



Postpartum hypertension: Care in the hospital, in the clinic and at home

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She/her

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Intersectionality and Disclosures



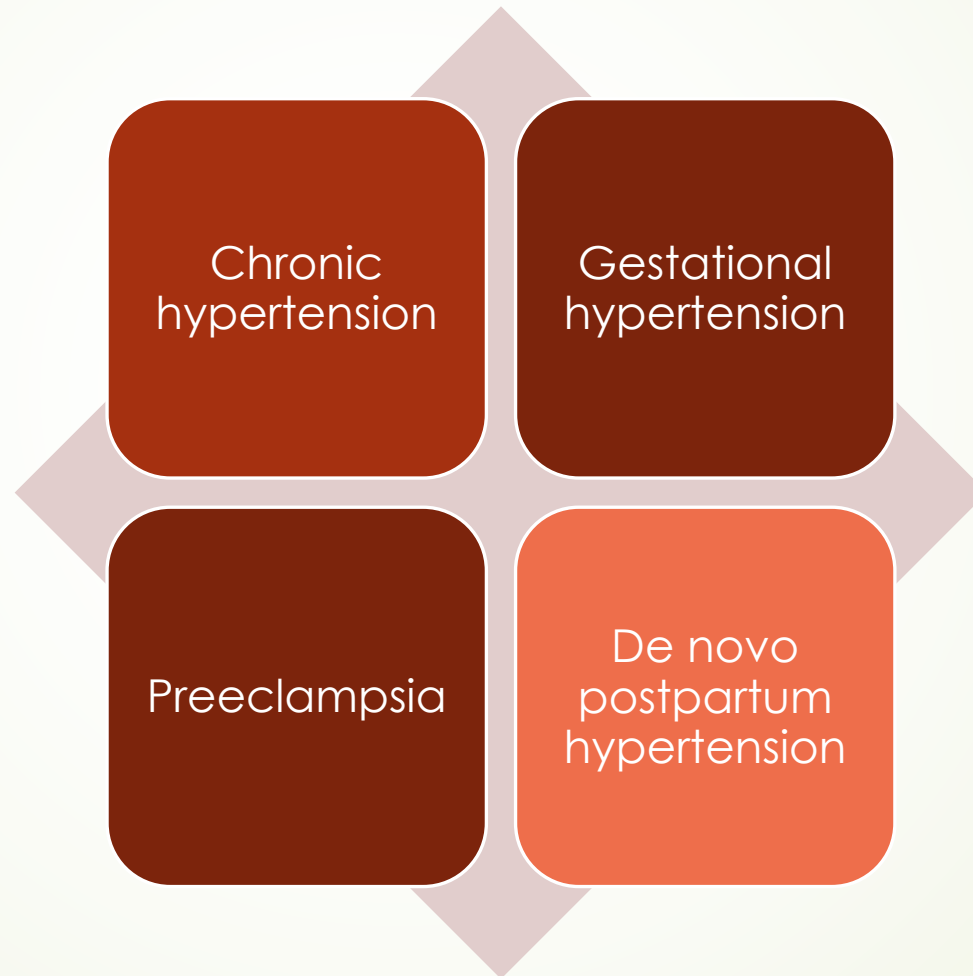
- ▶ I am a
 - ▶ white anglo
 - ▶ English speaking
 - ▶ cis-gendered woman
 - ▶ mother
 - ▶ physician
- ▶ No financial disclosure
- ▶ Pregnant person, birthing person, postpartum person, mother



Learning objectives

- ▶ Reframe interventions in chronic hypertension during pregnancy
 - ▶ Understand drivers of postpartum hypertension
 - ▶ Describe the relationship of postpartum hypertension and short- and long-term morbidity
 - ▶ Critically appraise approaches to effective home blood pressure monitoring in a postpartum population
- 

Hypertensive disorders of pregnancy





Key Principles of Pregnancy Associated Hypertension

Severe disease belongs in the hospital

Both pregnant person and fetus are at risk

Outpatient medications **not appropriate** for gestational hypertension or preeclampsia


Question to answer: Are there severe features of disease?

- ▶ Blood pressure level
 - ▶ SBP \geq 160mmHg
 - ▶ DBP \geq 110mmHg
- ▶ HELLP syndrome
- ▶ Symptoms of any kind that aren't easily resolved
- ▶ Fetal growth restriction (estimated weight <10%ile for age)
- ▶ Oligohydramnios
- ▶ If so aggressive management to reduce the risk of stillbirth or maternal harm
 - ▶ If <34 weeks hospitalization
 - ▶ Daily testing of mother and baby
 - ▶ Deliver at 34 weeks or at diagnosis of >34 weeks
 - ▶ Magnesium infusion to reduce the risk of eclamptic seizure




Use medications in chronic hypertension

- ▶ CHAP trial: RCT of 2408 pregnant people at 61 centers with cHTN <23 weeks
 - ▶ Compared medication at 140/90 to 160/105
 - ▶ Primary composite outcome of severe pre-eclampsia, iatrogenic PTB < 35 w, placental abruption, fetal/neo death
 - ▶ Lower in treatment group RR 0.82 (0.74,0.92)
 - ▶ Secondary outcome: birthweight <10%ile
 - ▶ No difference RR 1.04 (0.82,1.31)



In chronic hypertension,
start or increase medications for
BP \geq 140/90





Superimposed Pre-Eclampsia:

- ▶ Known chronic hypertension with:
 - ▶ New significant elevation of BP
 - ▶ New proteinuria (same criteria)
 - ▶ New kidney dysfunction (acute kidney injury or serum creatinine >1.2mg/dL)
 - ▶ New component of HELLP syndrome
- ▶ This is really confusing to diagnose

- ▶ Persistent BP \geq 160/110 in the pregnant patient should be considered equally dangerous if they have known chronic hypertension or not

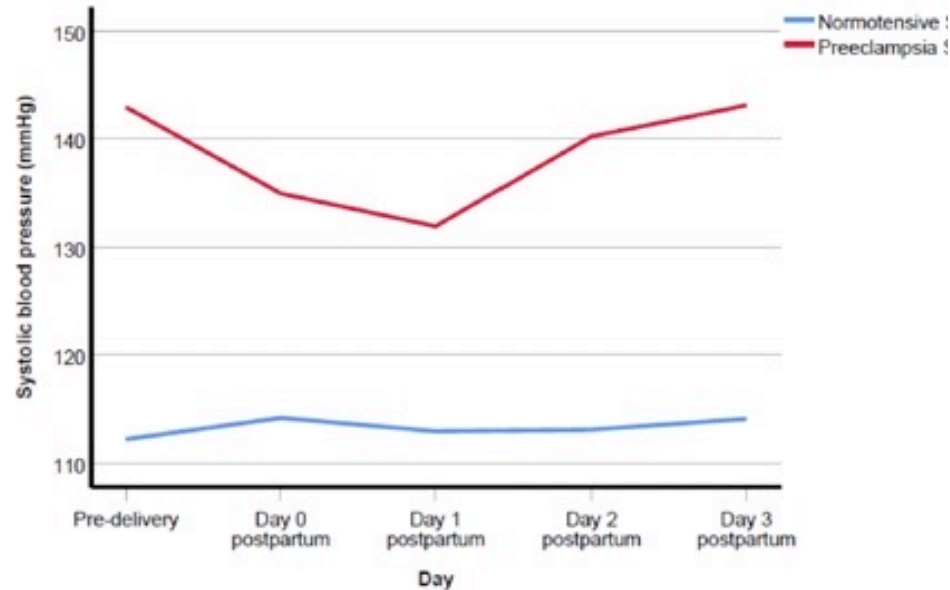
Postpartum: Expected Physiology



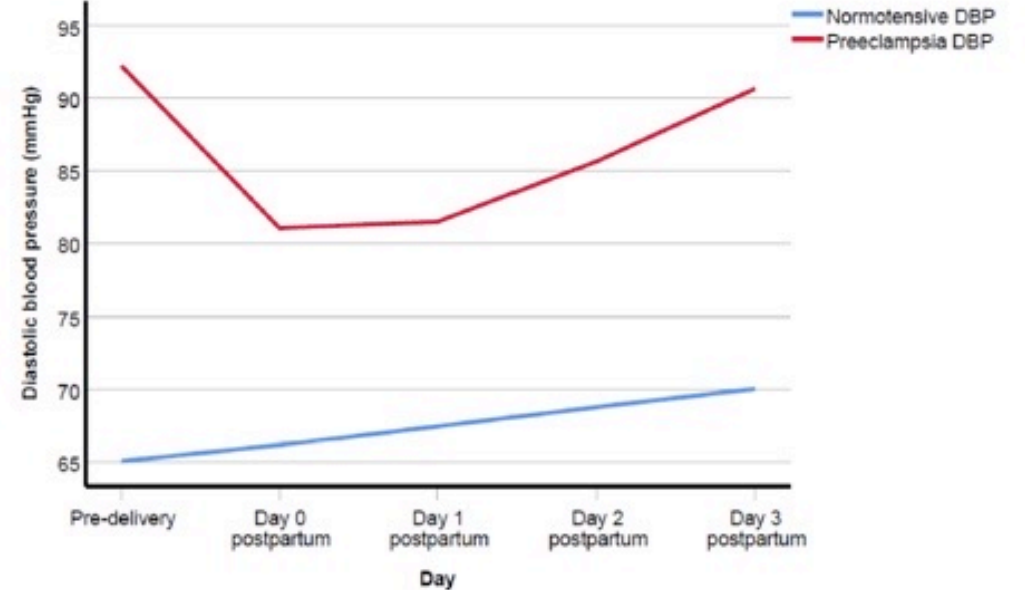


Does Postpartum Hypertension Matter?

