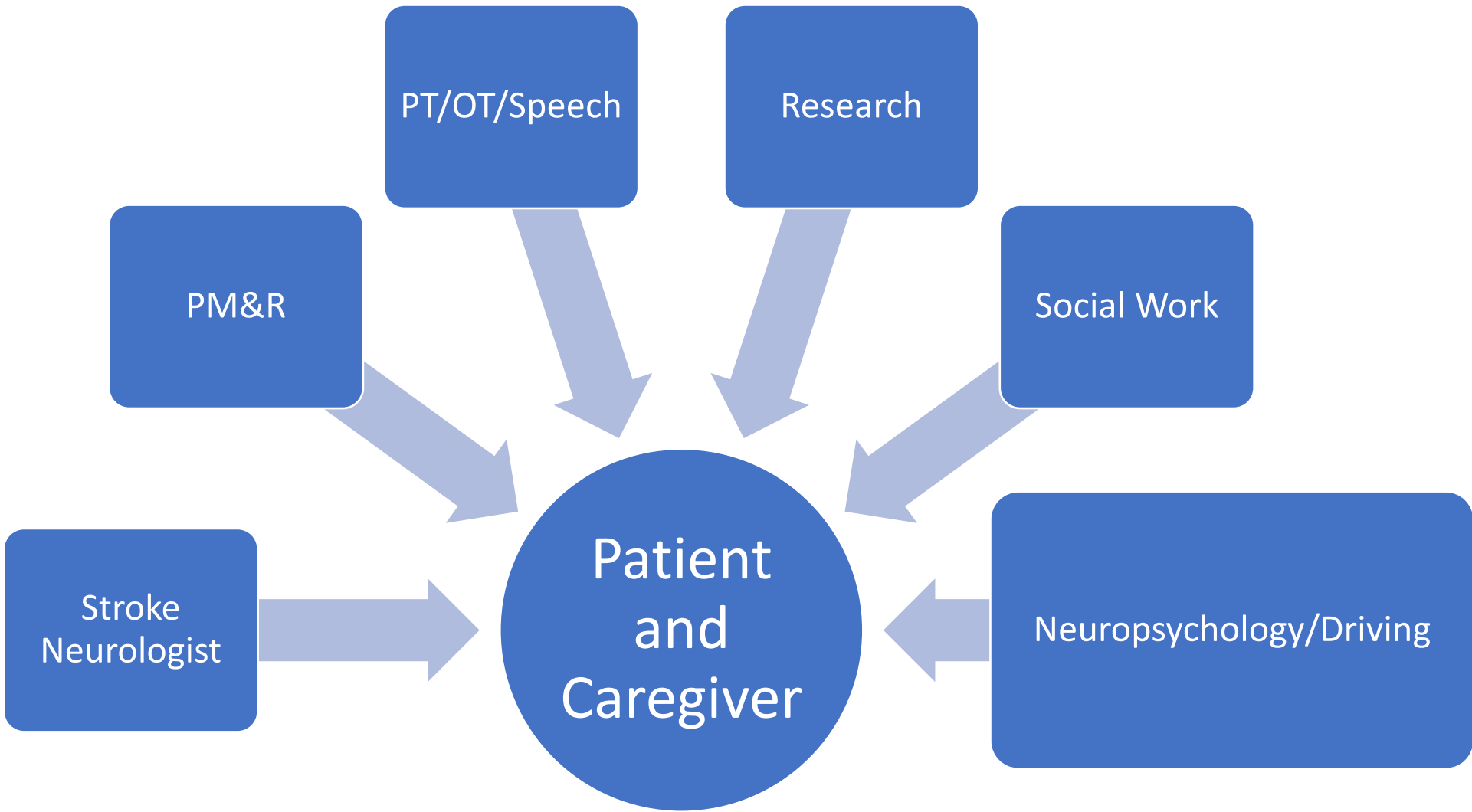
Why focus on the post-acute period?



