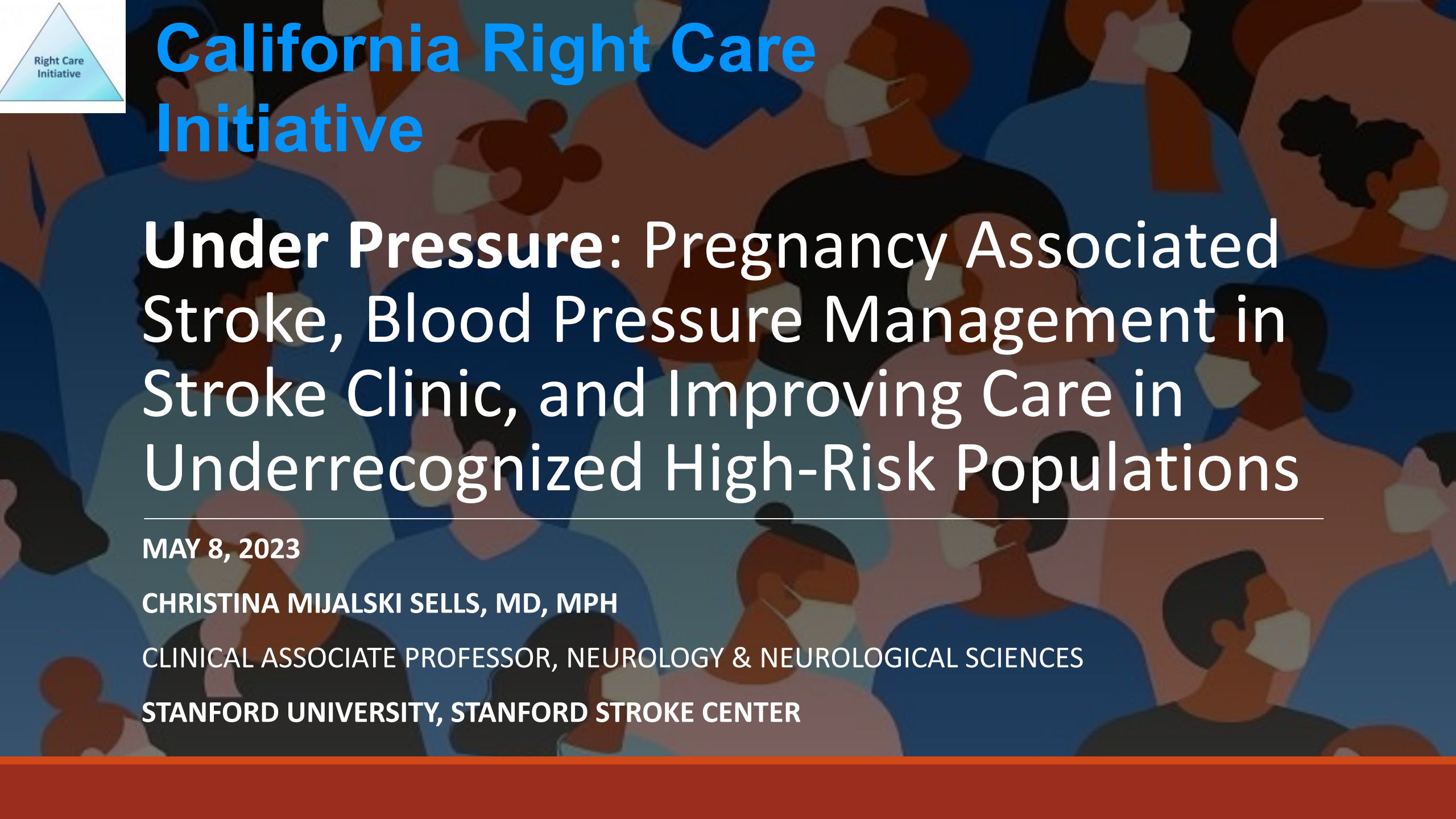


California Right Care Initiative

Under Pressure: Pregnancy Associated Stroke, Blood Pressure Management in Stroke Clinic, and Improving Care in Underrecognized High-Risk Populations

MAY 8, 2023

CHRISTINA MIJALSKI SELLS, MD, MPH

CLINICAL ASSOCIATE PROFESSOR, NEUROLOGY & NEUROLOGICAL SCIENCES

STANFORD UNIVERSITY, STANFORD STROKE CENTER

Disclosures

Stanford Health Care Health Equity & Diversity, Equity, and Inclusion (DEI) Research Grant. “Improving Blood Pressure Control in Stroke Patients by Increasing Access to a Home Blood Pressure Monitoring”.

No additional funding or affiliations

Stanford HEALTH CARE

Topics

1) Age and sex incidence of stroke

2) Risk factors and mechanisms of stroke during pregnancy and peripartum

3) Long-term effects of stroke during pregnancy, data review

4) Hypertension and stroke

5) Improving BP control in the Stroke Clinic

6) Improving timely access to neurological care in pregnant and peripartum patients

7) Discussion

Stanford HEALTH CARE

Epidemiology

Sex and age influence stroke diagnoses in the United States

- 20-59 years: Similar prevalence of stroke between men and women
- 60-79 years: Higher prevalence of stroke among men
- 80 years and older: Higher prevalence of stroke among women

Race and ethnicity are significant predictors of stroke incidence and outcomes within gender groups

- Socioeconomic status

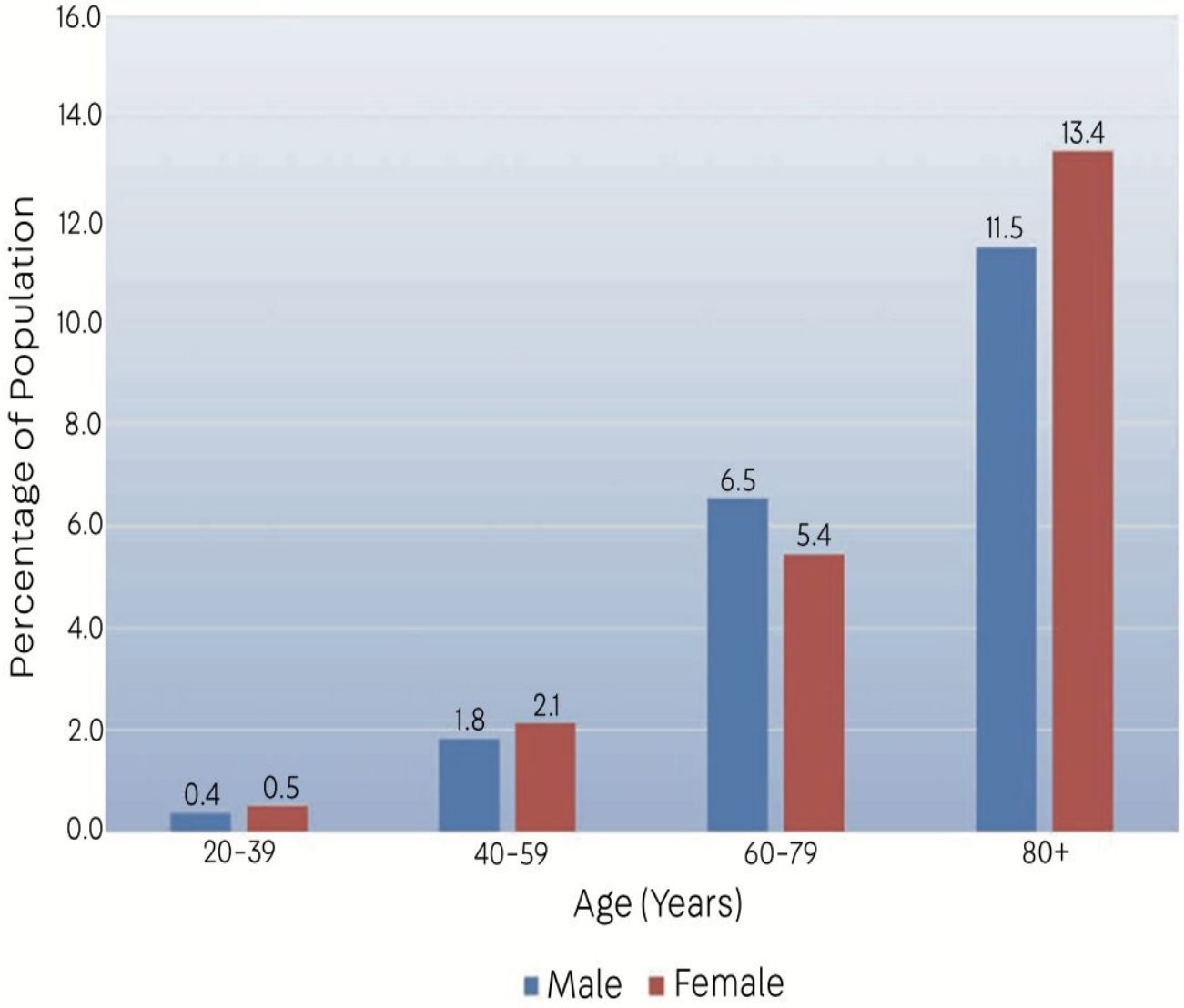


FIGURE 7-1

Prevalence of stroke by age and sex.

Reprinted with permission from Benjamin EJ, et al, Circulation.[2] © 2019 American Heart Association, Inc.

Figure 7.1. CONTINUUM (MINNEAP MINN) 2020;26(2, CEREBROVASCULAR DISEASE):363–385.

Stanford HEALTH CARE

Sex and Gender differences in stroke

Reproductive and hormonal factors affect stroke risk and incidence in women

- **Pregnancy**, contraception and, hormonal replacement therapy after menopause, hormone therapy in gender affirming treatment, IVF treatment

Presenting symptoms of stroke may vary between women and men

- Women are older, live alone, have increased comorbidities (age effect).*

Treatment of stroke and risk factors differ between men and women

- Women less likely to be treated with thrombolysis, anticoagulation for atrial fibrillation

Stroke outcomes are influenced by age, pre-stroke functional s comorbidities

- Severity, Functional status, Mortality

Stanford HEALTH CARE

Pregnancy

Risk of stroke increases 3-times during pregnancy and the postpartum period, approximately 30/100,000 [9]

- Ischemic stroke, hemorrhagic stroke, cerebral venous sinus thrombosis

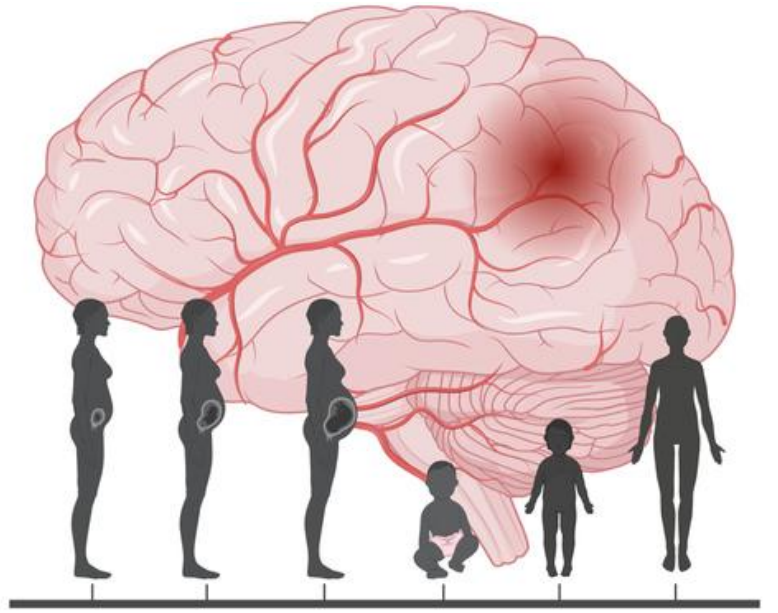
Risk factors Ischemic stroke, hemorrhagic stroke, cerebral venous sinus thrombosis

- Age >35
- Eclampsia/pre-eclampsia (Hypertensive disorders of pregnancy)
- Smoking
- C-section
- **Migraine with aura*

Figure 7.1. CONTINUUM (MINNEAP MINN) 2020;26(2, CEREBROVASCULAR DISEASE):363–385.

Stanford HEALTH CARE

Mechanisms of PAS



Gestational weight gain and birth weight predict increased cerebrovascular disease risk of the offspring

Hypertensive disorders of pregnancy

- Eclampsia, Pre-eclampsia, PRES and RCVS

Cardioembolism

- PFO, pulmonary shunt
- Cardiac disease or pregnancy-associated cardiomyopathy

Cervical artery dissection

- >5 times increased risk, also increased risk of partner violence
- Associated with hypertensive disorders pregnancy (50%), RCVS, PRES

Other

- Hypercoagulability, Cerebral venous thrombosis (1/3 PAS, 75% postpartum)
- Vasculopathy: Moyamoya, PRES, RCVS

1) *Li et al. Thrombotic therapy for ischemic stroke secondary to paradoxical embolism in pregnancy. Neurologist 2012, 18(1):44-48*
2) *Mitchell et al. RCVS and bilateral vertebral artery dissection presenting in a patient after cesarian section. J Neurointerv Surg 2014 ; 6(1):e5*
3) *Salehi et al. Association between pregnancy amd cervical artery dissection. Ann Neurol 2020 88(3) 596-602*

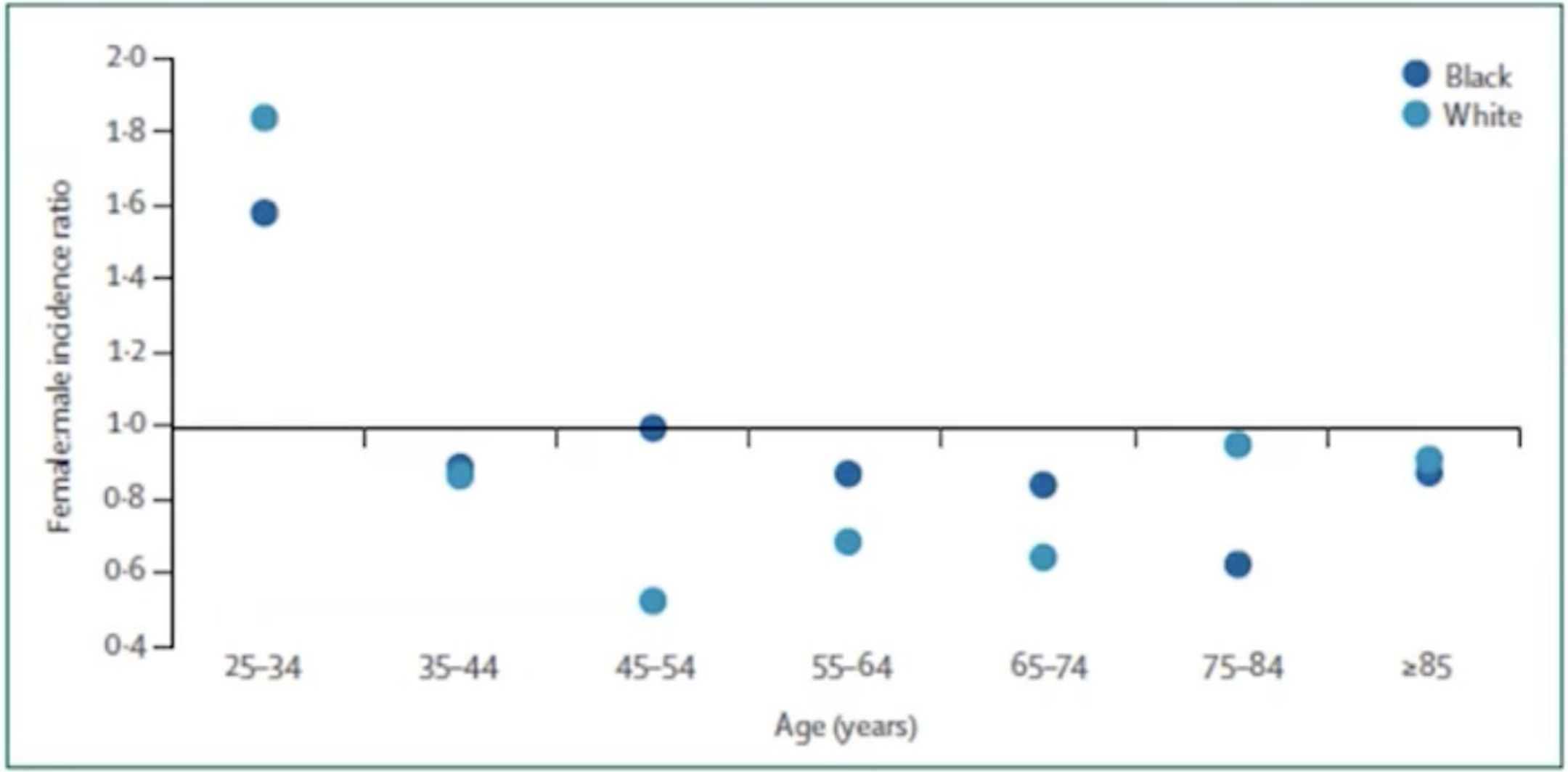


***Figure 3*: Female:male incidence ratios for stroke by age**
Data from the Greater Cincinnati–Northern Kentucky Stroke Study.[4]