Postpartum BP excursion is higher after HDP



< -----Day 1-3 ----- >
Systolic blood pressure



< -----Day 1-3 ----- >
Diastolic blood pressure

HDP is associated with Postpartum CV SMM

- Increased risk for
 - **Stroke**
 - **Acute renal failure**
 - **DIC**
 - **Pulmonary edema**
 - **Heart failure**
 - **Death**

Type of HDP	aOR	CI
Chronic hypertension	3.84	1.94-7.58
Gestational hypertension	3.71	2.09-6.55
Pre-eclampsia without severe features	3.48	1.84-6.58
Pre-eclampsia with severe features	4.74	2.25-9.95

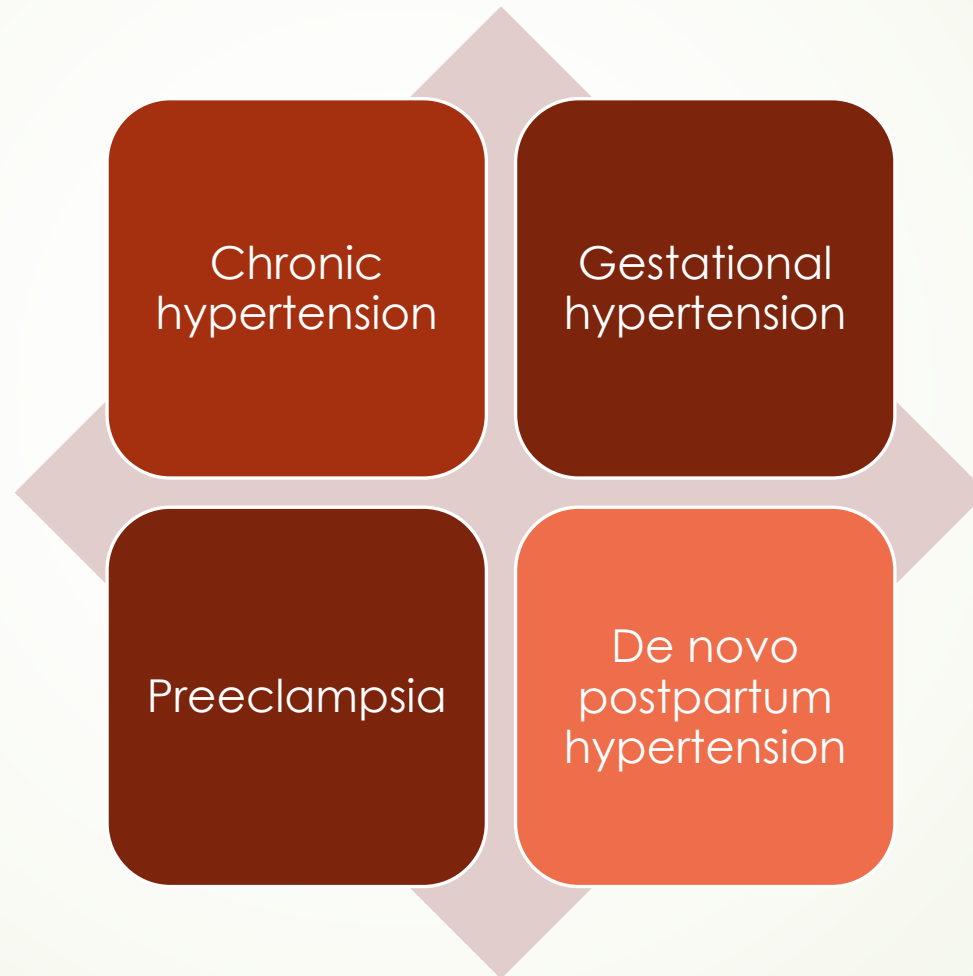


Most postpartum stroke occurs day 7-9

- Retrospective cohort of >4M deliveries 2013-2014
- 58.4% of postpartum strokes occurred in first 10 days postpartum
- Patients with HDP – postpartum day 8.9
- Patients with chronic hypertension – postpartum day 7.8
- **81% of postpartum stroke occurred in people with no chronic or pregnancy induced hypertension**

Too et al, Obstetrics & Gynecology, 2018

Hypertensive disorders of pregnancy



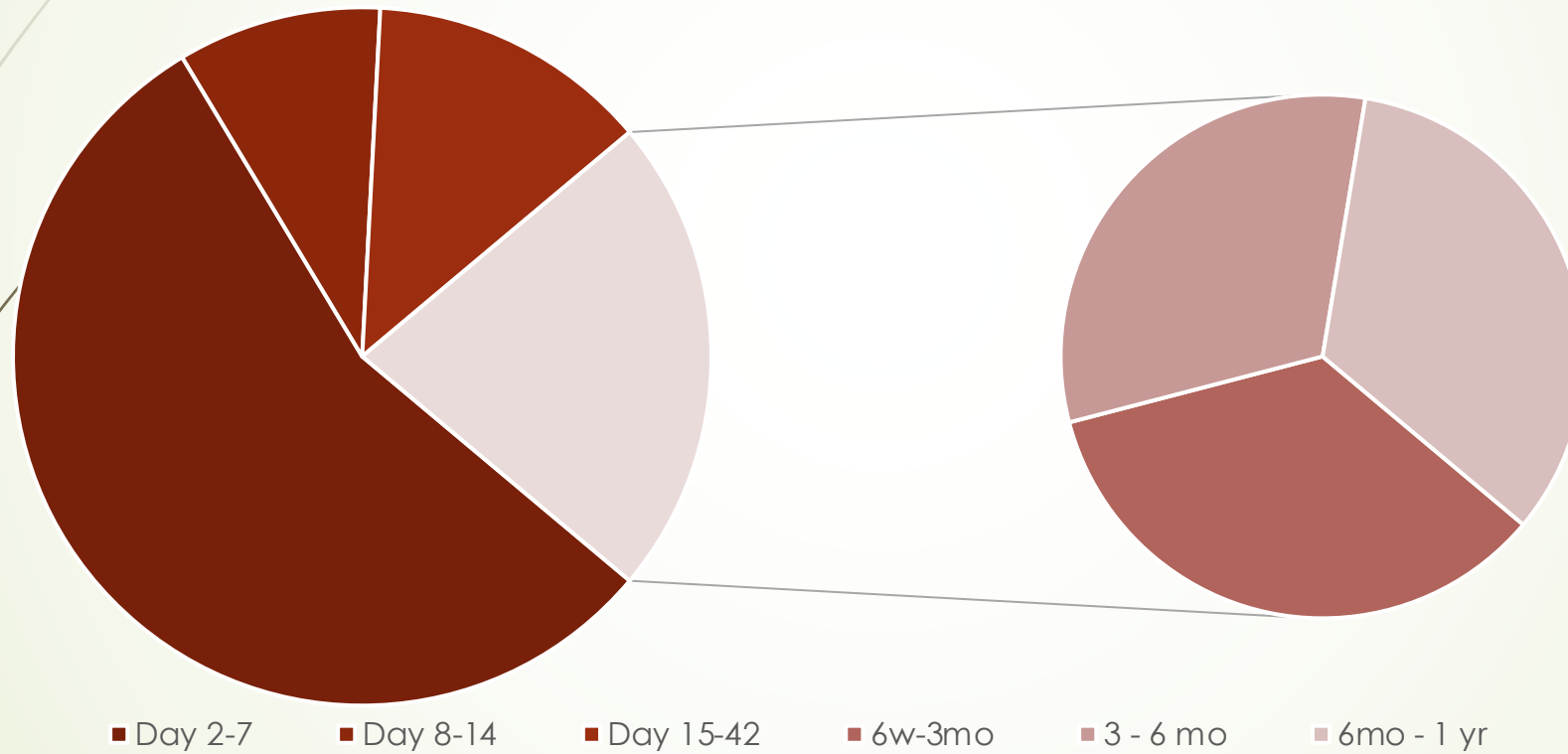
De novo postpartum hypertension

- ▶ 2+ elevated BP readings. >24 hours after delivery in a person without a prior diagnosis of HDP or chronic HTN
- ▶ Prevalence in an otherwise normotensive postpartum population ~9-12%
- ▶ Risk factors
 - ▶ GDM
 - ▶ Older age
 - ▶ Cesarean
 - ▶ BMI >30
 - ▶ NonWhite race

CS	Smoke	Age	Risk
No	Never	<35	5.5%
		≥35	11.4%
	Current/Former	<35	10.8%
		≥35	7.5%*
Yes	Never	<35	12.9%
		≥35	24.8%
	Current/Former	<35	29.6%
		≥35	29.2%

Bigelow et al, AJOG
Goel et al, Circulation
Redman et al, Obstetrics and Gynecology
Kelleher & Yarrington, Hypertension

Timing of dn-ppHTN



22% occurred
6w -1 year
after delivery



HDP is associated with ongoing chronic hypertension

Incidence of chronic hypertension is **28%** in the first 2 years after delivery with HDP