With Stroke Recovery Clinic



Stroke Recovery Model



UAB Stroke Recovery Clinic

HEALTH & MEDICINE

New UAB Medicine stroke rehab clinic offers unique one-stop shopping

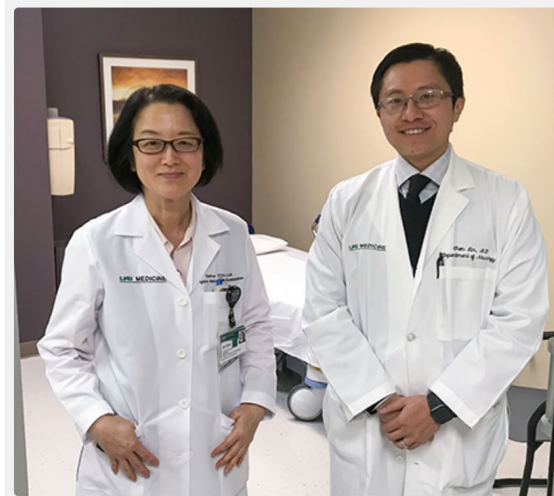
by Bob Shepard

January 30, 2019 | Print | Email

The new [UAB Medicine Stroke Recovery Clinic](#) at the [University of Alabama at Birmingham](#) will provide a unique opportunity for those recovering from a stroke to wrap the entire outpatient experience into one package. The multidisciplinary clinic offers the combined expertise of stroke neurologists with rehabilitation physicians and therapists so patients can have all their medical and rehabilitation needs met at one time in one place. The combination clinic is one of only a very few across the country and the only one of its type in the Southeast.

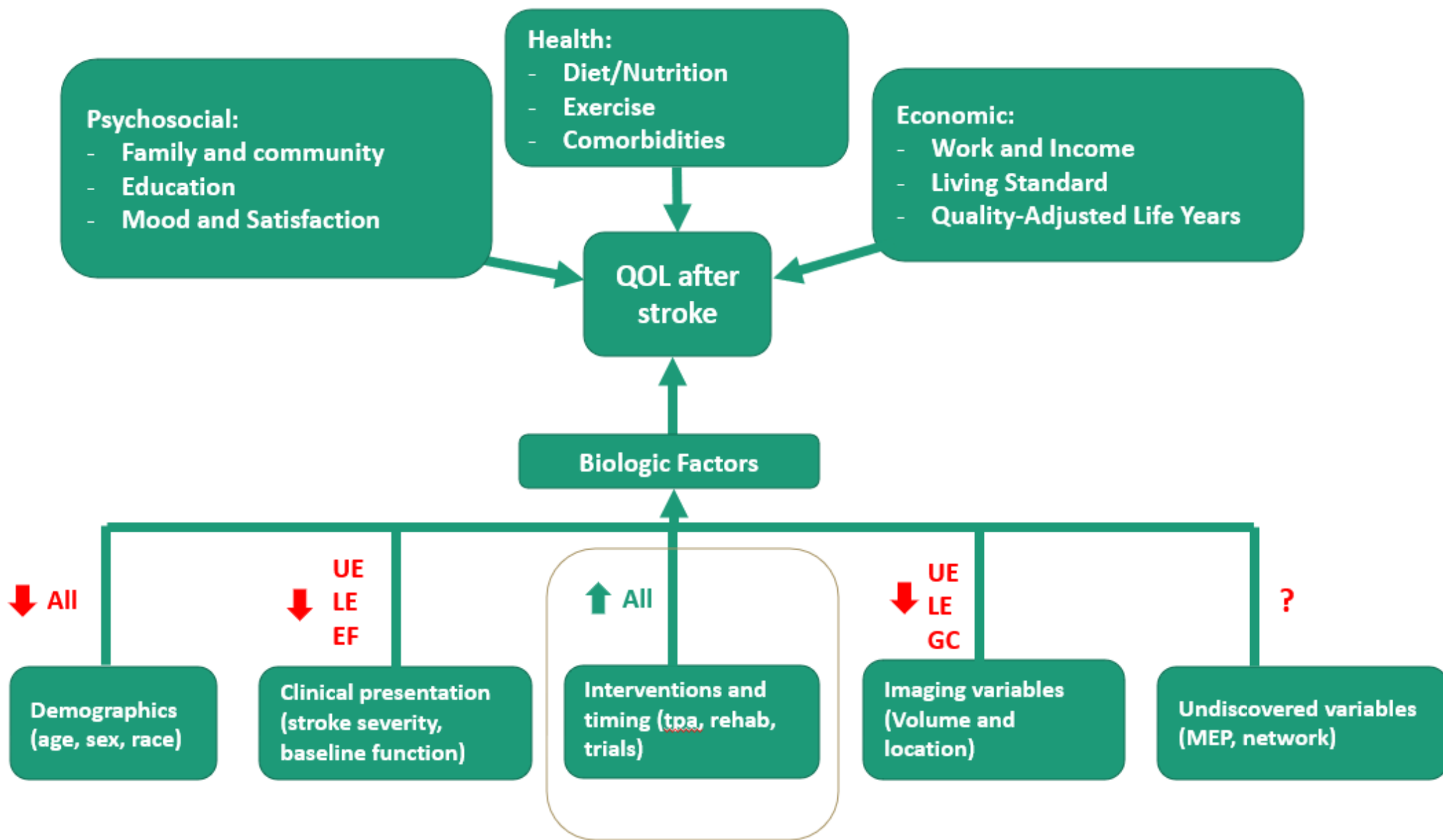
"Alabama is in the heart of the stroke belt, the region throughout the Southeast with the highest incidence of stroke in the nation," said Chen Lin, M.D., assistant professor in the [UAB Department of Neurology](#) in the [School of Medicine](#). "Only a fraction of stroke survivors