MASSACHUSETTS GENERAL HOSPITAL
INSTITUTE FOR HEART, VASCULAR AND STROKE CARE

Go AS et al. Circulation 2013; 127:e6-e245;; Reeves MJ at al, Lancet Neurology 2008; 7:915-26

Age at Menses

There is a U-shaped curve between age at onset of menarche and incidence of stroke:

- UK study: women 60 and 64 years of age [4]
- Onset at 10 years or younger increases future risk of stroke by about 25%
- Onset at 17 years + increases lifetime RR
- Strongest trend in CAD and Hypertension

Associations:

- Lower SES is associated with earlier onset of menarche
- Childhood obesity: SES, increased and longer duration of estradiol exposure [5, 6]

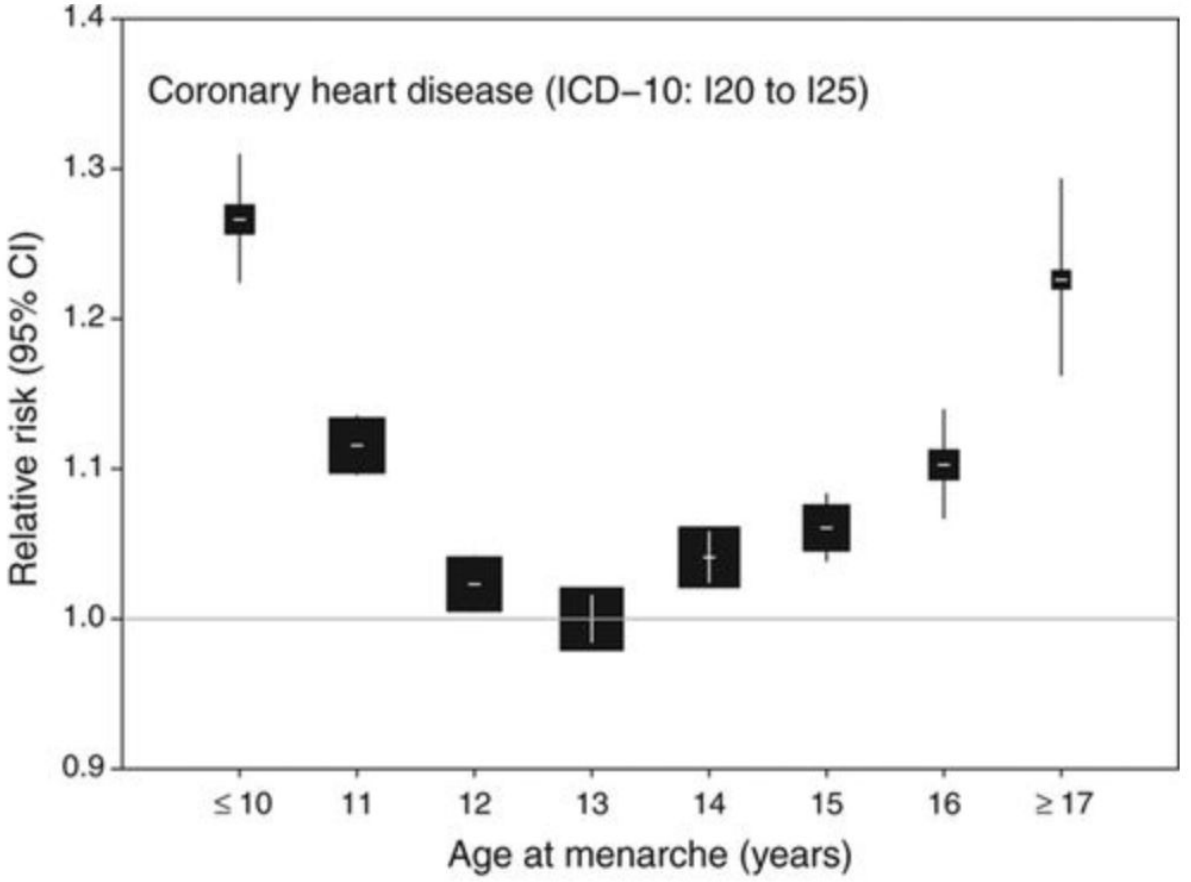


Figure 7.1. CONTINUUM (MINNEAP MINN) 2020;26(2, CEREBROVASCULAR DISEASE):363–385.

Table of Contents

February 2023 - Volume 54, Issue 2

☐ Mark all

Jump to

Editorial Board Masthead

☐ 🔓 **Editors and Editorial Board**

Stroke. 2023 | Volume 54, Issue 2: 291–293, originally published January 23, 2023,
https://doi.org/10.1161/STR.0000000000000425

PDF/EPUB | Export Citations

Stroke: Highlights of Selected Articles

☐ 🔓 **February 2023 *Stroke* Highlights**

Stroke. 2023 | Volume 54, Issue 2: 294, originally published January 23, 2023,
https://doi.org/10.1161/STROKEAHA.122.042150

PDF/EPUB | Export Citations

Go Red for Women

☐  🔓 **Investigation on Gender Differences in Leadership of Stroke-Related Clinical Trials**

Bharat Rawlley, Sarah Marchina, Stefanie P. Cappucci, Bhanu Gogia, Jia-Yi Wang,

This Issue

February 2023
Vol 54, Issue 2

Previous | Next

Stanford HEALTH CARE

Sex-related Disparities in Stroke

1. Women and Leadership of stroke clinical trials
2. Sex differences in Onset and Progression of CAA
3. Sex differences in Carotid Atherosclerosis: A systematic Review and Meta-analysis
4. Sex-related differences in Outcomes of Endovascular Treatment for Anterior Circulation LVO
5. **Maternal Health Outcomes after Pregnancy-Related Stroke: A Population-based Study with 19 Years of Follow-up.**
6. Post-stroke Disability: Association Between Sex and Patient-Reported Outcomes
7. Worst Stroke Outcomes in a Model of Pre-eclampsia is associated with Poor Collateral Flow and Oxidative Stress
8. Sex Differences in Capillary Reperfusion After Transient Middle Cerebral Artery Therapy Occlusion in Diabetic Mice

Stanford HEALTH CARE

Maternal Health Outcomes After PAS

Few publications, most focus on subsequent pregnancy outcomes

- Stroke recurrence during pregnancy is low, ~ 2-3%

"Maternal Health Outcomes after PAS: A Population-based 19-years of Follow-up" (*Stroke.* 2023;54:337–344).

Retrospective Cohort, Pregnant adults ≤ 49 years with a stroke:

- 1) Pregnant patients with and without stroke
- 2) Pregnant stroke patients compared to non-pregnant stroke patients

Comparison 1 (Preg with and w/o stroke):

Outcome	Preg with stroke (217)	Preg w/o stroke (1,296,256)
Hypertensive d/o of pregnancy	12% ↑	2.5%
Multiparous	↑	
Readmission or death	41.6%	17.3%
Vascular event readmission	3%	None

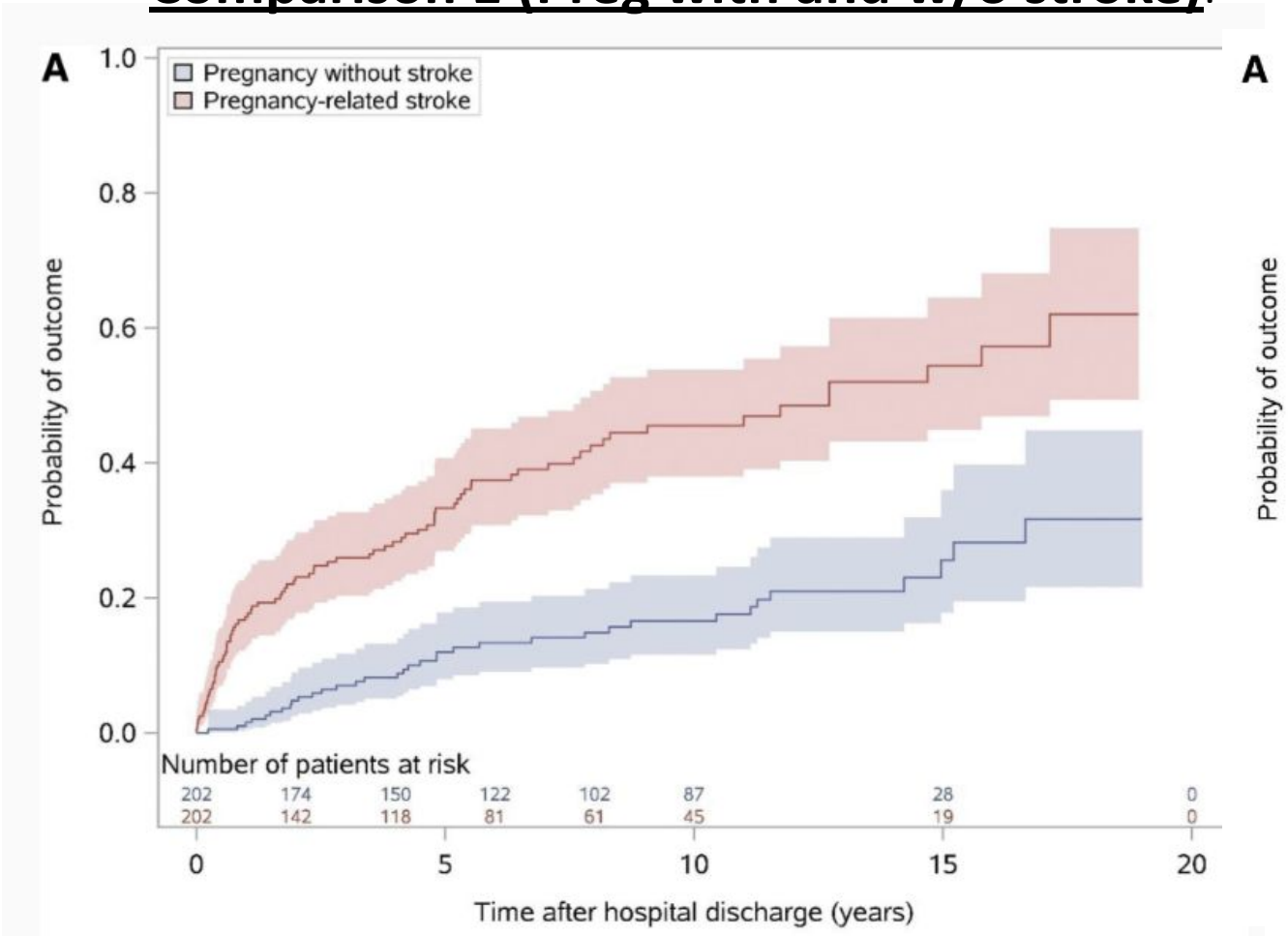
Comparison 2: (Stroke with and w/o pregnancy):

Outcome	Preg with stroke (217)	Non-preg with stroke (7,604)
tPA	<5 pts	17%
Endovascular therapy	0	12%
Age	32	42
CVST	33.2 % ↑	5.4%
Hypertensive d/o of pregnancy	12% ↑	2.7%

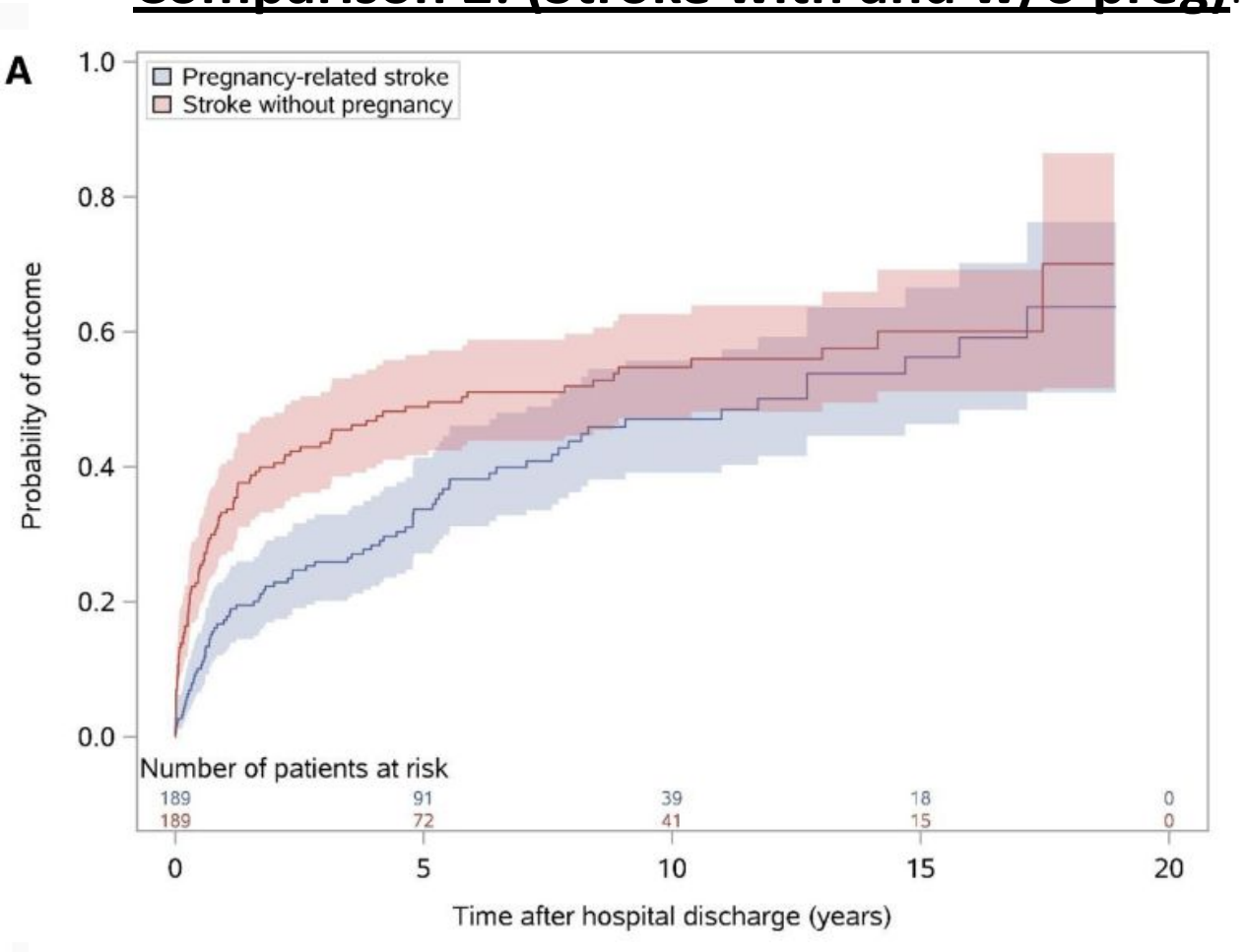
Stroke. 2023;54:337–344

Stanford HEALTH CARE

Comparison 1 (Preg with and w/o stroke):



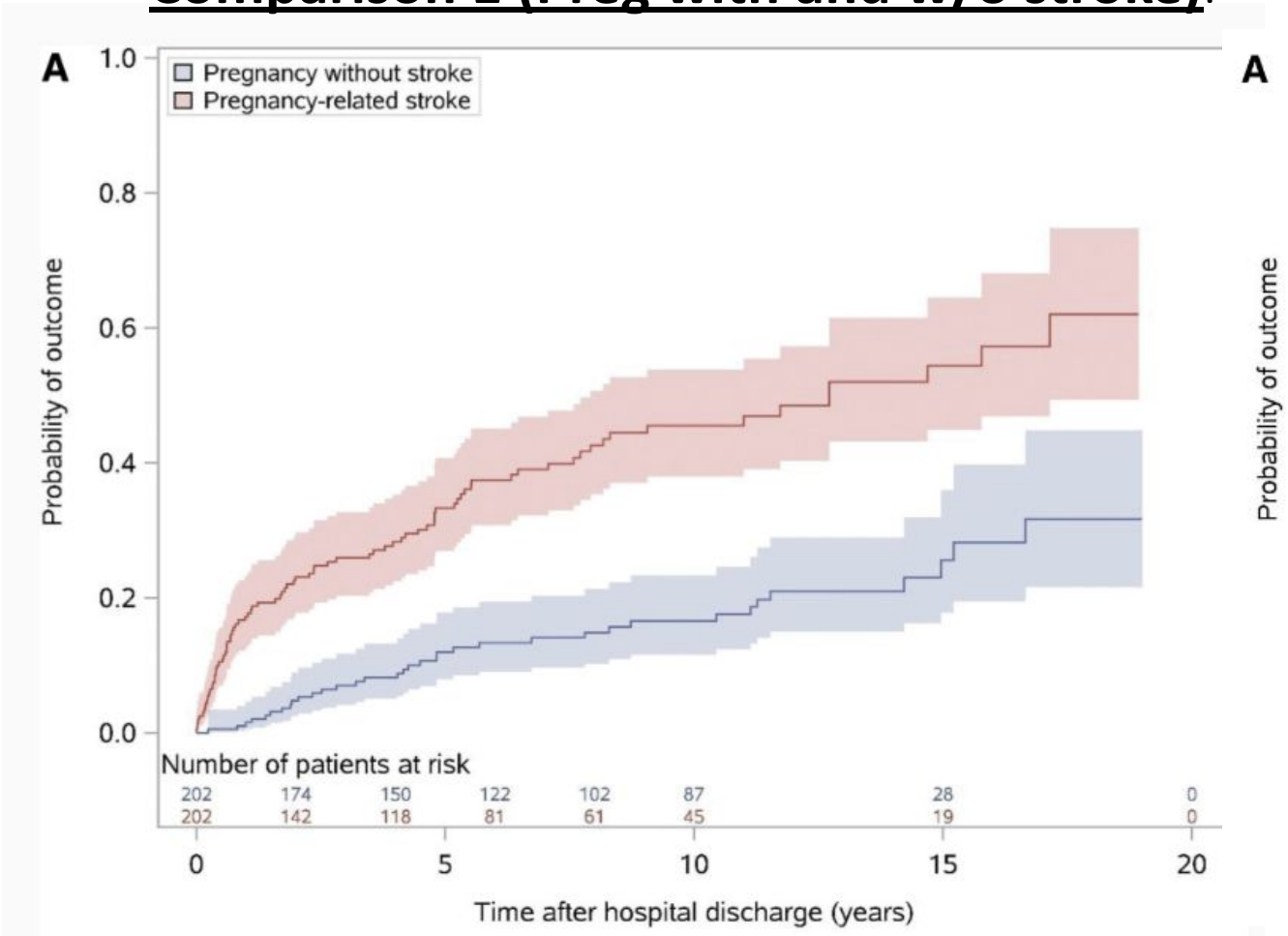
Comparison 2: (Stroke with and w/o preg):