Risk is highest in the **first 6 months** after delivery with HDP (18-fold odds vs normotensive group) compared to 1-2 years (7-fold odds)

Incidence of hypertension in the 2 years after a pregnancy without pre-eclampsia was 9.1%



Chronic disease after de novo postpartum hypertension

- ▶ Case control with 121 women with “delayed onset postpartum preeclampsia” and 26936 “uncomplicated controls”
- ▶ Subanalysis of longer term data:
- ▶ 86 cases and 169 controls had long term (>3 month) follow up data available (median 1.5 years)
 - ▶ 20.9% were still on an antihypertensive medication
 - ▶ Higher SBP (130 vs 112) and DBP (80 vs 70)
 - ▶ OR of 2.8 [1.5-2.4] of developing chronic hypertension

Redman et al, Obstetrics and Gynecology, 2019

COVID makes it worse

More HDP with COVID

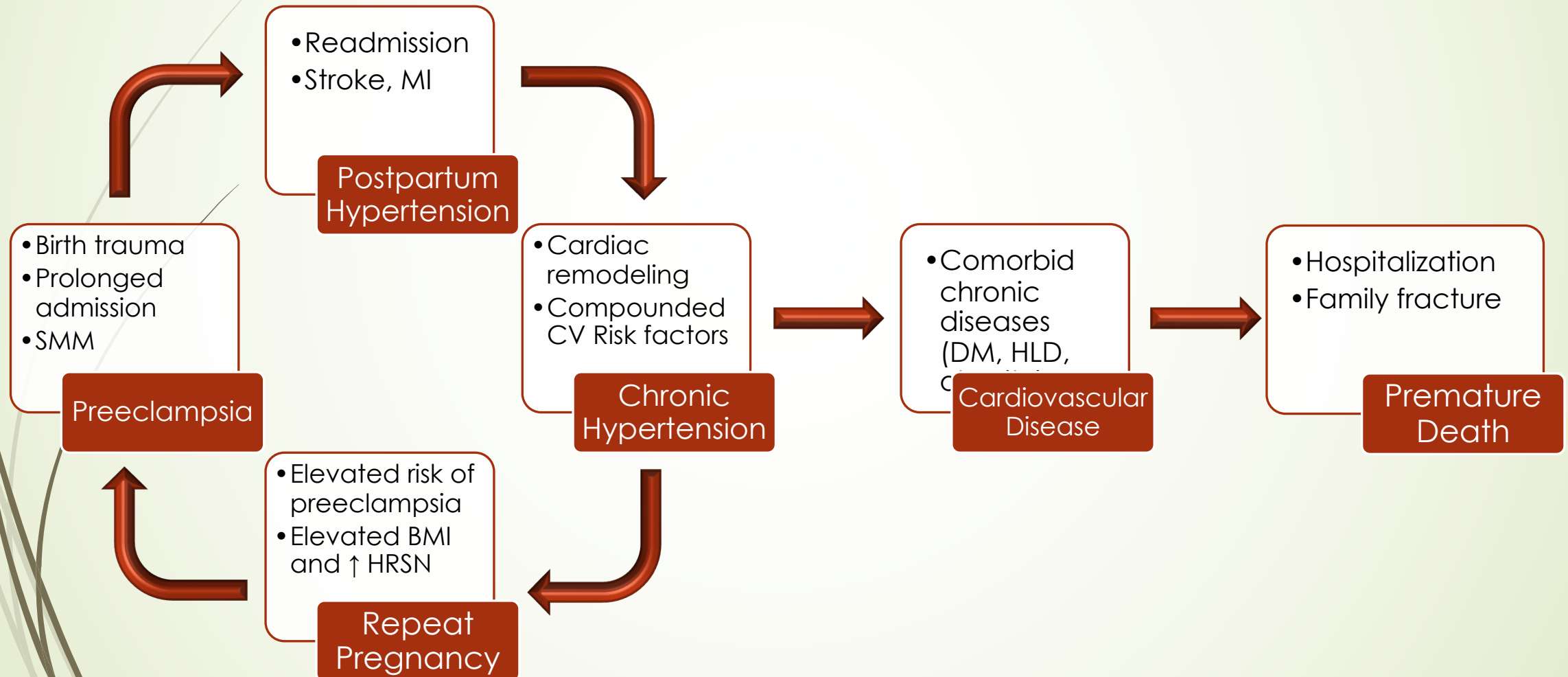
- ▶ Wei et al, Systematic review, 2021:
 - ▶ 42 studies, total N=438,548
 - ▶ Any COVID increased the risk of Preeclampsia
 - ▶ OR 1.33 (1.03, 1.73)
 - ▶ Severe COVID disease increased the risk further
 - ▶ OR 4.16 (1.55, 11.55)
- ▶ Villar et al, 2021 Multinational cohort
 - ▶ N = 2130 in 18 countries
 - ▶ Asymptomatic COVID increased the risk of preeclampsia
 - ▶ OR 1.63 (1.01,2.63)
 - ▶ Any COVID diagnosis increase the risk of preeclampsia
 - ▶ OR 1.76 (1.27,2.43)

More HTN after COVID

- ▶ Noted increase hypertension during COVID illness
 - ▶ Significant association with serum biomarkers for preeclampsia
 - ▶ Bimodal trends
- ▶ Increase chronic hypertension months after illness
 - ▶ 20.6% persistent HTN after hospitalization for COVID
 - ▶ 10.9% for non-hospitalized
 - ▶ 77.6% of US population has had COVID (7/2023)

Zhang et al, Hypertension 2023
Wei et al, CMAJ 2021
Villar et al, JAMA 2021

Lifecycle of preeclampsia





Self monitored blood pressure

American Heart Association recommends home blood pressure monitoring for all people with high blood pressure

- Help health care provider know if treatments are working

- Can confirm (or refute!) diagnosis of high blood pressure

Associated with improved outcomes:

- Lowered BP at one year

- Increases likelihood of adequate antihypertensive medication

- Improve self efficacy and trust?



What is different about postpartum?

- ▶ BP is variable day by day in the first two weeks
 - ▶ Time is more critical than adult population care
- ▶ Different framework of health interactions
 - ▶ The patient is not coming in anymore
 - ▶ There is more cardiovascular morbidity postpartum
 - ▶ 7% of maternal mortality is attributed to HDP, another 21% to other cardiac conditions
- ▶ Remote monitoring needs to be different for the postpartum person
 - ▶ Caring for a newborn
 - ▶ Cultural shift from care of self to care of other/family
 - ▶ Increase health related social needs postpartum




Postpartum remote BP monitoring is feasible and effective

- ▶ Numerous RCTs of self monitoring with text or telemedicine support
 - ▶ Increased capture of BP in the first 10-14 days post delivery
 - ▶ Increased capture of severe range BP
 - ▶ Decreased ED visits and readmissions for hypertension
- ▶ Home BP monitoring with self directed medication titration can work
 - ▶ Self directed group had LOWER mean SBP and DBP
 - ▶ Greatest difference seen at 6w postpartum
 - ▶ Self directed group had lower diastolic blood pressure after postpartum period
 - ▶ At 6,12, 26 weeks
- ▶ High levels of feasibility and satisfaction in multiple studies

Cairns et al, Hypertension 2018
Kitt et al, Hypertension 2021
Hirshberg, BMJ Qual Saf, 2018
Hirschberg et al, Obstet & Gynecol 2023
Sawyer et al, Obstet & Gynecol 2023