receive any rehabilitation after leaving the hospital. The Stroke Recovery Clinic encompasses the two medical disciplines most involved with treating stroke: the Department of Neurology and the Department of Physical Medicine and Rehabilitation."

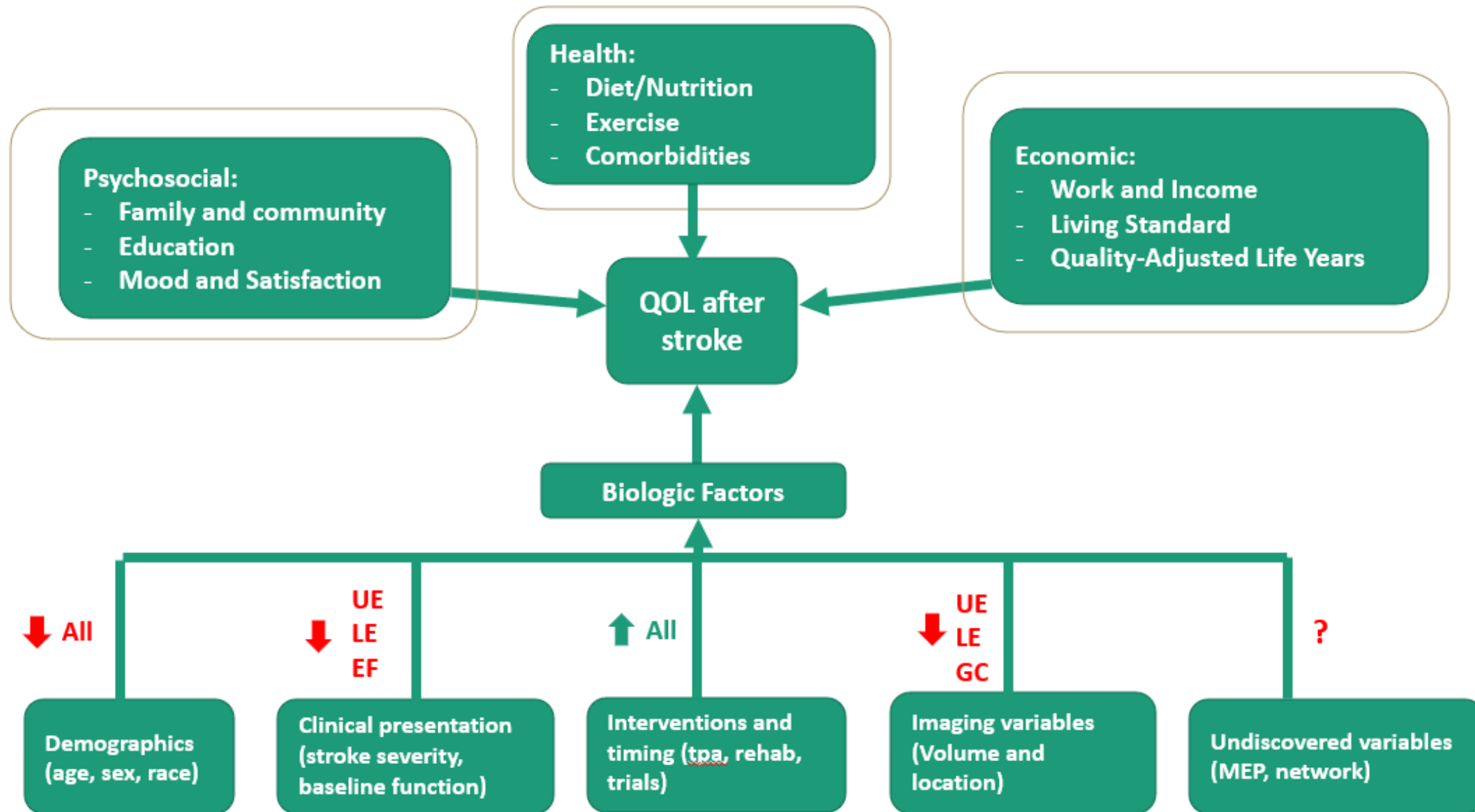


Xiaohua Zhou, M.D., and Chen Lin, M.D.

HRQOL Model in the hospital





HRQOL Model in Clinic

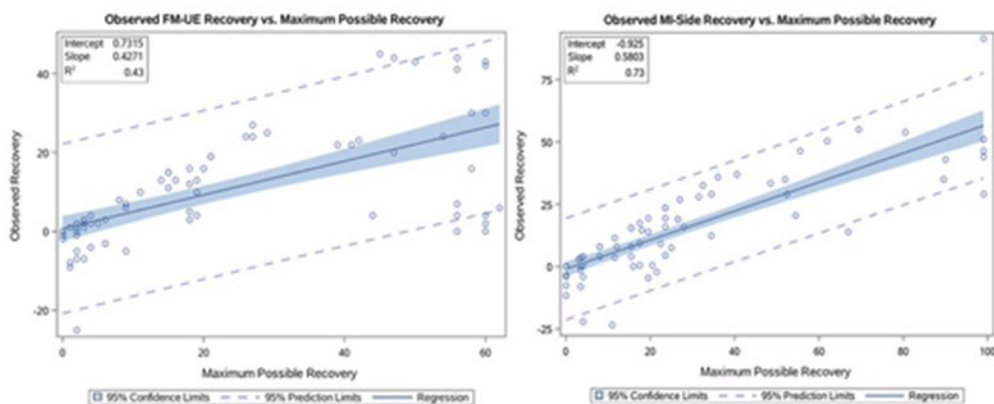




BRIEF REPORTS

Association of Proportional Recovery After Stroke With Health-Related Quality of Life

Chen Lin, MD , Kimberly Martin, PhD , Yurany A. Arevalo, MD, Richard L. Harvey, MD, and Shyam Prabhakaran, MD, MS



Failure to meet the proportional recovery thresholds for the Fugl-Meyer Upper Extremity and Motricity Index measures were not associated with impairment in health-related quality of life. Patients can maintain un-impaired quality of life despite not meeting expected proportional recovery thresholds.