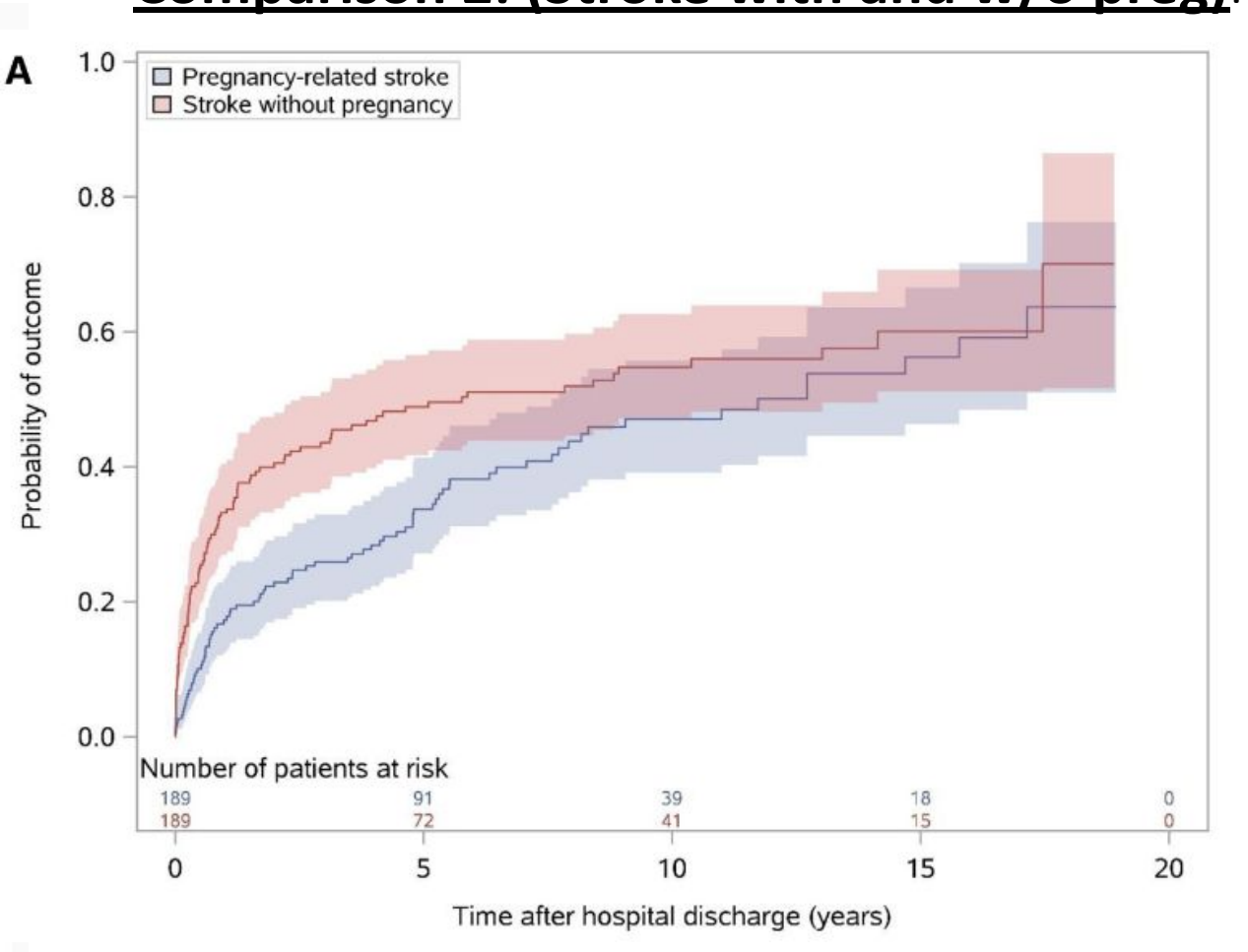
Stroke. 2023;54:337–344

Stanford HEALTH CARE

Comparison 1 (Preg with and w/o stroke):



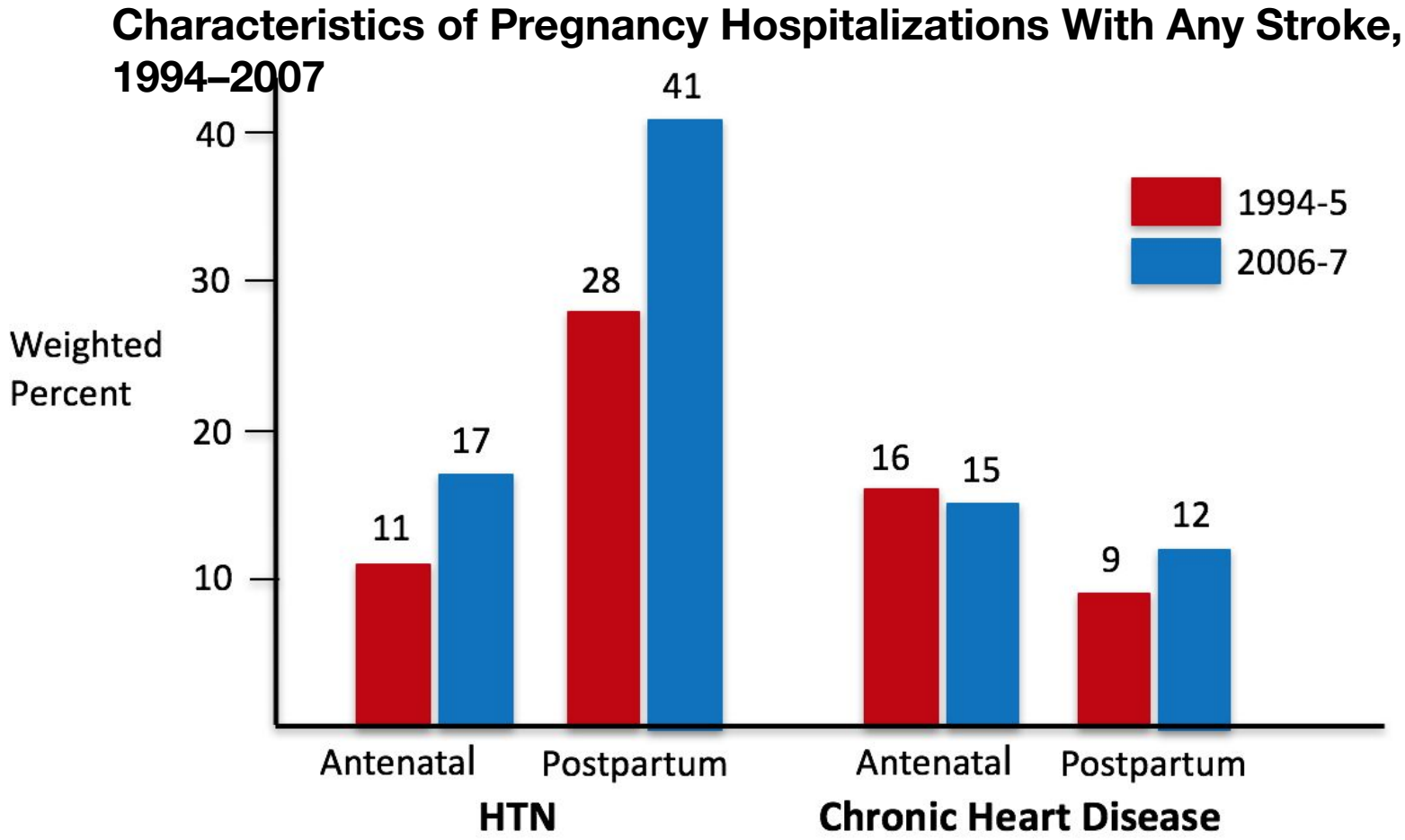
Comparison 2: (Stroke with and w/o preg):



Stroke. 2023;54:337–344

Stanford HEALTH CARE

Increase in PAS Follows HTN, CHD Rates



Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality

Stroke 2011;42:2564

Stanford HEALTH CARE

Dx: Pre-eclampsia

*__2014 ACOG guidelines__ even in the absence of proteinuria, a diagnosis of preeclampsia may be made if the patient has:

BP ≥ 140/90 +

1. Thrombocytopenia
2. Impaired Renal Function
3. Impaired Liver Function
4. Pulmonary Edema
5. Cerebral or Visual symptoms

Mild Preeclampsia	Severe Preeclampsia
BP ≥ 140/90 mm Hg after 20 weeks' gestation	BP ≥ 160/110 mm Hg
Proteinuria (300 mg/24 hr or 1+ result on dipstick specimen)	Proteinuria > 5 g/24 hr
	Elevated serum creatinine
	Pulmonary edema
	Oliguria
	Intrauterine growth restriction
	Headache
	Visual disturbances
	Epigastric or right upper quadrant pain
	Signs of HELLP syndrome

Pre-eclampsia with severe features

Poor predictive models for who will be affected

Stanford HEALTH CARE

Contraception and HRT

There is up to 2-times increased risk of stroke in women taking <u>ESTROGEN-containing</u> oral contraceptives [7]

- **Dose-dependent** relationship to estrogen, 1.7-2.0 x greater risk vs. non-users
- <u>Should be avoided</u> in women with history of any stroke (including pregnancy)
- <u>Physiologic</u> levels of estrogen can decrease activity of pro-inflammatory pathways
  - Decreases clot formation and endothelial damage

Figure 7.1. CONTINUUM (MINNEAP MINN) 2020;26(2, CEREBROVASCULAR DISEASE):363–385.

Migraine with Aura

- Associated with a 15-fold increased risk of stroke during pregnancy, also associated with Pre-eclampsia
- Endothelial dysfunction hypercoagulability is a well-established consequence
  - **PFO, dissections**

Stroke risk

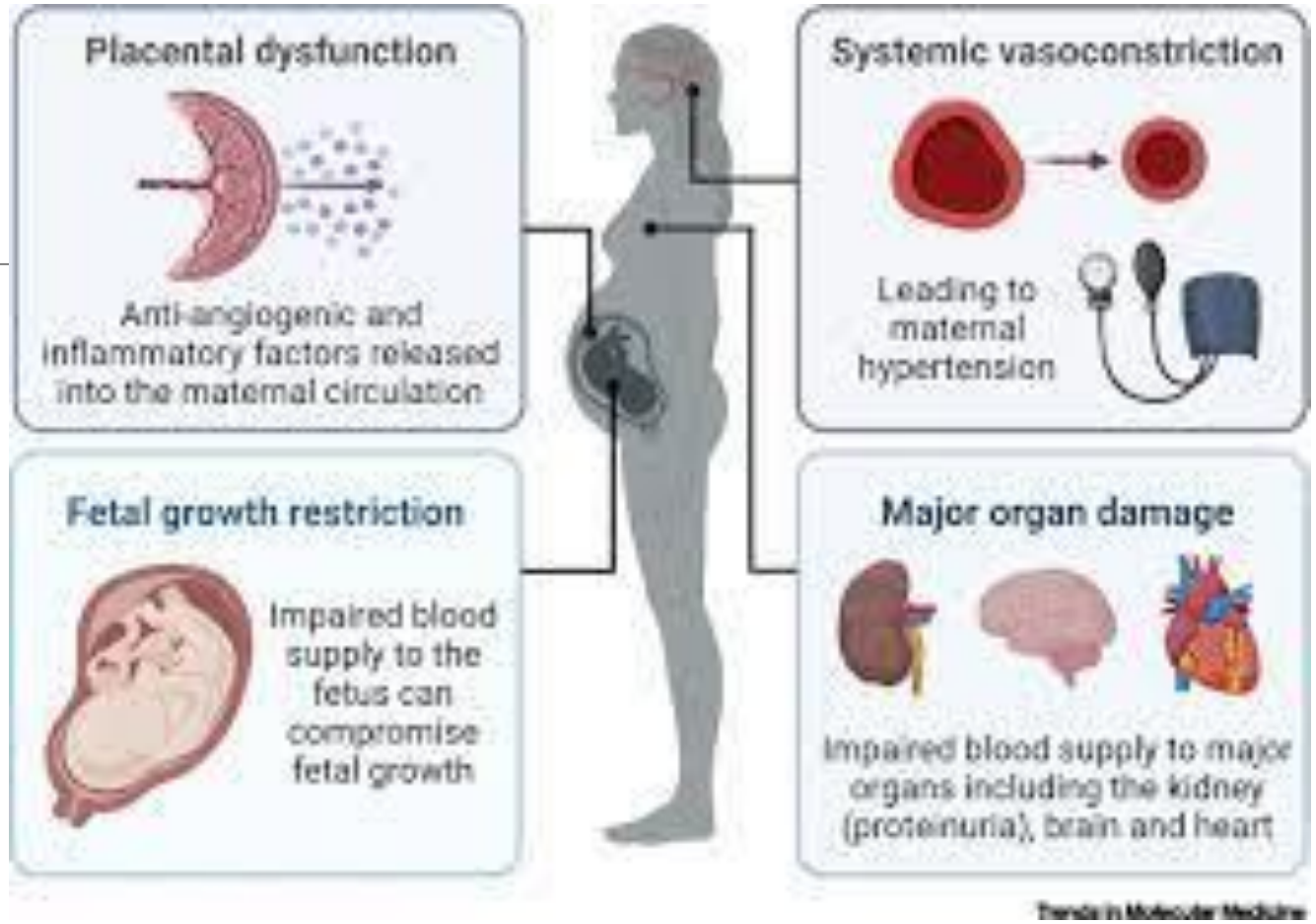
- OR ~ 2.5 for ischemic stroke
- OR ~2.25 for hemorrhagic stroke
- Migraine with aura + OCP: OR 7.2
- Migraine with aura + smoking: OR 9.03

Tietjen GE, Herial NA, White L, Utley C, Kosmyna JM, Khuder SA. Migraine and biomarkers of endothelial activation in young women. *Stroke*. 2009;*40*:2977–2982

Stanford HEALTH CARE

Tx: Pre-eclampsia

- **Low dose ASA 81 mg decreases Pre-eclampsia by 10-20%**
  - 2019 Cochrane review Meta-analysis, RR = 0.82
- Treatment is delivery, depending on gestational age
- Acute features usually resolve within 48 hours post partum
- Hypertension can worsen in the 1-2 weeks after delivery



Stanford HEALTH CARE

Prevention and Treatment of PAS

Prevention:

- Consider aspirin 81 mg in high-risk patients (Hypertensive disorders, ?migraine)
- Recognize, treat and monitor hypertensive disorders of pregnancy closely

Treatment of ischemic stroke:

- Risk of **withholding therapies**
- Thrombolysis and endovascular therapy (*should*) be considered in pregnancy [13]

Secondary prevention:

- Comprehensive work-up, testing, cardiac screening (blood tests, imaging, consultations) **close postpartum follow-up**
- Identification and control of risk factors, treatment of underlying disease
- Antithrombotic therapy

Figure 7.1. CONTINUUM (MINNEAP MINN) 2020;26(2, CEREBROVASCULAR DISEASE):363–385.

Stanford HEALTH CARE

Thrombolysis in pregnancy

Powers et al – 2018 Guidelines for Management of Acute Ischemic Stroke

Pregnancy	**_IV alteplase_ administration _may be considered_ in pregnancy when the anticipated benefits of treating moderate or severe stroke outweigh the anticipated increased risks of uterine bleeding.† (Class IIb; LOE C-LD)‡**

- Weak evidence (IIb)
- Limited data (C-LD)

Stanford HEALTH CARE

Pregnancy and tPA

1) Animal studies have shown no teratogenicity

2) tPA does not cross the placenta because of its **large molecular size**

3) Risk of fetal hemorrhage is low, BUT placental hemorrhage can result in miscarriage or stillbirth.