Lessons learned from implementing postpartum remote BP monitoring



36%
Black

50%
SPEAK PRIMARY
LANGUAGE
OTHER THAN
ENGLISH

32%
Latinx

2800
DELIVERIES PER
YEAR

BOSTON
MEDICAL
CENTER

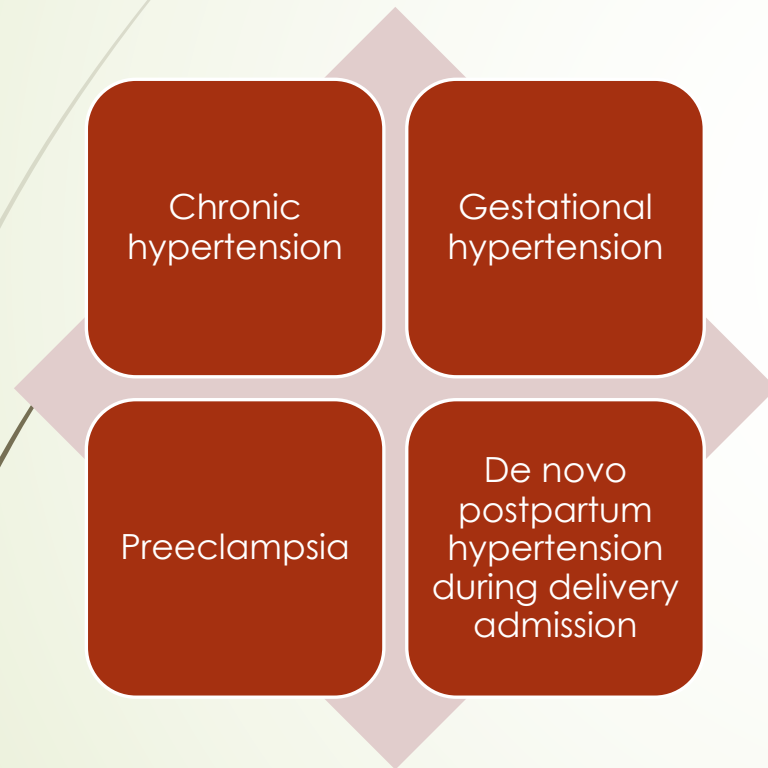
>80%
PUBLICLY INSURED
OR UNINSURED

BIRTH POPULATION:
HOSPITAL BASED
OB/GYN AND FM
PRACTICES AND 7
CHCS

> 50% HAVE AN
ANNUAL
HOUSEHOLD
INCOME BELOW
\$20,400

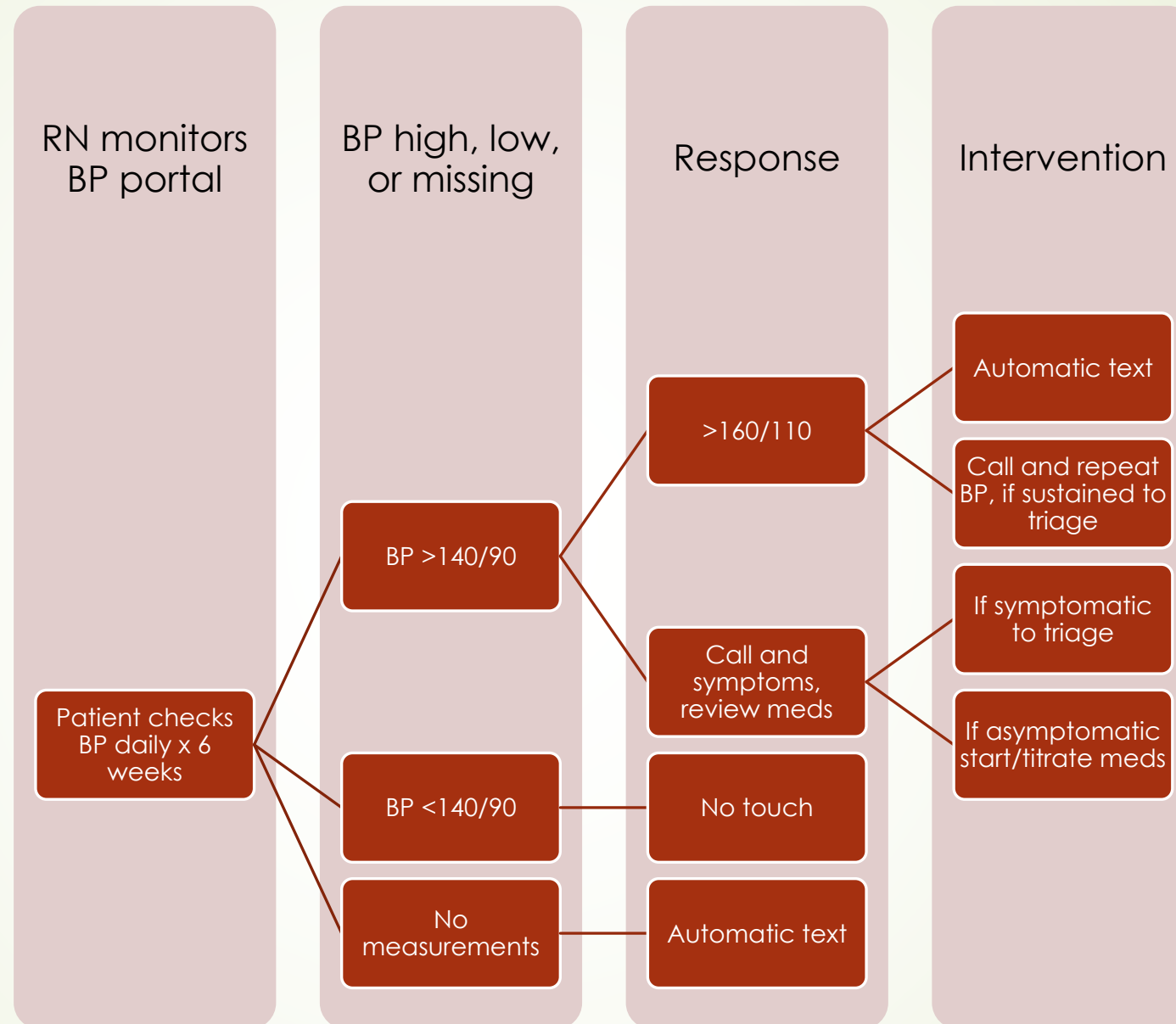
**NEW ENGLAND'S
LARGEST
SAFETY-NET
HOSPITAL**

Eligibility and Distribution of DME

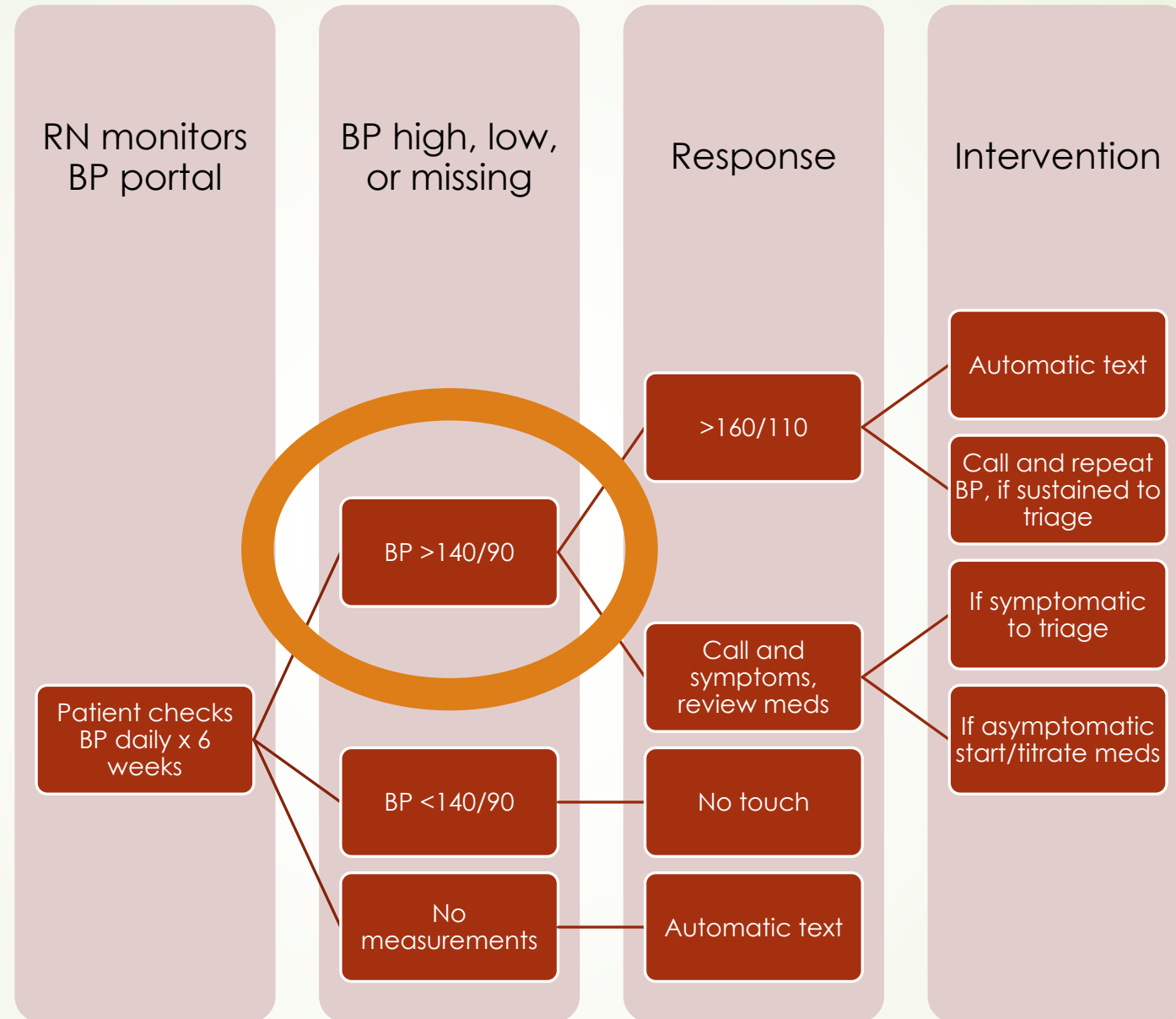


- Labor team, postpartum rounders identify risk
- DME distributed, fitted, linked to patient, EMR on postpartum unit
 - Medical students in early 2020
 - Postpartum nurses and unit coordinators
 - EPIC order with task list
- Patients instructed to check BP at home once a day for 6 weeks