If a patient falls in the woods...

Is it a bad outcome?

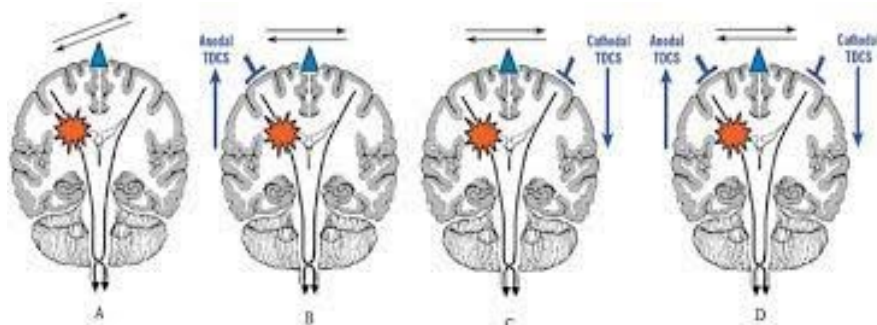
-What is a good outcome?



Research and new findings


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TRANSPORT2



Future Directions

- Better Integration of telehealth
- Continued longitudinal understanding of stroke recovery and HRQOL
- Multimodal intervention studies with the clinic:
 - repetitive reinforcement
 - focusing on appropriate outcome measure
 - neuromodulation
- Treating comorbidities to improve stroke outcomes:
 - pain, mental health, cognition, sleep, etc.

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Muhammad Mansour

...and many others

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