4) (Leonhardt) Retrospective analysis of 28 cases of IV tPA for various indications to treat women during pregnancy. Indications included stroke (10/28), cardiac valve thrombosis (7/28), PE (7/28), DVT (3/28), and MI (1/28).

- **Complications of thrombolysis for the specified indications did not exceed what was expected for non-pregnant patients.**
- Increased elective terminations in critical illness

Leonhardt G, Gaul C, Nietsch HH, Buerke M, Schleussner E. Thrombolytic therapy in pregnancy. J Thrombolysis 2006;21(03):271–276

Stanford HEALTH CARE

TNK vs. tPA in pregnancy

1. tPA and TNK have a similar molecular weight (59 kD) and should not cross the placenta.
2. (TNK) “Drug has been shown to elicit maternal and embryo toxicity in rabbits given multiple IV administrations; subsequent embryonic deaths were secondary to maternal hemorrhage and no fetal anomalies were observed”
3. Studies of thrombolysis in pregnancy
   - Most data in tPA and streptokinase, few cases of TNK → good outcome
4. Conclusion: Likely as safe, continue to follow data

Table 2. Molecular weights of thrombolytic agents.[23]

Thrombolytic agent	Molecular weight (Da)
Alteplase (rtPA)	59042.3
Urokinase	31126.5
Streptokinase	47286.7
Tenecteplase	58951.2
Reteplase	39589.6

Da: Daltons; rtPA: recombinant tissue plasminogen activator.

1) Gomes et al. Thrombolysis in pregnancy: a literature review, The Journal of Maternal-Fetal & Neonatal Medicine, 2019. 32:14, 2418-2428
2) Gartman. The use of thrombolytic therapy in pregnancy, 2013. Obstetric Medicine 6(3) 105–111

Stanford HEALTH CARE

Opportunities to improve care

1) Improve recognition of high-risk patients and treatment of stroke (and hypertensive disorders of pregnancy) during pregnancy and peripartum
   - **Acute stroke care: Obstetric Stroke Code**
2) Facilitate close follow-up of high-risk pregnant and peripartum stroke patients in the outpatient setting
   - **Mitigating risk: Neuro-obstetric/Women's neurology Clinic**
3) Improve overall control of BP in the outpatient setting (Stroke Clinic)
   - **QI project: Documentation, recognition □ BPA + pharmacy agreement**
4) Reduce healthcare disparities for monitoring and control of blood at home
   - **SHC DEI Grant for post-stroke admission home BP monitoring**

Obstetric Stroke Code

1) WORKFLOW

- **Few cases, rare event – estimated ~6 each year**
- Inconsistent location and modality of imaging
- Variable plan for post-stroke monitoring

2) EDUCATION

- Lack of familiarity with stroke code in obstetric patients
- Knowledge gap regarding stroke in pregnancy, thrombolysis in pregnancy, and hypertensive disorders of pregnancy
- Missed opportunity in outpatient care

Obstetric Stroke Code Workflow

0-10 min: Activating a stroke code

- Is there a new neurological deficit (severe or sudden headache, sudden-onset weakness, sensory change, vision loss or double vision, speech difficulty, ataxia)?
- Last seen normal within the last 24 hours?

Call 211: Obstetric Stroke Code (include patient age, room/location, MD name, and call back #) to activate.

History and exam:

- Risk factors? (Hypertension, pre-eclampsia/eclampsia, hypercoagulable or bleeding disorder, heart disease, arrhythmia, prior stroke or other cerebrovascular disorder, other vascular disorder, cancer)
- Last seen normal? **(NOT time of symptom onset)**
- On blood thinners?
- NIHSS score, or other description of exam findings?

Adult neurology:

- ❑ Call back within 5 min
- ❑ Bedside eval STAT with NIHSS
- ❑ Coordinate care/orders with primary (OB) team

OB provider/physician (within 10 minutes):

- ❑ Place order for CT angiogram head and neck with contrast (IMG111143)
- ❑ Call the Pediatric Neuroradiology Fellow to confirm scanner location and protocol.
- ❑ Call CT tech to coordinate transport (pgr #28502)

OB RN/other provider:

- ❑ Call OB Rapid Response
- ❑ Place IVs, labs and neuroprotection per orders

10-30 min: Neuroprotection, care coordination, imaging logistics

Adult neurology

- ❑ Oversee workflow - communicate with radiology, anesthesia as needed

Neuroradiology fellow

- ❑ Protocol scan

OB nurse

- ❑ Prepare for transport to CT, provider at bedside

OB provider

- ❑ Place "Pediatric Stroke" order set" after discussing with Neurology
- ❑ Assist with patient stabilization and transport

Unit manager or secretary

- ❑ Notify imaging if services are not needed to release hold on scanners
- ❑ Cancel stroke code as needed

ORDER SET: "PEDIATRIC STROKE"

IMAGING: **ALL TO BE COMPELTED AT **LPCH**, NOT SHC

Default:

- ❑ **STAT CT head/CTA head and neck at LPCH** (hyperacute ischemic stroke, tPA or thrombectomy candidate), will also exclude hemorrhage

Other (secondary discussion after initial imaging, suggested context):

- ❑ **MRI brain, MRA head/neck TOF, no gadolinium** (Ischemic stroke, thrombectomy)
- ❑ **Noncontrast CT head** (suggested for hemorrhage or clinical instability only)

Neuroprotection:

- ❑ NPO, IV placement, Neuro checks q15min
- ❑ If concerned for hemorrhage, HOB at 30 degree. Otherwise, HOB flat.

Labs:

- ❑ INR, PTT, CBC, fibrinogen, CMP

Target time to CT: 30 min Target time to thrombolysis: < 60 minutes

STAT CT/CTA Head and neck in LPCH

Ischemic stroke suspected +/- large vessel occlusion

- ❑ If no hemorrhage → discuss with Neurology resident/fellow and OB attending → order tPA through "Pediatric stroke" order set
- ❑ If tPA administered, Neurology resident/fellow will admit to the NeuroICU in 500P, pending delivery plan (Neurology to place admission orders)
- ❑ If LVO, discuss with OB attending and Neurology resident/fellow → Neuro will escalate to SIR case

Intracranial hemorrhage present on CT

- ❑ Discuss with Neurology resident/fellow and admit to the NeuroICU in 500P (pending delivery plan)
- ❑ Treat hypertension: Goal SBP <140

NUMBERS:

Adult Neurology/Stroke: pager #19988

OB Anesthesia team: (paged via OB Rapid Response)

- Group pager # 47
- Alert Charge RN + page OB anesthesia on call

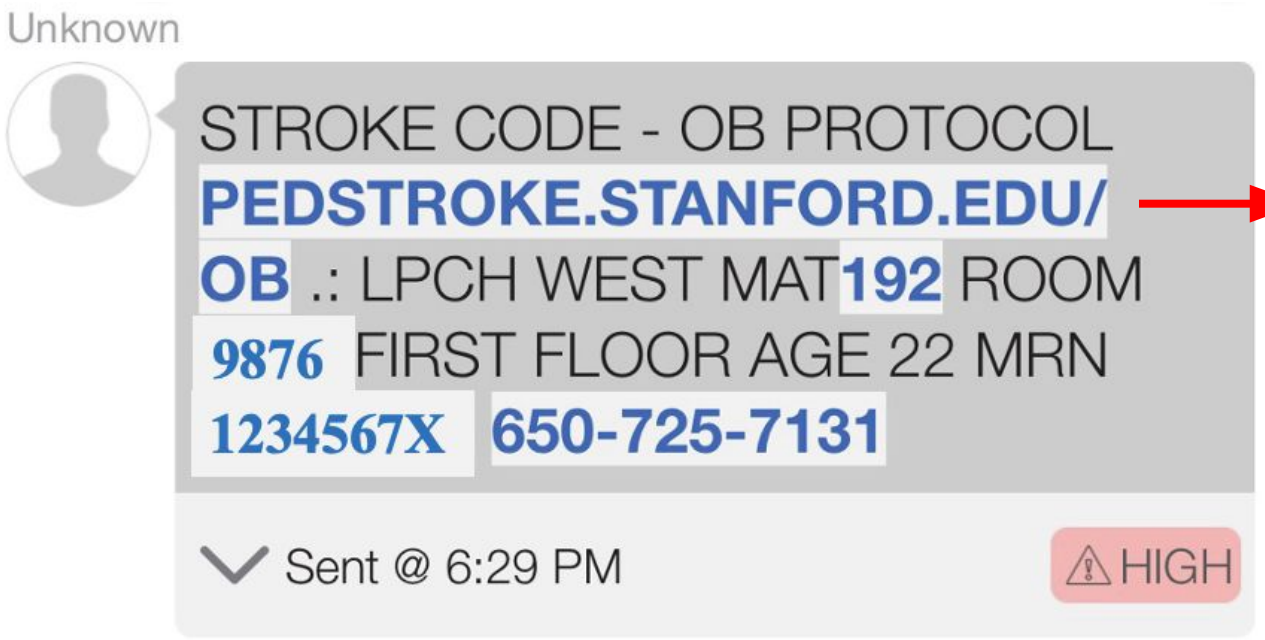
Radiology

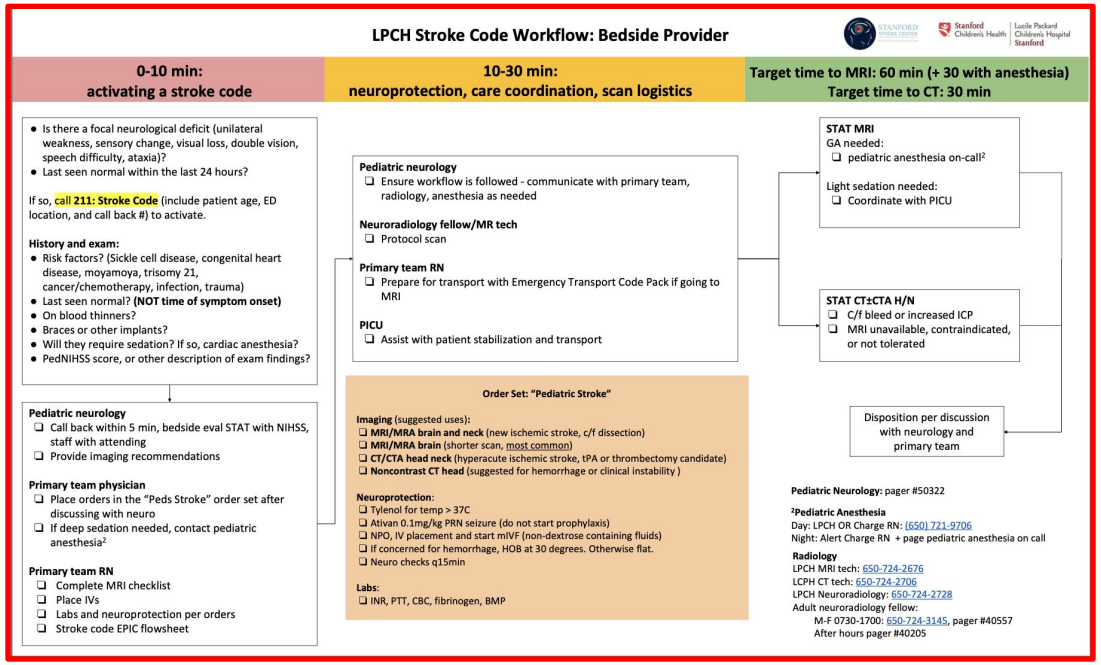
- LPCH CT tech: (650-724-2706), pager #28502
- LPCH MRI tech: pager # 18109

Pediatric Neuroradiology fellow

- M-F 0730-1700: (650) 724-2728
- After Hours page "Ped neuroradiology fellow" (650) 736-1173

Obstetric Stroke Code Page





- Link directly to workflow chart
- Location of patient, Provider name and contact #
- Set location and modality of imaging

Improving Reproductive Neurological Care

Image source: Shutterstock

Peripartum patients with neurologic symptoms and/or disease require timely evaluation and care

- Women with previous neurological conditions are at higher risk for severe maternal morbidity at the time of delivery and postpartum readmission
- Stability of maternal disease affects the health of the growing fetus
- Pregnancy increases risk for neurologic disorders (e.g. preeclampsia, RCVS, VST, lowered seizure threshold)

Stanford HEALTH CARE

Current state to Project Goals

Retrospective chart review

Identified patients with a pregnancy diagnosis within 9 months of the referral date.

1) Median days from referral to appointment:

Pregnant pts: **61 days**

Non-pregnant pts: **85 days**

2) Peripartum state is:

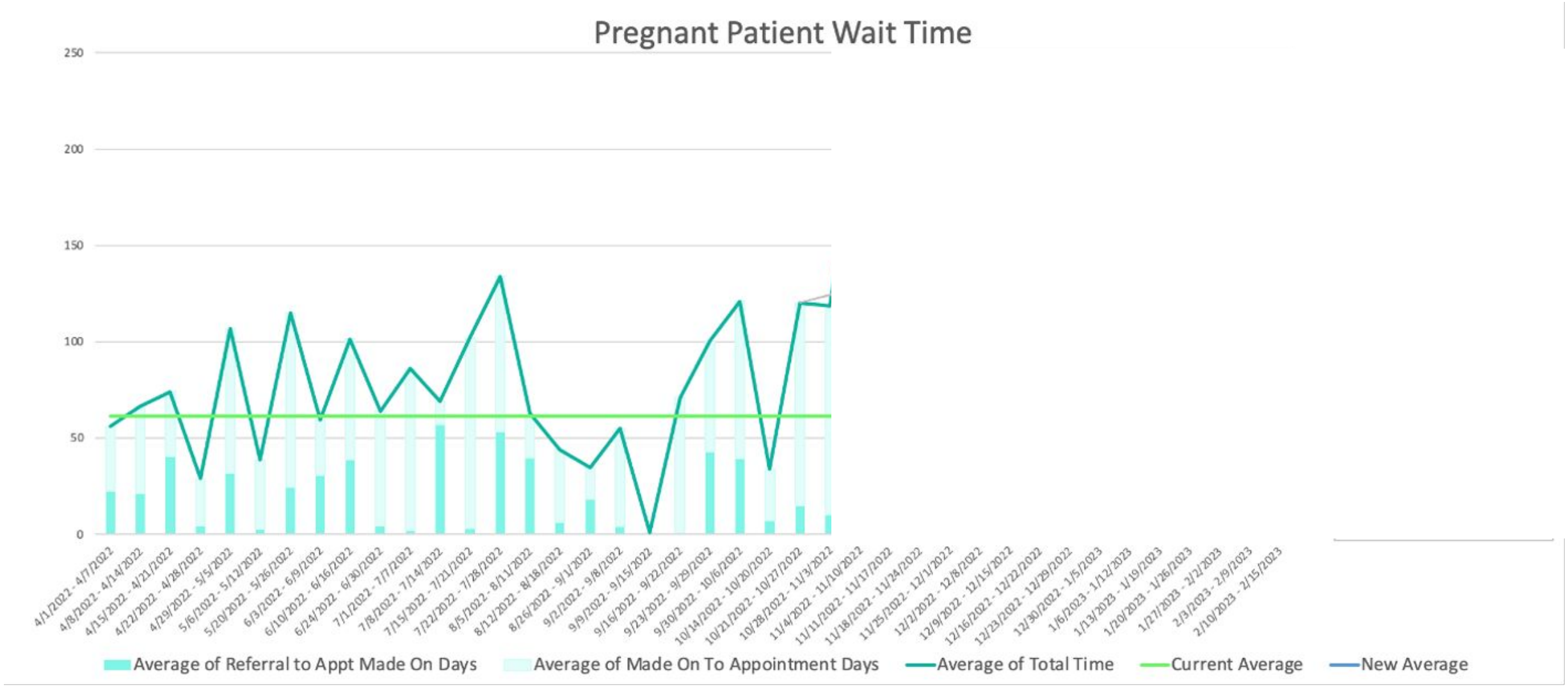
Not routinely screened for **nor identified** in the referral process