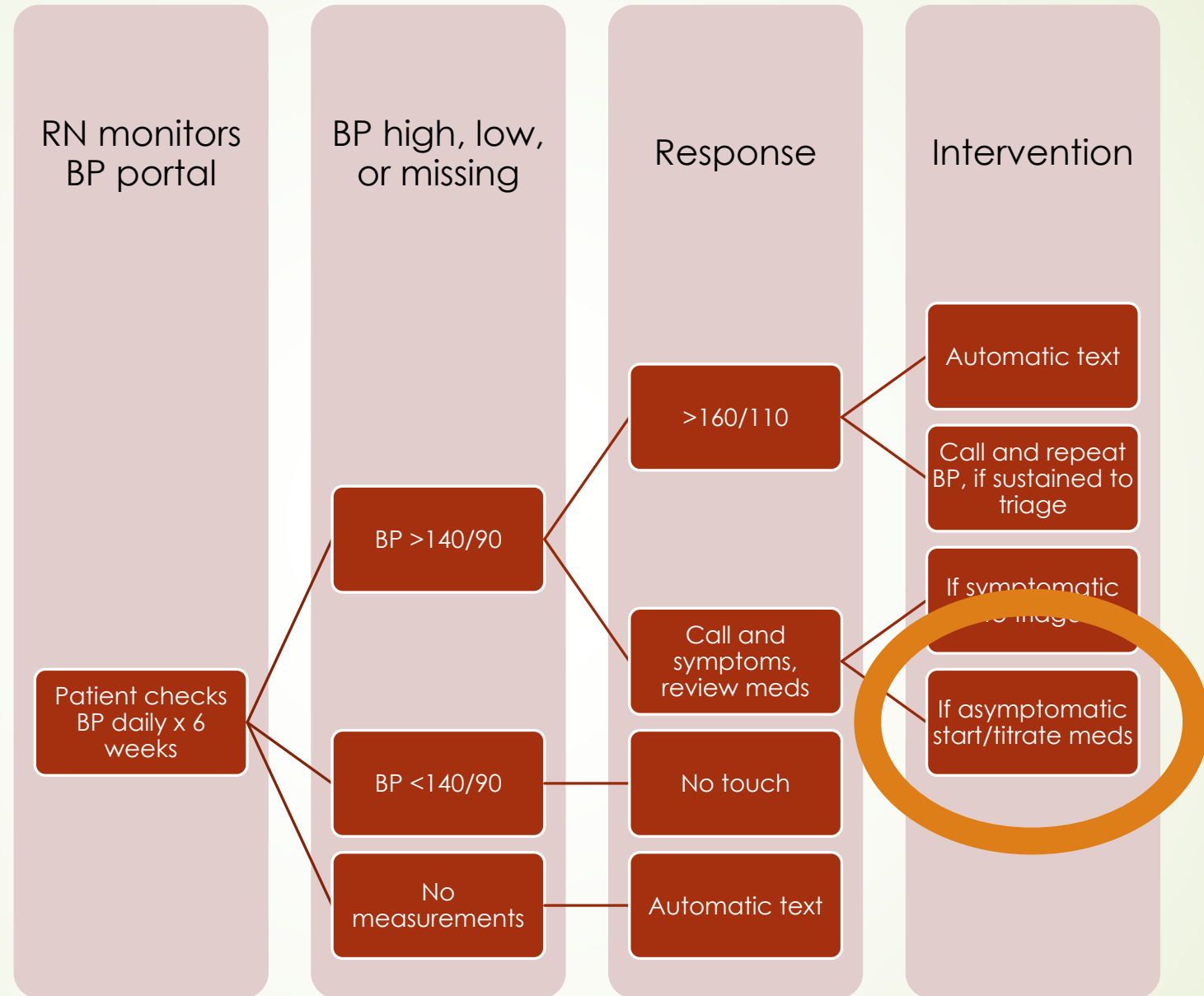
Initial rollout done with 6-8 hours of an ambulatory RN per week – typically two sessions of 3-4 hours each



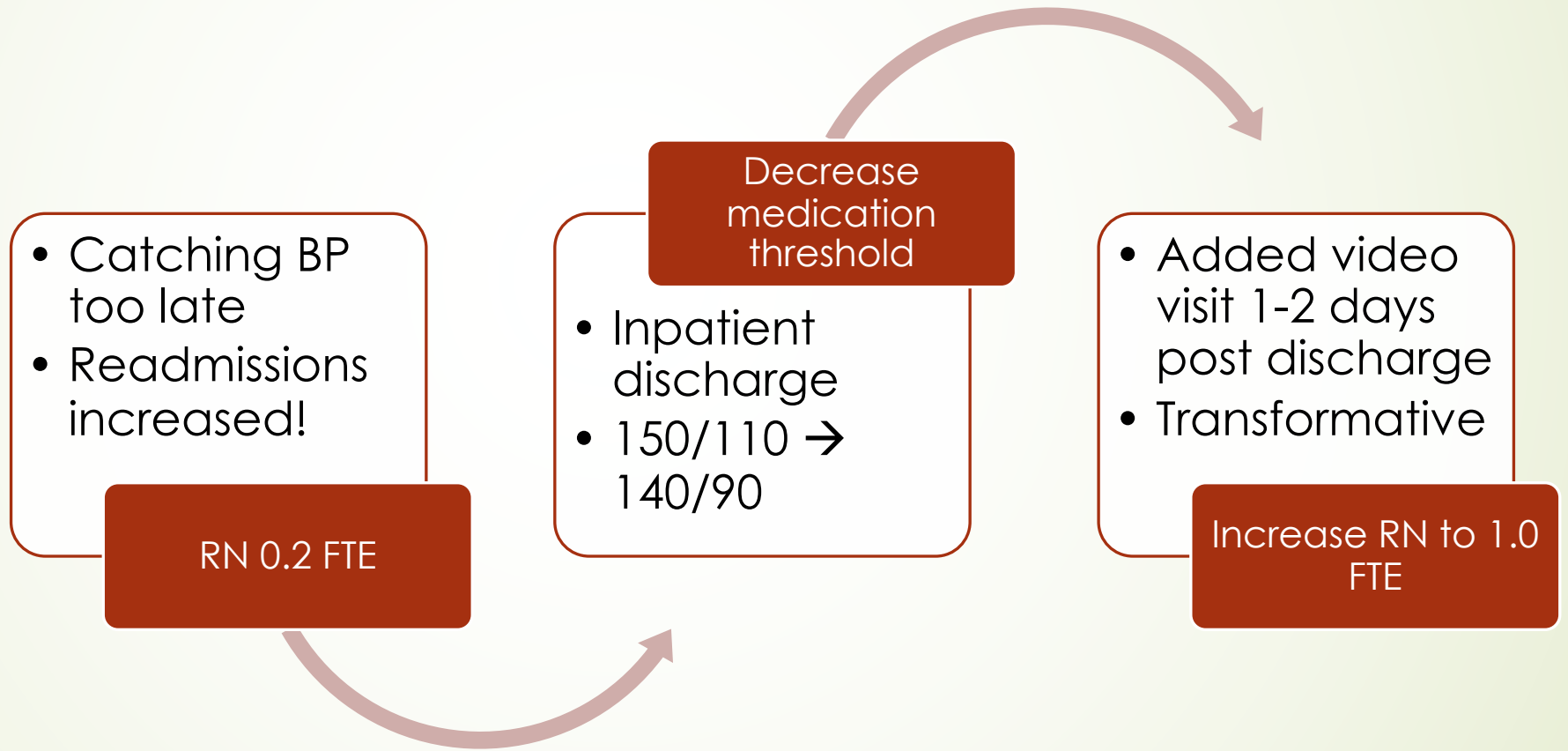
Initial rollout done with 6-8 hours of an ambulatory RN per week – typically two sessions of 3-4 hours each



Initial rollout done with 6-8 hours of an ambulatory RN per week – typically two sessions of 3-4 hours each



BP changes too quickly in the 10 days postpartum

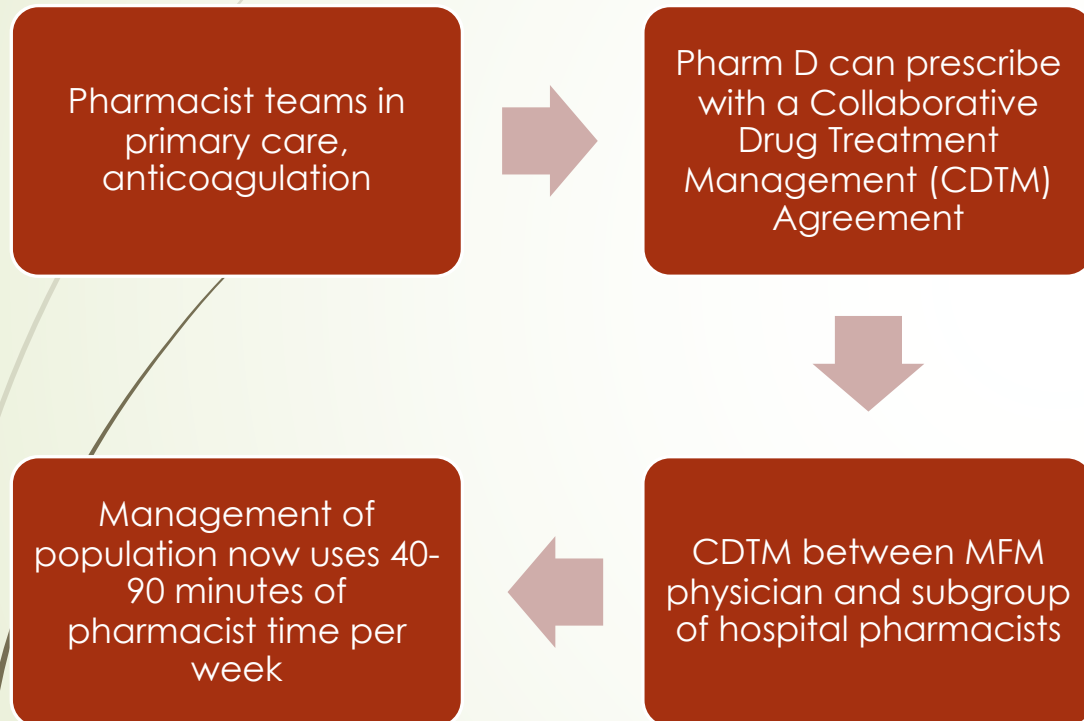


Getting a prescription

- Algorithms for medications by MFM
 - Preferred nifedipine XL for ease of use
- OB Backup physician (doc of the day)
 - Numerous roles
 - Not immediately available
 - Varying levels of comfort prescribing a medication they won't follow
- Considered other APP
- Pharmacists

Timing is
essential in
postpartum
cardiovascular
physiology!