Not considered urgent

Goals

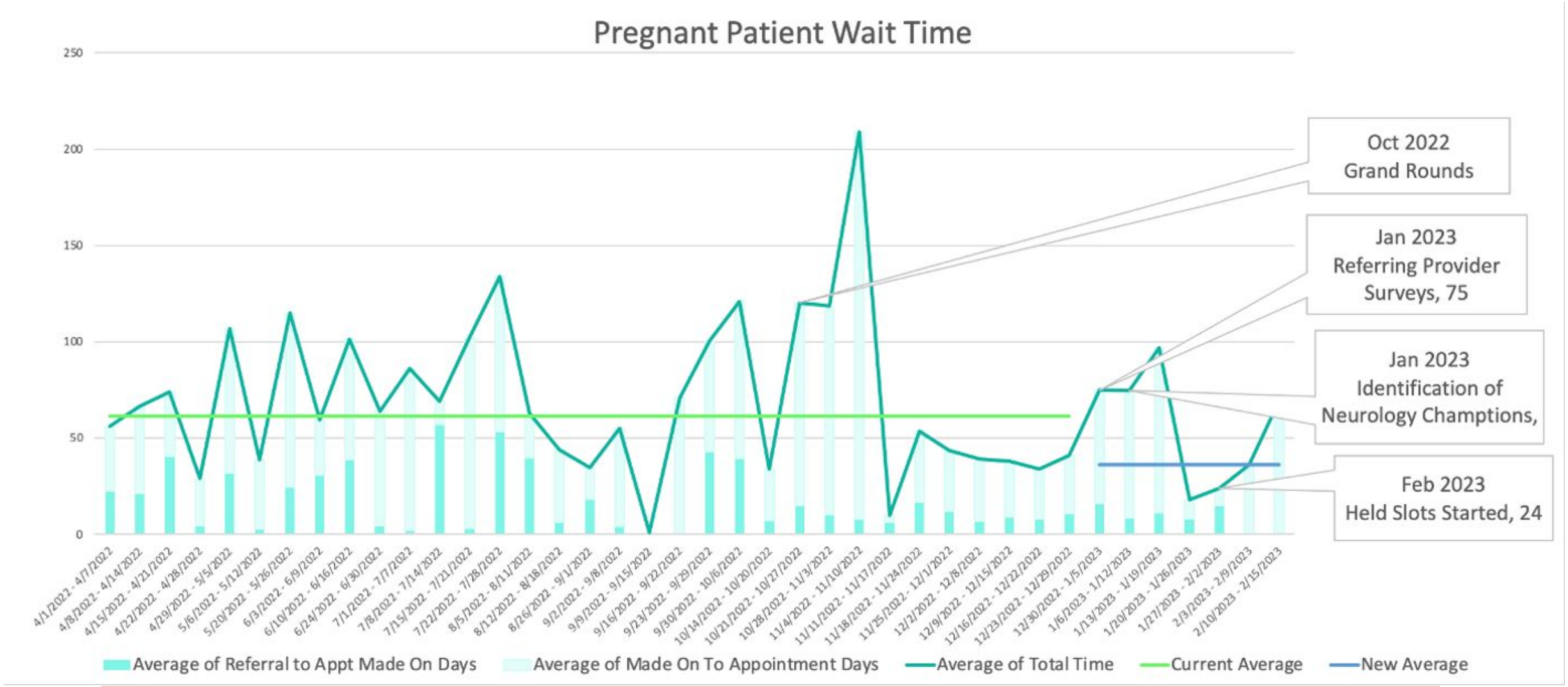
1. **Decrease time** from referral to scheduled appointment for peripartum patients
2. **Increase designated neurology appointments** for peripartum-related referrals from 0 to 2 appointments weekly

Stanford HEALTH CARE



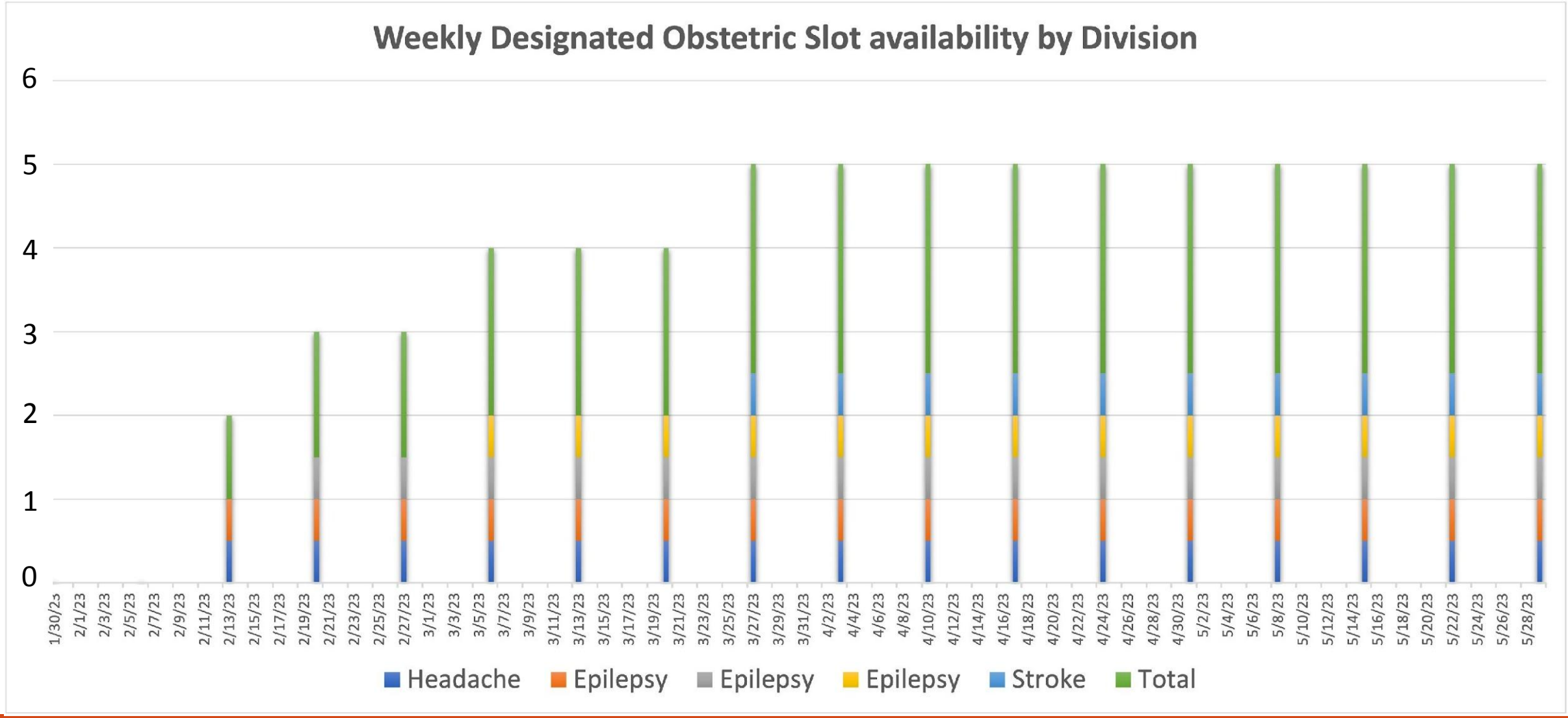
Baseline: Pregnant patient wait time median **61.5 days** in 2022 (referral to apt date)

Stanford HEALTH CARE

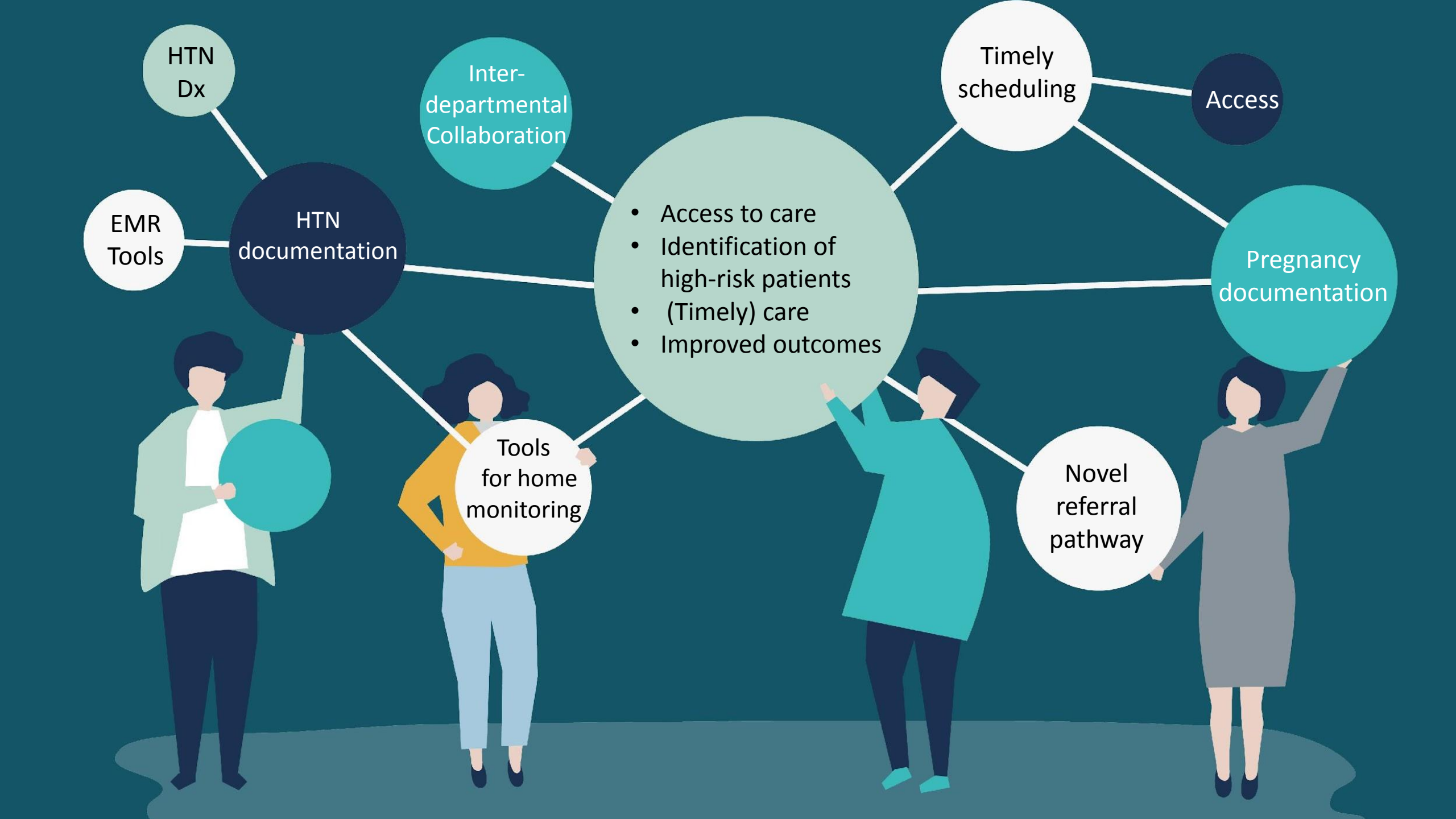


Baseline: Pregnant patient wait time median **61.5 days** in 2022 (referral to appointment date)
2023 NEW Median: for pregnant patients **36 days**

Stanford HEALTH CARE



Increased the number of held slots from **0 to > 2 per week (5)**


HTN Dx
Inter-departmental Collaboration
Timely scheduling
Access
EMR Tools
HTN documentation
• Access to care
• Identification of high-risk patients
• (Timely) care
• Improved outcomes
Pregnancy documentation
Tools for home monitoring
Novel referral pathway

Stanford HEALTH CARE

Hypertension and risk of stroke

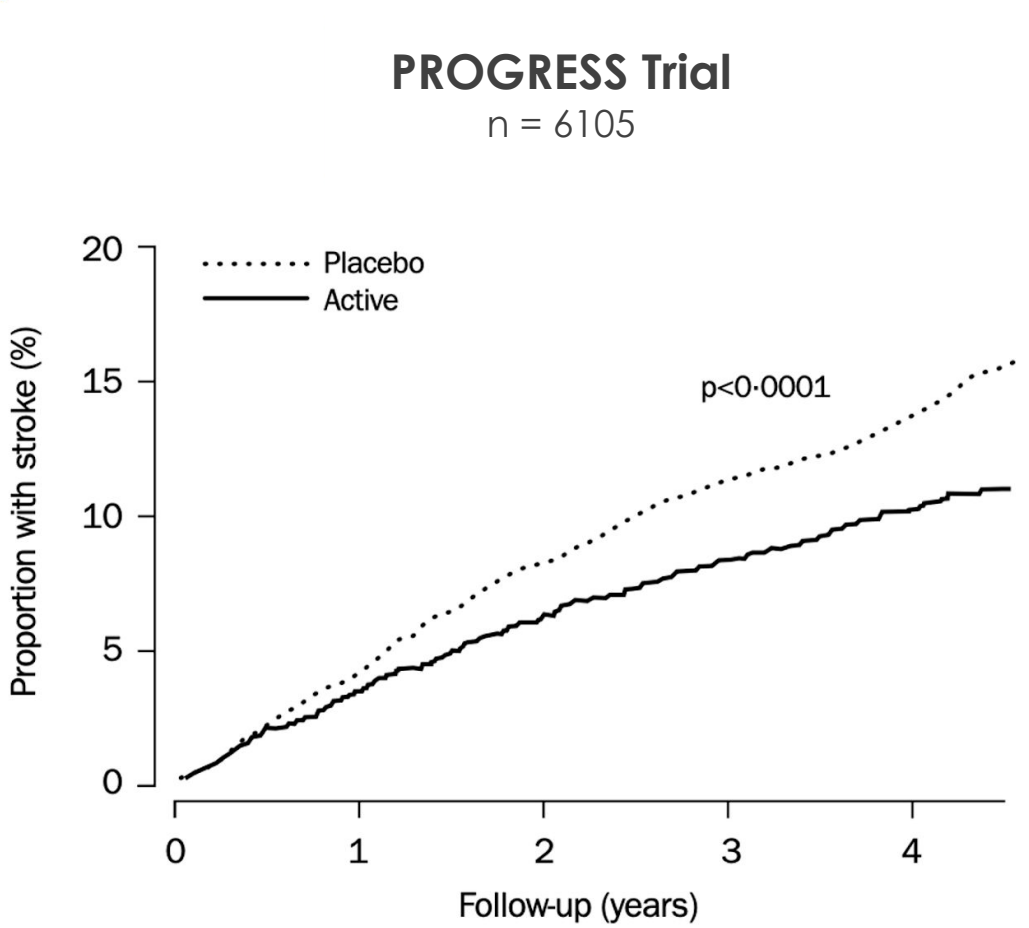
	Odds Ratio	Population Attr. Risk
Hypertension	3.89	51.8%
Smoking	2.09	18.9%
Waist-to-hip ratio	1.42	26.5%
Diet risk score	1.35	18.8%
Physical activity	0.69	28.5%
Diabetes	1.36	5.0%
Alcohol intake	1.51	3.8%
Psychosocial factors	1.35	5.2%
Cardiac causes	2.38	6.7%
ApoB to ApoA1 ratio	1.89	24.9%

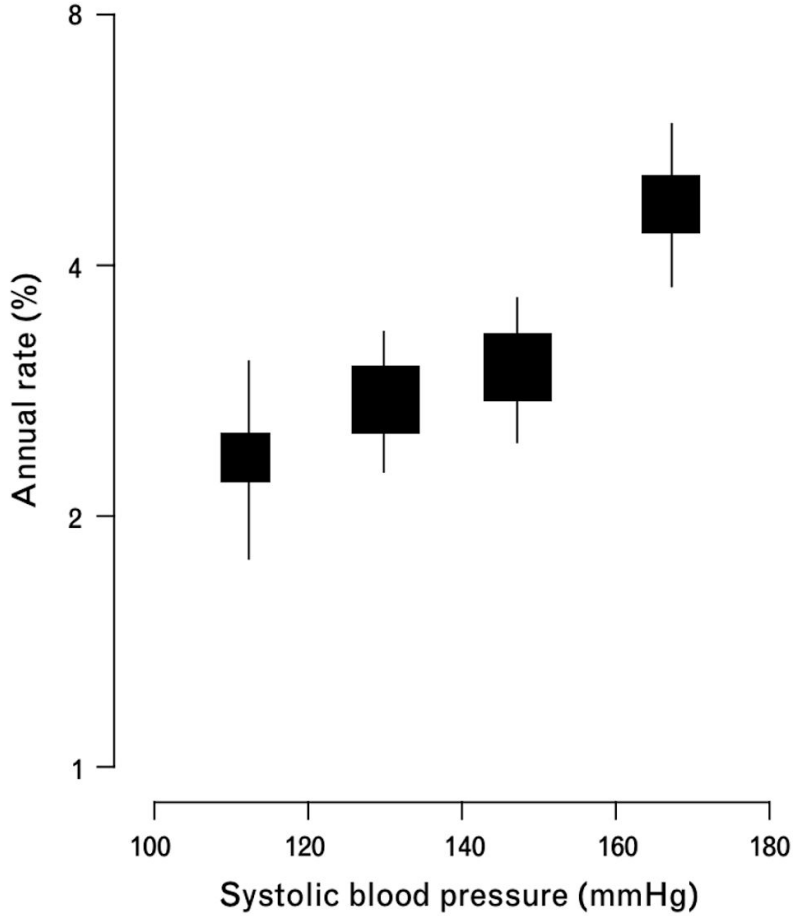
INTERSTROKE Study
n = 6000
(2337 AIS, 663 ICH, 3000 Controls

O'Donnell et al. 2010, *Lancet*

Stanford HEALTH CARE

Hypertension is related to stroke risk





Arima et al 2006, *J Hypertens.*; PROGRESS Collaborative Group 2001, *Lancet*

Stanford HEALTH CARE

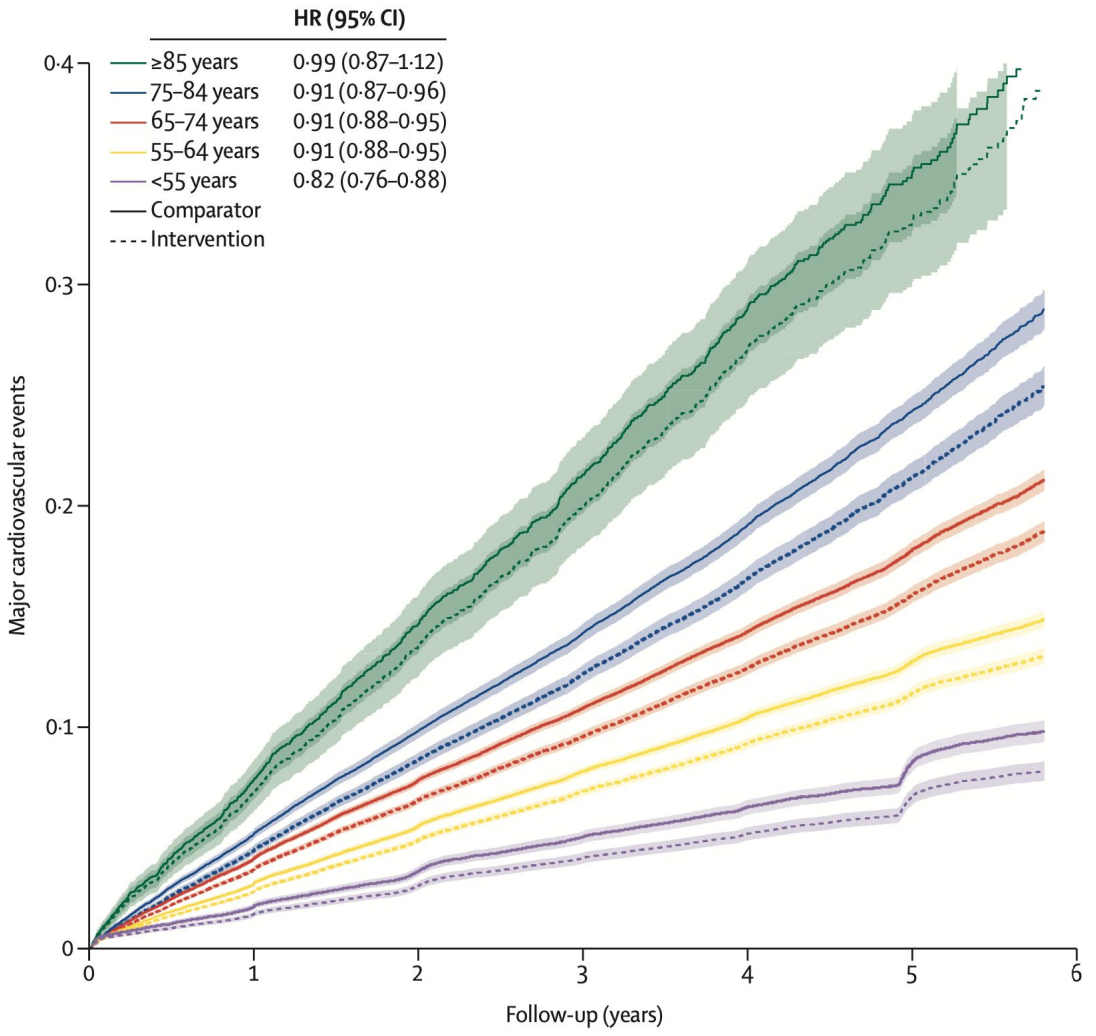
Blood Pressure and Stroke Mortality

	Intervention		Comparator		Hazard ratio (95% CI) per 5 mm Hg reduction in systolic blood pressure
	Events	Total	Events	Total	
Stroke					
<55 years	476	21599	640	20734	0·71 (0·63 to 0·81)
55–64 years	1763	59704	2200	67569	0·87 (0·82 to 0·93)
65–74 years	2584	59640	3313	68020	0·90 (0·85 to 0·95)
75–84 years	1505	24783	1954	28989	0·92 (0·85 to 0·99)
≥85 years	139	2247	195	2529	0·88 (0·71 to 1·10)

Adjusted $p_{interaction}$=0·0095

Unadjusted $p_{interaction}$=0·0019

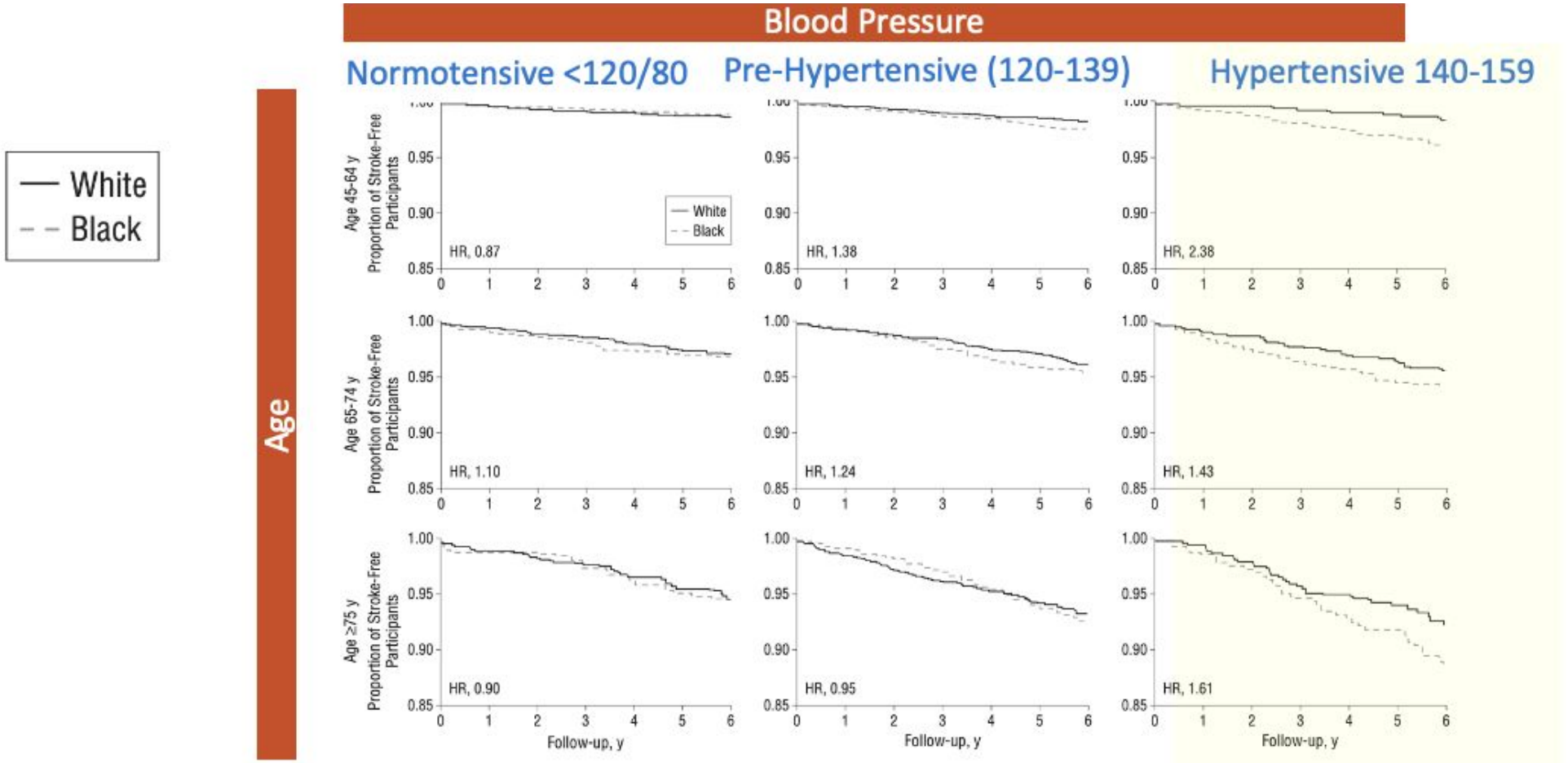
51 RCTs
n = 358,707



The Blood Pressure Lowering Treatment Trialists' Collaboration, *Lancet* 2021

Stanford HEALTH CARE

Racial disparity in HTN control and care



Arima et al 2006, *J Hypertens.*; PROGRESS Collaborative Group 2001, *Lancet*

Improving Blood Pressure In Stroke Clinic

Hypertension is a major risk factor for recurrent stroke, yet it remains poorly controlled in stroke survivors treated at Stanford

- Only 9% of stroke survivors at Stanford have blood pressure controlled 12 months after stroke
- Treatment of hypertension should be supported in the clinic through identification and expedited management
- Telemedicine has limited the traditional evaluation of hypertension

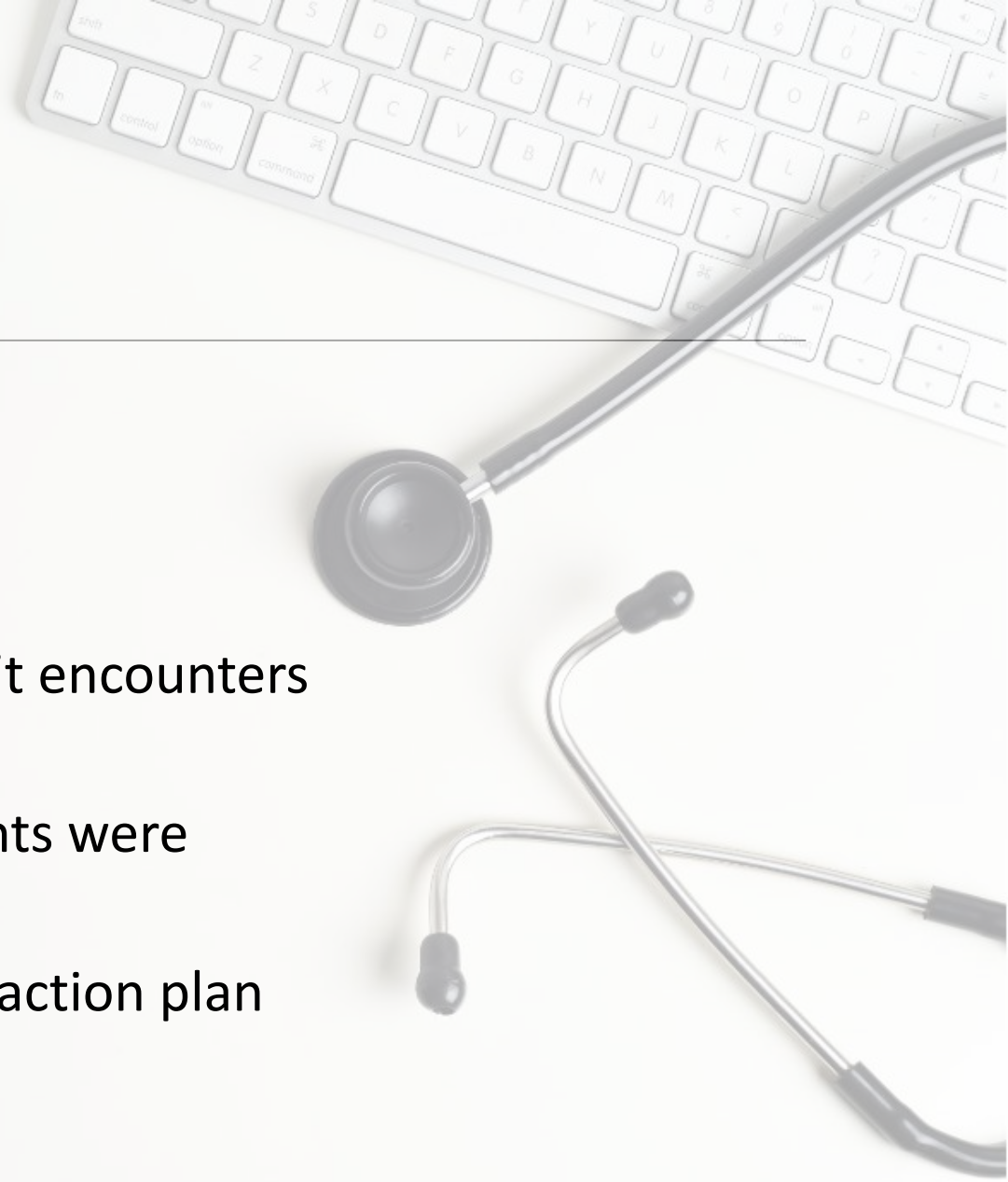
Stanford HEALTH CARE

Current State:

<u>2-week retrospective chart review:</u>

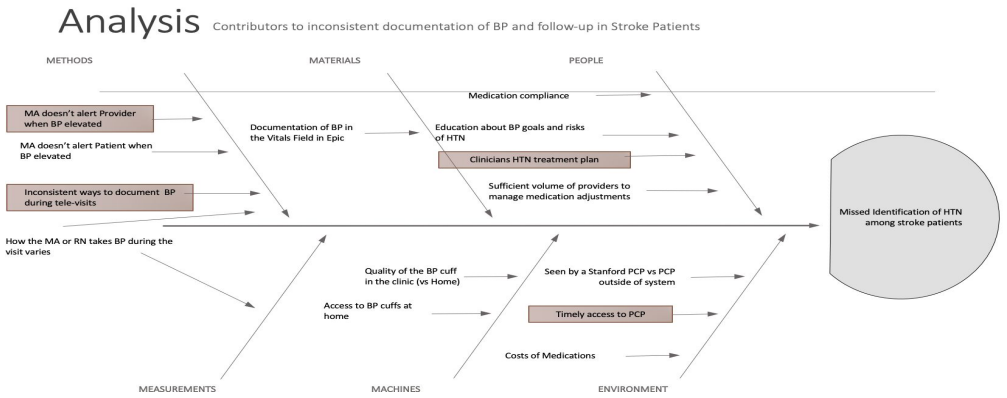
30% of stroke clinic visits were virtual

- BP was infrequently documented in virtual visit encounters (~10-20%).
- When documented, about half (46%) of patients were hypertensive.
- When acknowledged, only 32% had a specific action plan that addressed the high BP.



Stanford HEALTH CARE

BP QI Project



Key Drivers	Interventions / Countermeasures
BP must be measured and accurate - confirming when it's elevated	Develop written protocol for MAs emphasizing a re-check of an elevated blood pressure, and reporting to the provider if still elevated on re-check. Level 2
	Pre-visit calls for telemedicine appointments where BP is taken (order of priority): (1) BP taken from earlier that day, (2) take the BP during the phone call, (3) pt takes the BP prior to the appt and alerts the provider, (4) use the last 3 BP recordings from prior visits (.last3BP). Level 1
Standardizing documentation for telehealth and patient	Changing the Provider Telehealth Template to include: (1) Today's Blood Pressure: ***, (2) .vs, (3) .last3BP Level 1
	Nurses starting the Encounter to input vitals directly into the flowsheet so BPs are associated with the virtual visit encounters. Level 2
Provider needs to be aware of an elevated BP in the encounter	Automatic EPIC alert when MD provider opens chart if a patient's BP is elevated (taken from Primary Care Division). Similar BPA for MAs taking the blood pressure. Level 3
Patient has access to a provider that can adjust BP meds	SmartSet connecting the BPA for hypertensive patients to an order set that addresses elevated BP, including a referral to the PCP for patients with an SHC PCP and/or ability to refer to SHC Pharmacy for BP Titration. Level 2
Patient will adhere to follow-up plan (and has access)	In the discharge instructions from the hospital, identify that patients should invest in a BP cuff to have by the time of their clinic follow-up. Level 1
Patient has access to a home cuff for telehealth visit BPs	Provide BP Cuffs to patients discharged from the Stroke Service - similar to how SHC has access to glucometers.

Stanford HEALTH CARE

Project Goals

1. **Documentation** of blood pressure during the clinical encounter from 60% (in-person and telehealth visits) to 90%

2. **Improve number** of hypertensive patients seen within 2 weeks of their Stroke Clinic Appointment to:
   - **Stanford PCP** from 40% to 55%.

     Or
   - **Pharmacy** from 0% to 20%.

Problem

Hypertension is a principal target for secondary stroke prevention, but only a minority of patients admitted to Stanford with an acute stroke have blood pressure under control (< 130/80) in outpatient follow-up.

Aim

Help improve the detection and treatment of blood pressure in the stroke clinics at Stanford Health Care.