Interprofessional collaboration with pharmacists



- Provided education about postpartum physiology, hypertension and morbidity
- Allocated pharmacist staff time each day
- Initially staffed with 1.0FTE → 0.1 FTE
- Created e-consult to pharmacist
- Pop-off to MFM

Considerations of equity and barrier assessment

	Non-Hispanic White (n=118)	Non-Hispanic Black (n=464)		Hispanic/Latine (n=388)	
Metric	Mean (SD)	Mean (SD)	p-value*	Mean (SD)	p-value*
Total Days ^a	16.9 (10.7)	15.0 (10.2)	0.0742	14.6 (10.0)	0.0319
Last Day ^b	31.0 (11.8)	31.7 (11.5)	0.5679	29.5 *12.0)	0.235

^aNumber of days out of 42 days that participants measured their BP

^bLast day a participant reported a BP measurement within the six-week postpartum period

*p-value for t-test comparing independent means among Black and Hispanic patients with White patients

Iterations of education

- Four languages capture nearly 85% of our patients

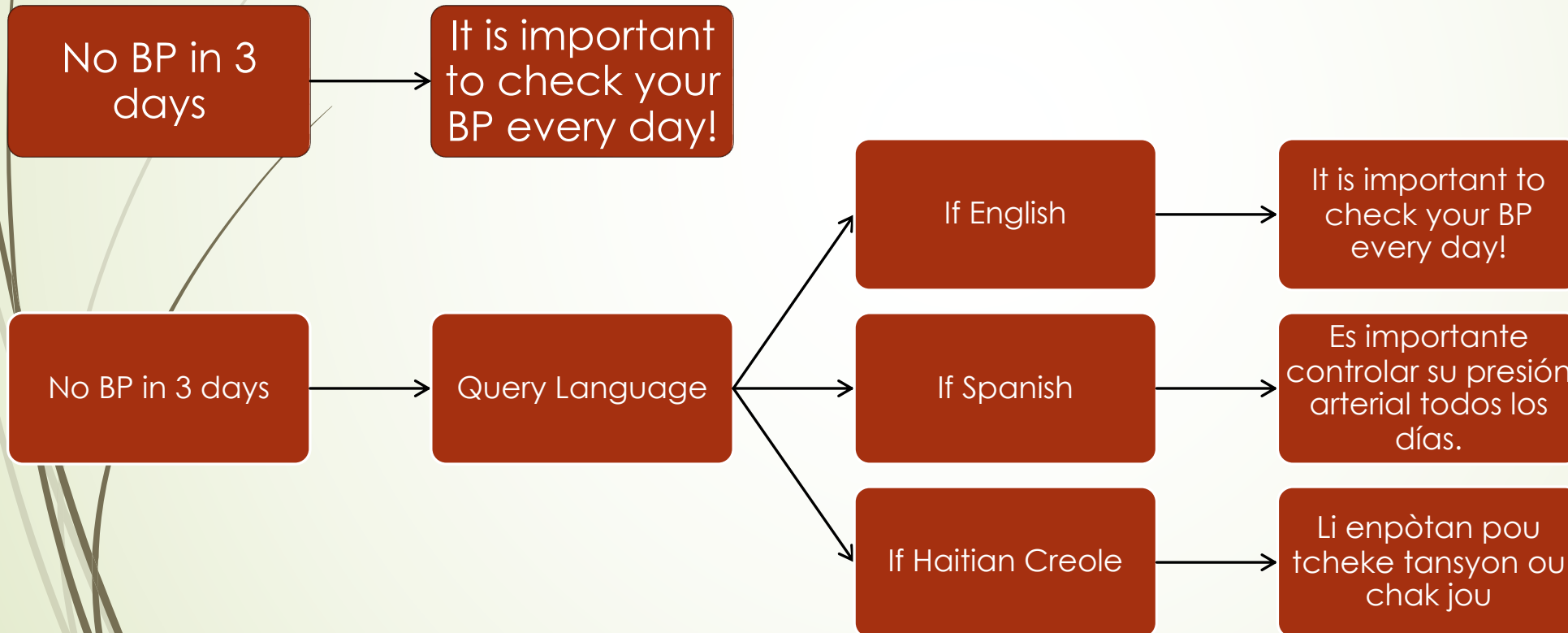
2020:

- Verbal instructions with postpartum nurse with interpreter
 - Written instructions
 - Pictorial instructions
 - Video about postpartum hypertension
 - QR
- } English
Spanish
Haitian Creole
Portuguese

2022:

- Expanded RN to full time role
- added telemedicine visit for every patient 24-48 hours after discharge

Language barriers in a texting world





Language aligned touchpoints

Initiation



Reinforcement



Nudges / Maintenance



Social barriers

Noted gap between prescription and change in BP patterns

- “I couldn’t get to the pharmacy for a few days”

Reached out to hospital pharmacy leadership

- Mail-order service used by many

Leveraged hospital pharmacy courier service

- Geriatrics, homebound
- If prescription in by 1pm it can be delivered to patient’s door by 5pm