Stanford HEALTH CARE

Interventions

Written protocol on BP measurement and documentation for in-clinic and telemedicine visits

Best Practice Advisory (BPA) to re-check BP if elevated and alert provider if BP >130/80

BPA SmartSet with options to address elevated BP, including referral to PCP and/or referral to Pharmacy

Collaborative Practice Agreement (CPA) with Pharmacy for BP management

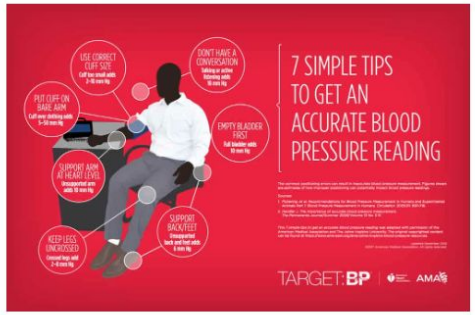
Controlling High Blood Pressure in Outpatient Stroke Clinic

At-A-Glance Measure	If	Then
Controlling High BP	BP > 129/79	1. Virtual touchpoint (visit, refill, MyHealth message): Request recent home BP reading (date and value) and document in "Patient Reported Vitals" 2. Clinic visits: Recheck BP if initial reading is > 129/79

Recommended Workflow

Clinic Visits:

During rooming, if a patient's blood pressure reading is > 129/79, a Best Practice Advisory (BPA) prompts PCCs to recheck the patient's blood pressure in 2 minutes using optimal technique.



If the repeat blood pressure (or most recent blood pressure reading in the patient encounter) is > 129/79, upon opening the patient's chart, in the future an interruptive Best Practice Advisory (BPA) prompts Providers to acknowledge the elevated reading and open the Hypertension SmartSet to assist with making a follow-up plan.

Until the BPA is implemented, MA should communicate to the Provider that the blood pressure was elevated on second check.

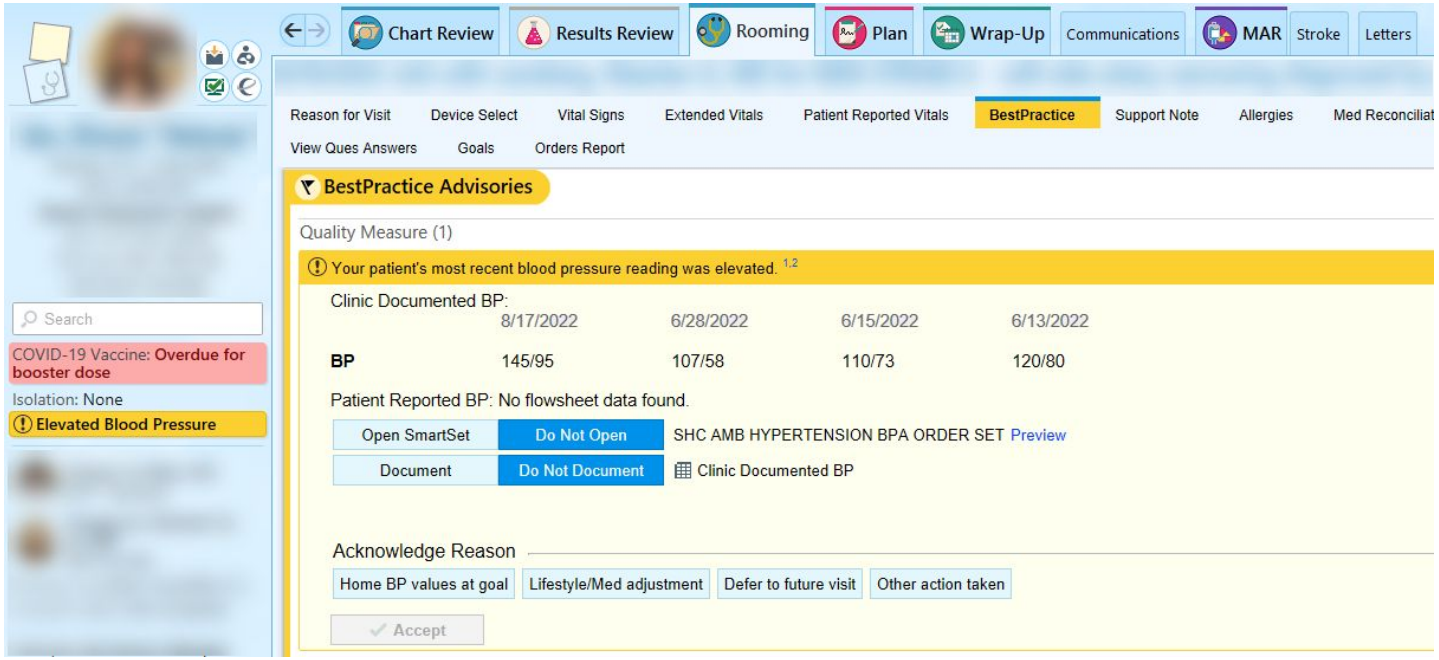
Interventions

Written protocol on BP measurement and documentation for in-clinic and telemedicine visits

Best Practice Advisory (BPA) to re-check BP if elevated and alert provider if BP >130/80

BPA SmartSet with options to address elevated BP, including referral to PCP and/or referral to Pharmacy

Collaborative Practice Agreement (CPA) with Pharmacy for BP management



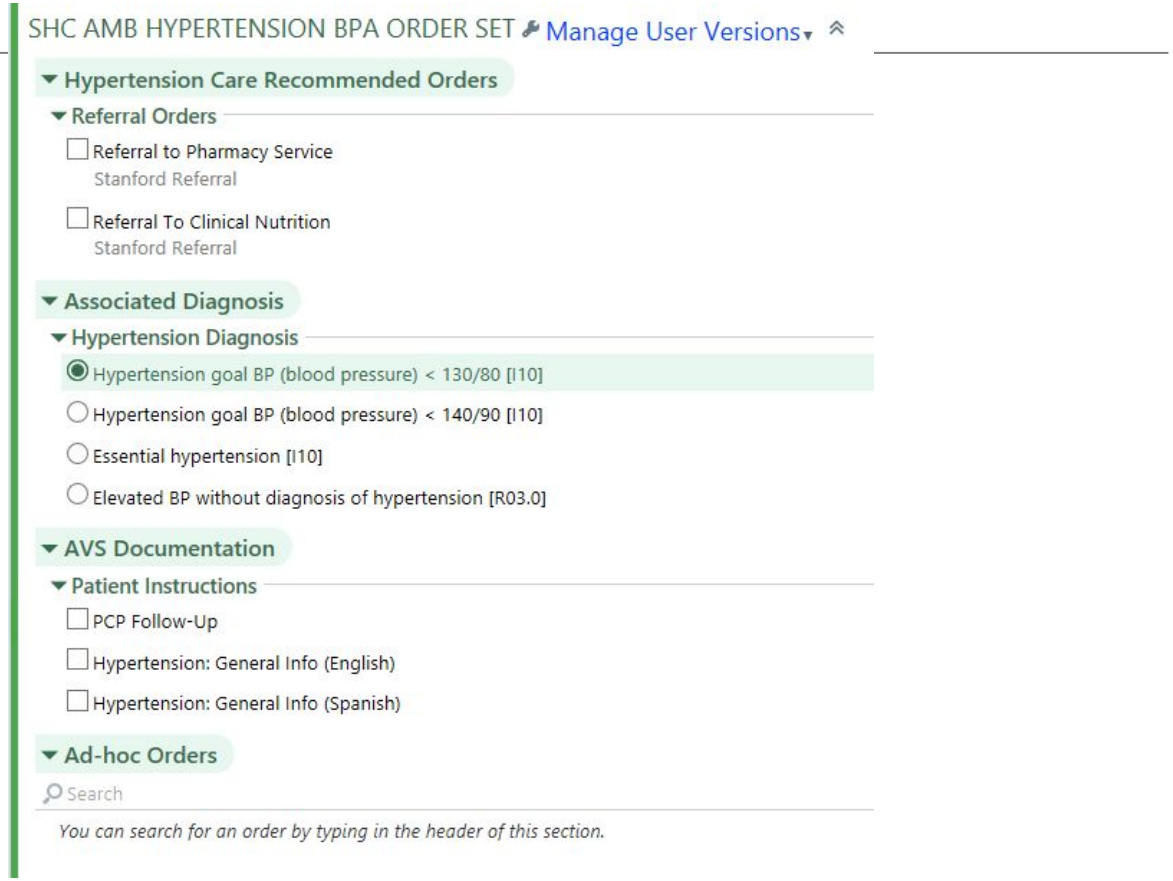
Interventions

Written protocol on BP measurement and documentation for in-clinic and telemedicine visits

Best Practice Advisory (BPA) to re-check BP if elevated and alert provider if BP >130/80

BPA SmartSet with options to address elevated BP, including referral to PCP and/or referral to Pharmacy

Collaborative Practice Agreement (CPA) with Pharmacy for BP management



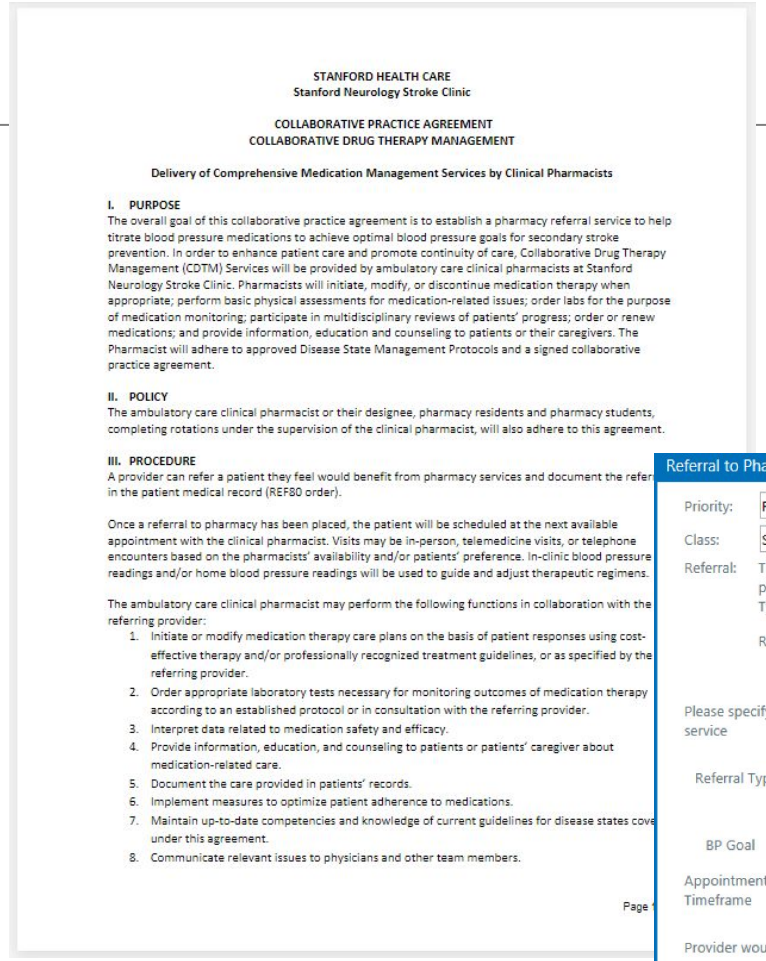
Interventions

Written protocol on BP measurement and documentation for in-clinic and telemedicine visits

Best Practice Advisory (BPA) to re-check BP if elevated and alert provider if BP >130/80

BPA SmartSet with options to address elevated BP, including referral to PCP and/or referral to Pharmacy

Collaborative Practice Agreement (CPA) with Pharmacy for BP management



STANFORD HEALTH CARE
Stanford Neurology Stroke Clinic

COLLABORATIVE PRACTICE AGREEMENT
COLLABORATIVE DRUG THERAPY MANAGEMENT

Delivery of Comprehensive Medication Management Services by Clinical Pharmacists

I. PURPOSE
The overall goal of this collaborative practice agreement is to establish a pharmacy referral service to help titrate blood pressure medications to achieve optimal blood pressure goals for secondary stroke prevention. In order to enhance patient care and promote continuity of care, Collaborative Drug Therapy Management (CDTM) Services will be provided by ambulatory care clinical pharmacists at Stanford Neurology Stroke Clinic. Pharmacists will initiate, modify, or discontinue medication therapy when appropriate; perform basic physical assessments for medication-related issues; order labs for the purpose of medication monitoring; participate in multidisciplinary reviews of patients' progress; order or renew medications; and provide information, education and counseling to patients or their caregivers. The Pharmacist will adhere to approved Disease State Management Protocols and a signed collaborative practice agreement.

II. POLICY
The ambulatory care clinical pharmacist or their designee, pharmacy residents and pharmacy students, completing rotations under the supervision of the clinical pharmacist, will also adhere to this agreement.

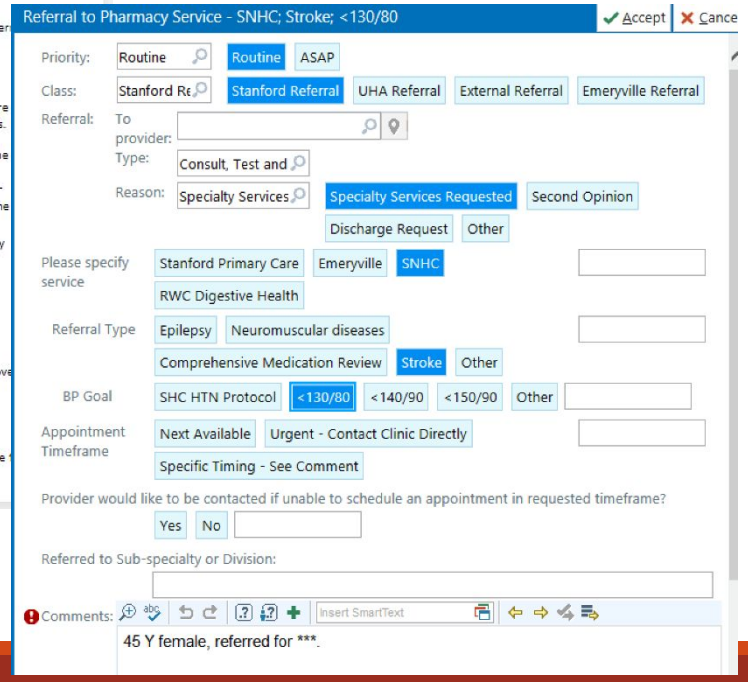
III. PROCEDURE
A provider can refer a patient they feel would benefit from pharmacy services and document the refer
in the patient medical record (REF80 order).

Once a referral to pharmacy has been placed, the patient will be scheduled at the next available appointment with the clinical pharmacist. Visits may be in-person, telemedicine visits, or telephone encounters based on the pharmacists' availability and/or patients' preference. In-clinic blood pressure readings and/or home blood pressure readings will be used to guide and adjust therapeutic regimens.

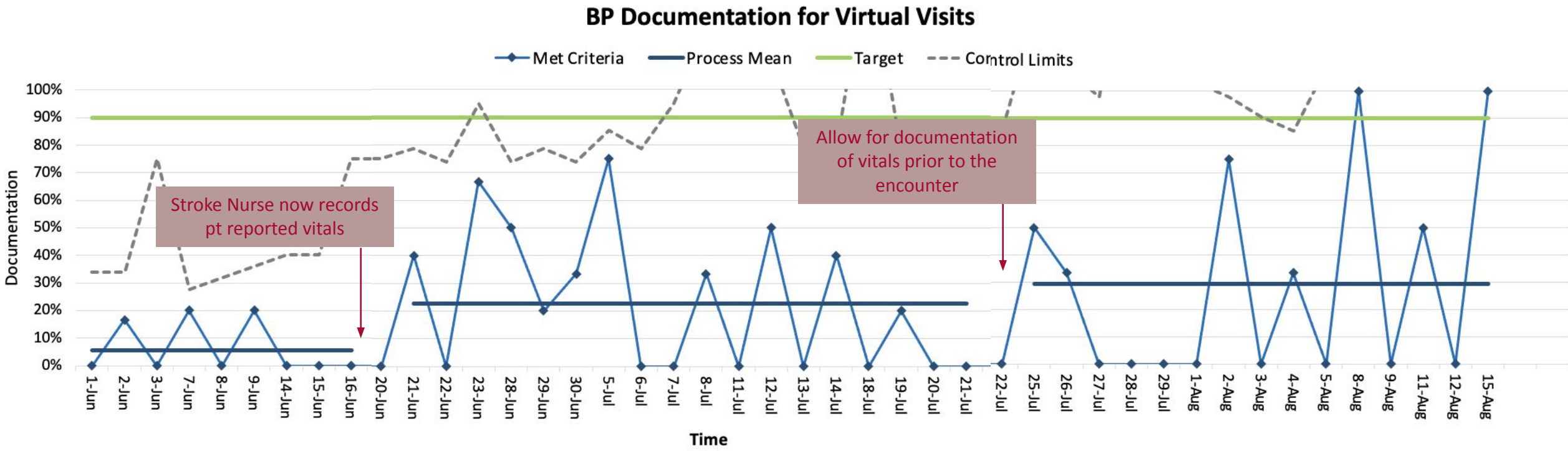
The ambulatory care clinical pharmacist may perform the following functions in collaboration with the referring provider:

1. Initiate or modify medication therapy care plans on the basis of patient responses using cost-effective therapy and/or professionally recognized treatment guidelines, or as specified by the referring provider.
2. Order appropriate laboratory tests necessary for monitoring outcomes of medication therapy according to an established protocol or in consultation with the referring provider.
3. Interpret data related to medication safety and efficacy.
4. Provide information, education, and counseling to patients or patients' caregiver about medication-related care.
5. Document the care provided in patients' records.
6. Implement measures to optimize patient adherence to medications.
7. Maintain up-to-date competencies and knowledge of current guidelines for disease states cove
under this agreement.
8. Communicate relevant issues to physicians and other team members.

Page



Results: Documentation for Virtual Visits



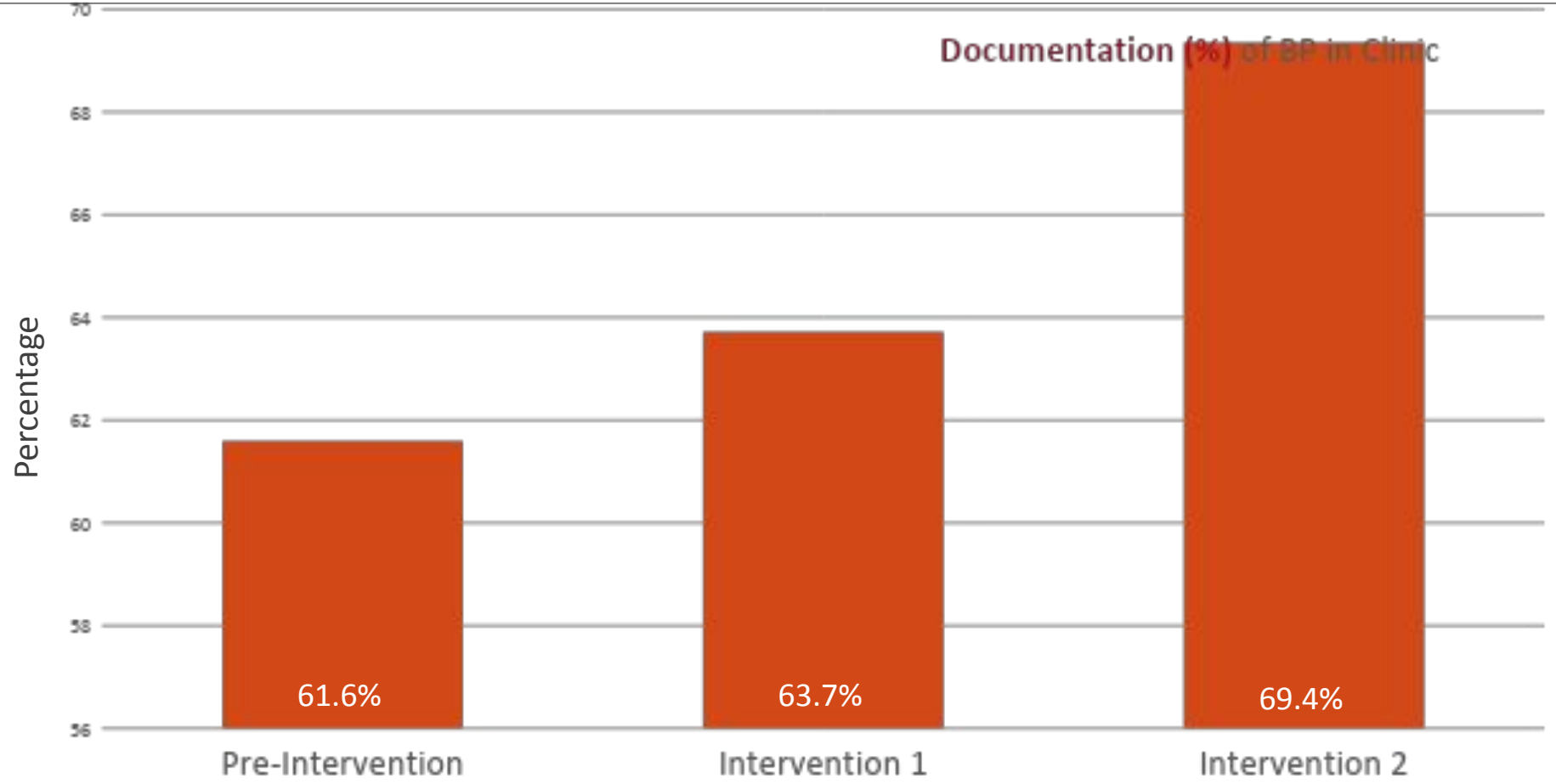
Baseline
Average documentation rate: **5.6%**

Intervention 1
Average documentation rate: **22.5%**

Intervention 2
Average documentation rate: **29.4%**

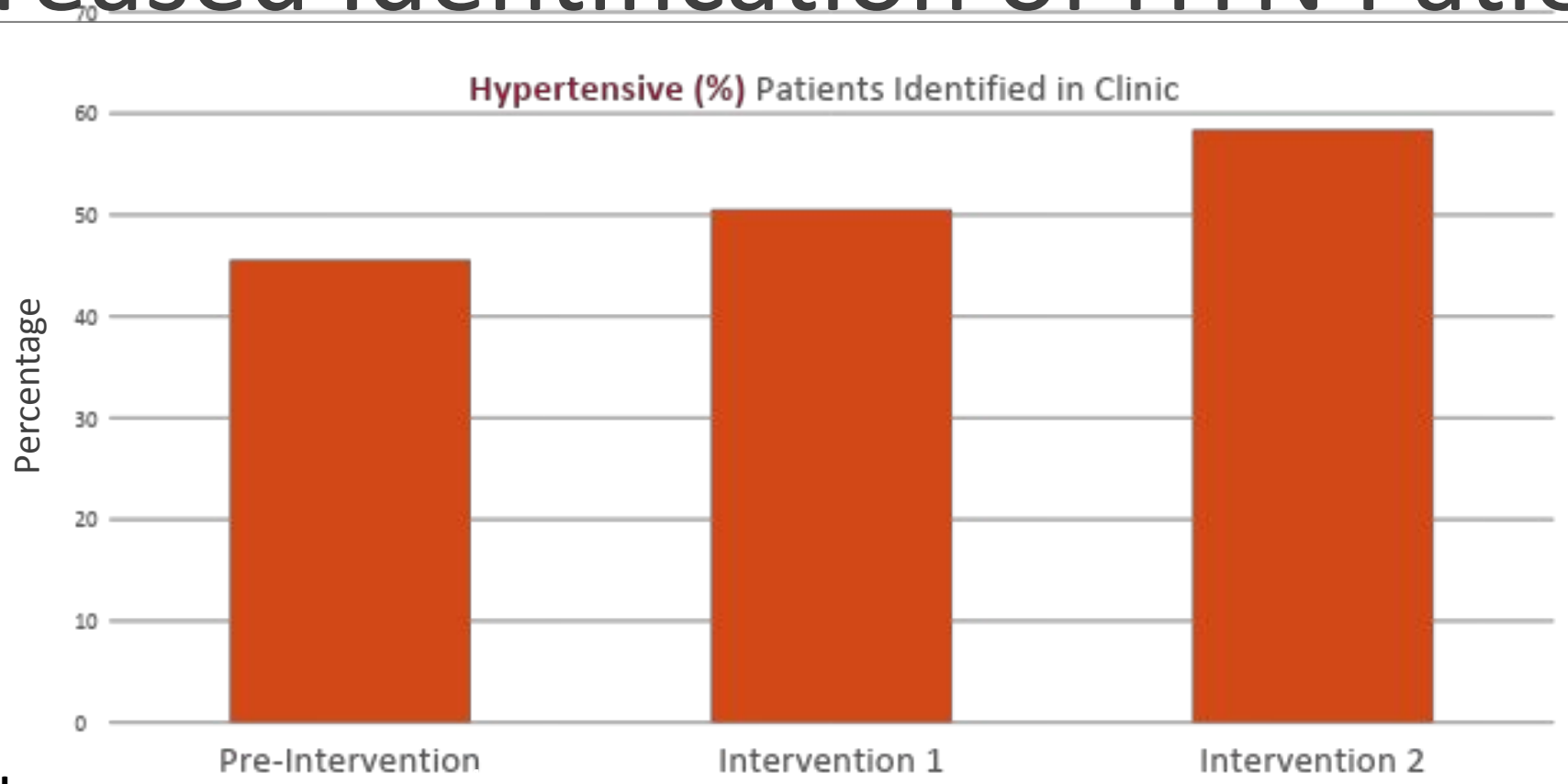
Stanford HEALTH CARE

Results: Increased Documentation



Stanford HEALTH CARE

Increased Identification of HTN Patients



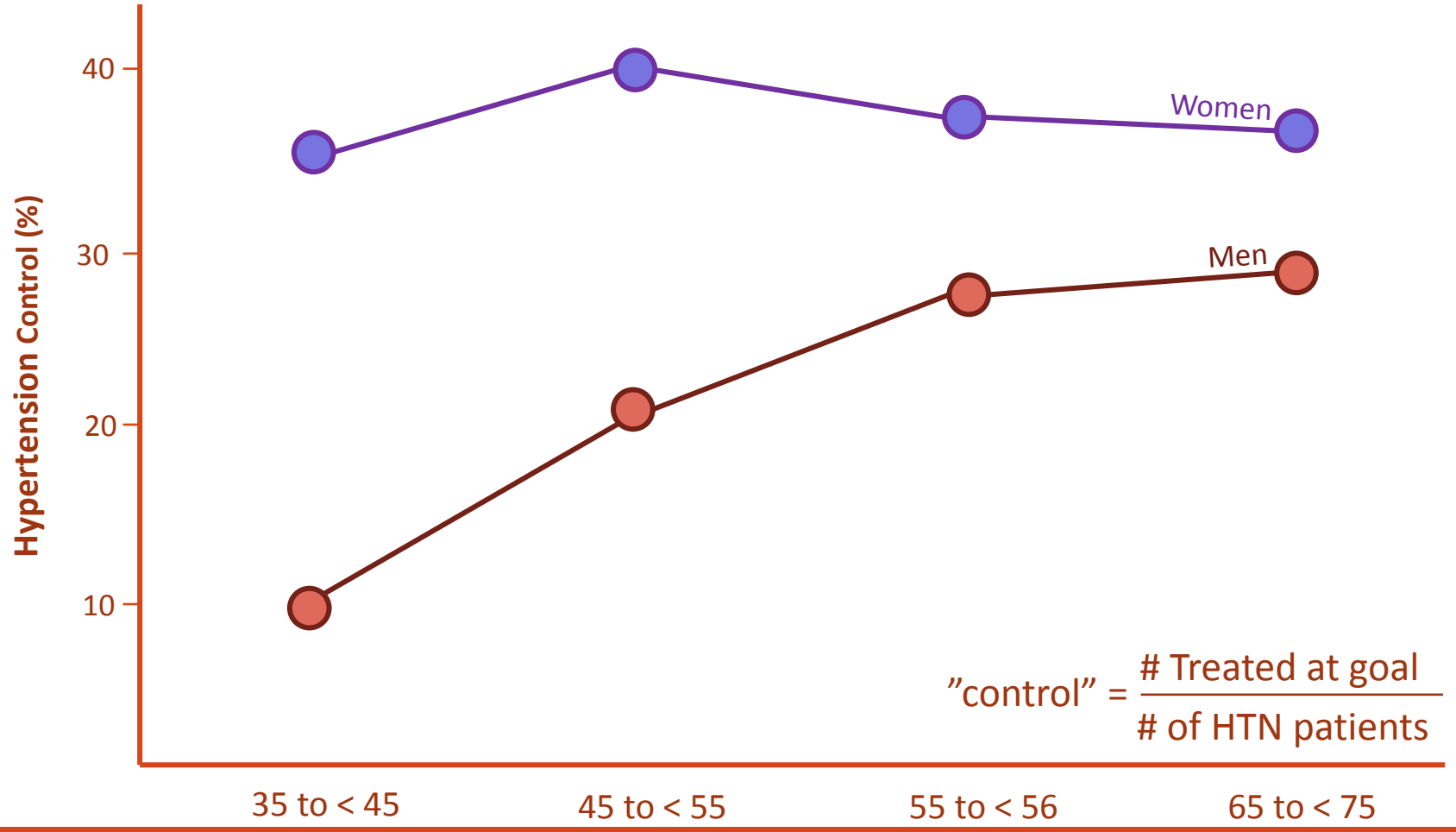
Average identified as HTN per clinic day:

Pre-Intervention	Intervention 1	Intervention 2
2.4 Patients	**5.4** Patients	**6.4** Patients

Stanford HEALTH CARE

Outpatient BP Control Non-compalince

Survey year(s)	1988–1994
Sample	National
N	17 530
Participation, %	82
Age range, y	18–80+
Sampling method*	Multistage, population registry
BP measured by	Physician



Wolf-Maier et al 2003, *Hypertension*

Stanford HEALTH CARE

Health Equity & Diversity, Equity, and Inclusion (DEI) Research Grant Program

Barrier to Care: Home BP monitoring

> Not covered by all **insurance plans**.

> Disproportionately affect **racial and ethnic minorities** as well as those from **lower socioeconomic status**.

> Pilot studies[1] suggest **access to monitoring** can improve BP control irrespective of medication.

Home BP Cuff Grant:

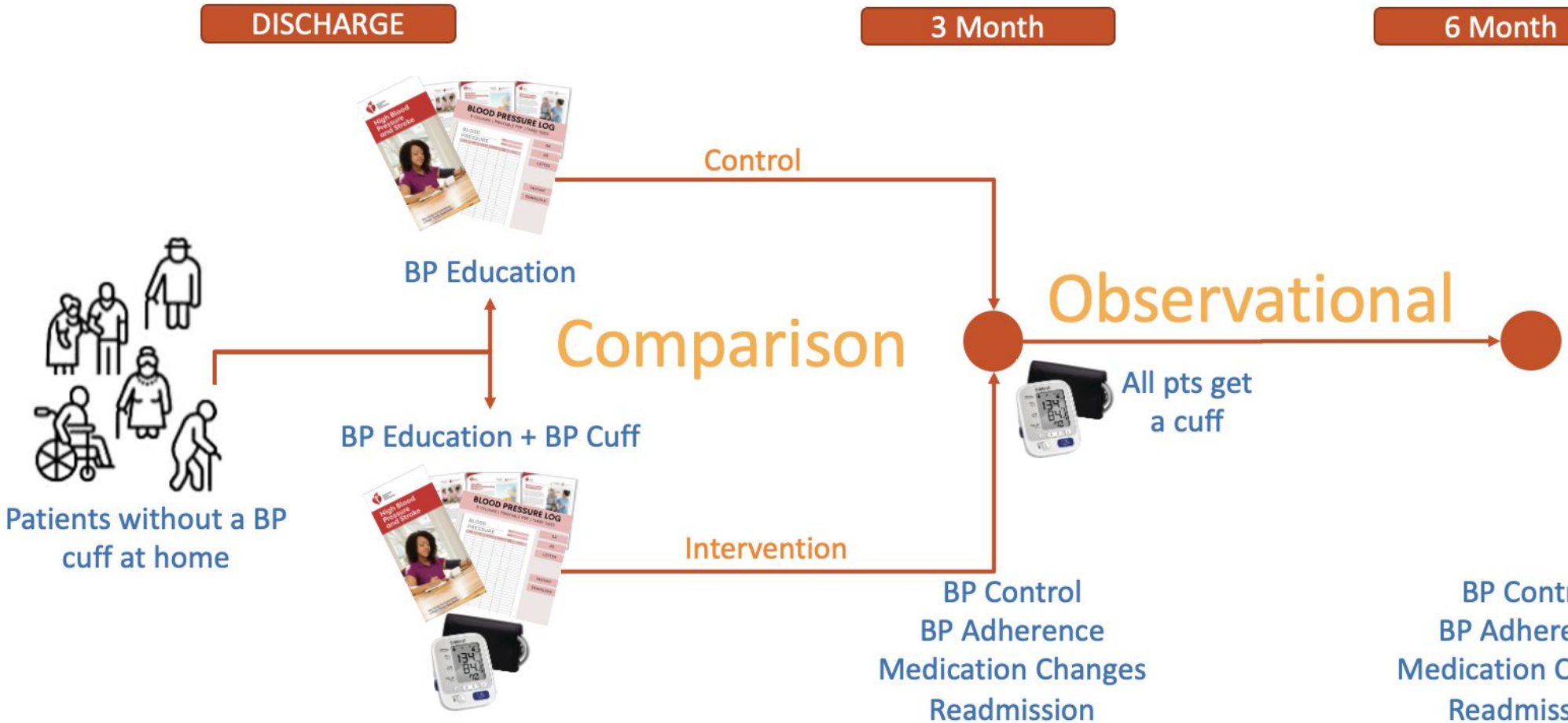
1. Patients* over the age of 18 admitted to the **SHC stroke service (L5)** and discharging to **home** or **acute rehab.**
2. Diagnosis of Ischemic Stroke, Hemorrhagic Stroke, TIA, or otherwise deemed to be at **increased risk of stroke**.
3. **No usable home BP cuff** available
4. Diagnosis of **hypertension**.

**Based on enrollment may restrict to at-risk groups during study period.*

[1]Fuchs et al 2012, *J Hypertens*

Stanford HEALTH CARE

BP Monitoring in the outpatient setting



Stanford HEALTH CARE

THANK YOU!

Please contact me with any follow-up questions

Email: cmsells@Stanford.edu

Stanford Stroke Center Offices: (650) 723-4448