Updated experience

Monday
9am

Patient
checks BP
and its high

RN calls or
texts, ROS

RN places E-
consult to
pharmacist

RN calls
patient to
confirm
address

RN
coordinates
with
pharmacy

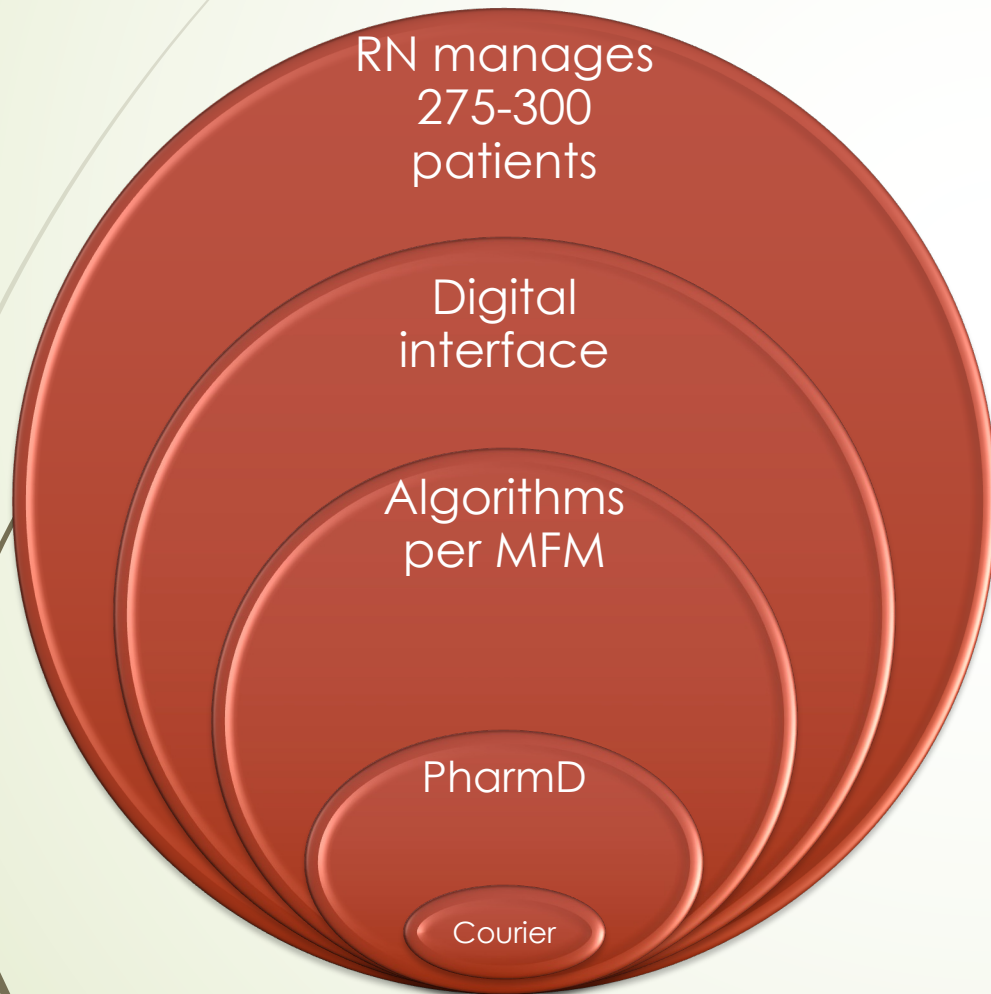
Courier
brings med
to patient's
home

Monday
5pm

Patient
takes new
medication

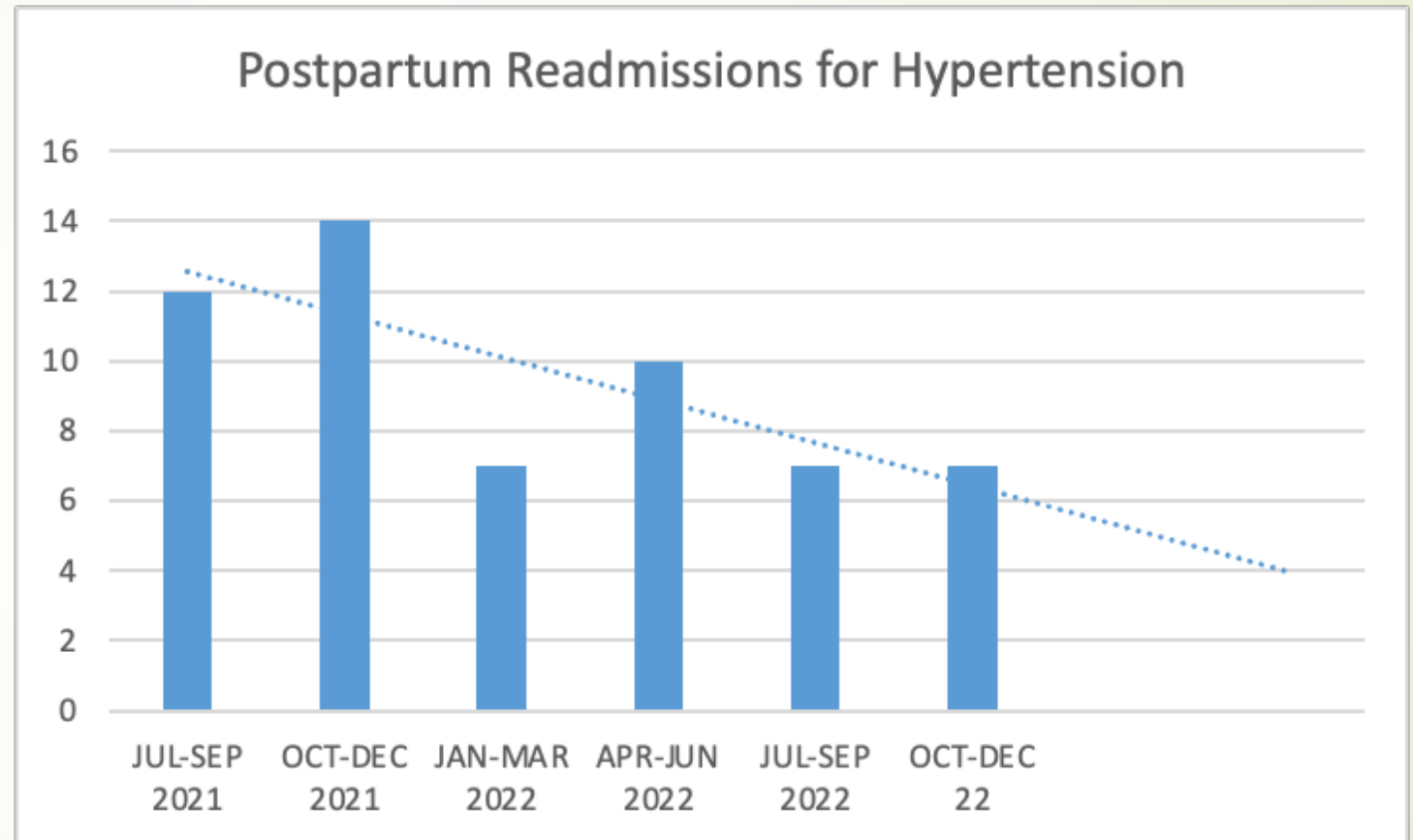


Scaling



- Iterated digital interface
- Direct data to flowsheets
- Telemedicine from RN all reimbursed
- Closed loop e-consultations
- Minimal time from pharmacist team (10 - 12/week)
- Courier only for new medications

Readmissions for hypertension are finally coming down





Lessons learned for a postpartum remote BP program

- Teaching and DME distribution should be part of postpartum discharge
- Double down on education for patients
 - Not just how but why
- Take the doctor out of the equation as much as possible
 - Algorithms
 - Consider using a pharmacist
- Keep a low threshold to intervene with medications
- All communication should be language aligned
- Consider social barriers to hypertension management

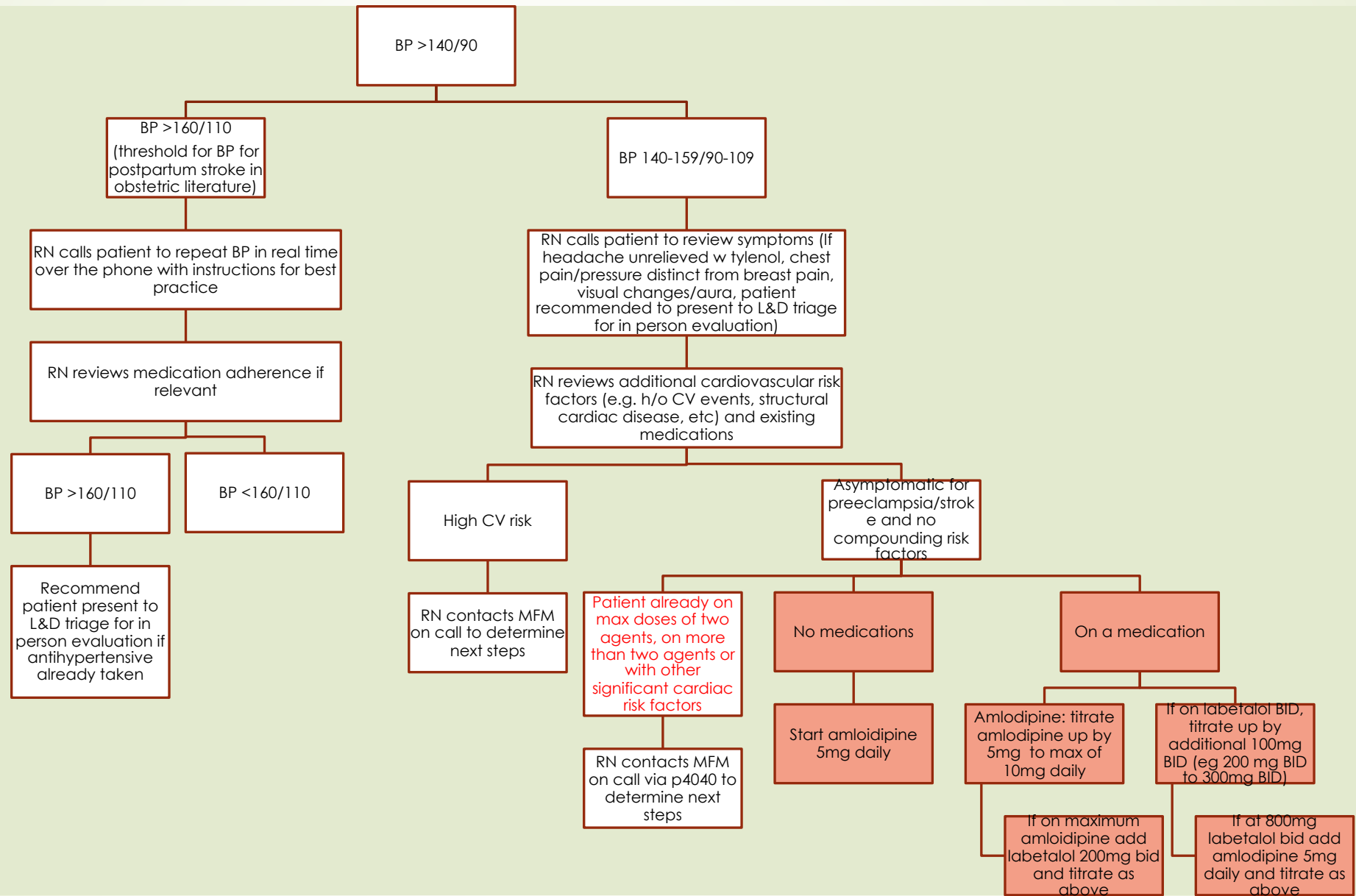


Postpartum Algorithm

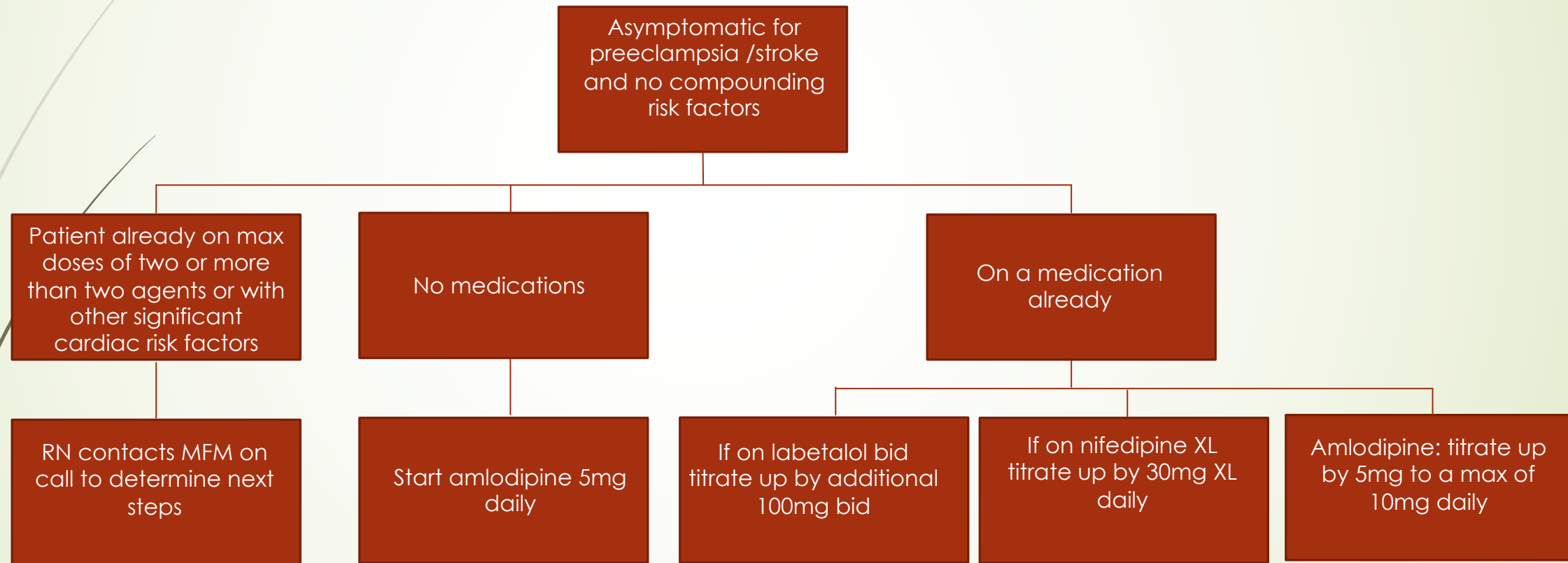
Based on daily BPs

CDTM with Pharmacists

Postpartum Hypertension



Focus on medication algorithm





Approach for antepartum population management

BP 3x/week

RN led

Dx

BP range

GA

Steps

Chronic HTN

>160/110

140-159/90-109

<20 weeks

>20 weeks

>34 weeks, or newly elevated BP or nursing concern

< 20 weeks

> 20 weeks

If missed meds, take and recheck in 2 hrs

If repeatable, recommend ED regardless of sx. If pt declines then increase medications.

Recommend L&D triage to evaluate fetus & adult wellbeing regardless of sx.

Telemedicine assessment

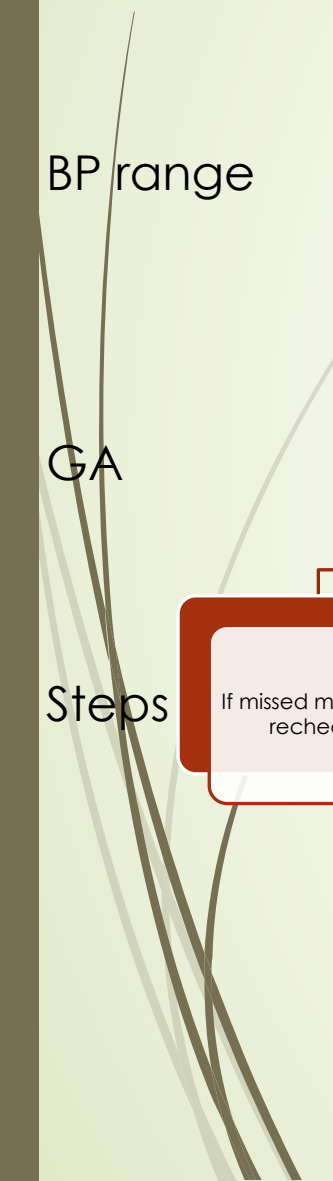
e-Consult to MFM to initiate/titrate medications

Recommend L&D triage for in-person evaluation for superimposed preeclampsia

Flag provider to arrange earlier PNF for labs, fetal testing

RN to F/up e-consult recommendations and close loop w patient

Provider and MFM will determine uptitration of medications



Dx

BP range

GA

Steps

No preexisting HTN & history of Pre-e, gHTN in prior pregnancy:

>160/110 & repeatable?

140-159/90-109 & repeatable?

<20 weeks

>20 weeks

< 20 weeks

> 20 weeks

Add chronic hypertension to problem list with two readings >4hrs apart

Recommend ED visit regardless of sx. If pt declines then initiate medications

Recommend L&D triage immediately, advise they will be in the hospital several hours and possibly overnight

Add chronic hypertension to problem list after two readings 4 hrs apart

Flag primary provider and recommend MFM consult to discuss new diagnosis of cHTN.

If occurs x 2 establishing a NEW diagnosis, recommend L&D triage for evaluation of preeclampsia

Order MFM e-consult with indication medication initiation for chronic hypertension

If BPs continue in this range, see chronic hypertension management flow

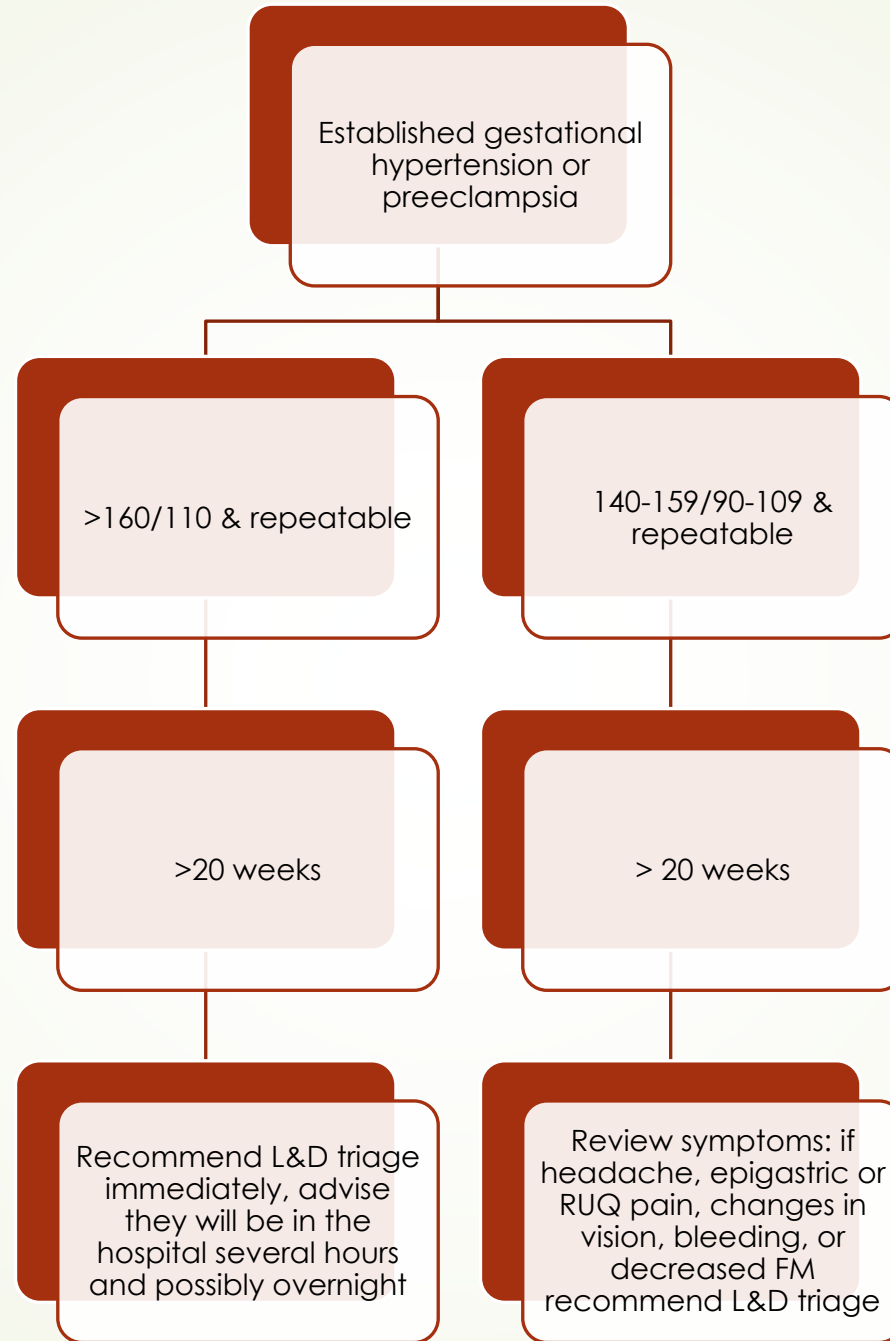
Dx



BP range

GA

Steps



NB: There is no role for outpatient medications with gestational hypertension or preeclampsia. If a patient is being managed with the assumption of chronic hypertension, their problem list should indicate chronic hypertension.



Take-aways

- ▶ There are more opportunities to improve care for pregnant people with known chronic hypertension
- ▶ Home blood pressure improves outcomes and decreases return to hospital for postpartum people with HDP
- ▶ There is a way to implement it that does not drain your system
 - ▶ Algorithms
 - ▶ Clinical partners in unexpected places

Thank you

