Ensuring safe and equitable discharge: a quality improvement initiative for individuals with hypertensive disorders of pregnancy

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► Additional supplemental material is published online only. To view, please visit the journal online (https://doi.org/10.1136/bmjqs-2024-017173).

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Received 26 January 2024
Accepted 3 April 2024

To cite: Zacherl KM, Sterrett EC, Hughes BL, *et al*. *BMJ Qual Saf* Epub ahead of print: [please include Day Month Year]. doi:10.1136/bmjqs-2024-017173

ABSTRACT

Objective To improve timely and equitable access to postpartum blood pressure (BP) monitoring in individuals with hypertensive disorders of pregnancy (HDP).

Methods A quality improvement initiative was implemented at a large academic medical centre in the USA for postpartum individuals with HDP. The primary aim was to increase completed BP checks within 7 days of hospital discharge from 40% to 70% in people with HDP in 6 months. Secondary aims included improving rates of scheduled visits, completed visits within 3 days for severe HDP and unattended visits. The balancing measure was readmission rate. Statistical process control charts were used, and data were stratified by race and ethnicity. Direct feedback from birthing individuals was obtained through phone interviews with a focus on black birthing people after a racial disparity was noted in unattended visits.

Results Statistically significant improvements were noted across all measures. Completed and scheduled visits within 7 days of discharge improved from 40% to 76% and 61% to 90%, respectively. Completed visits within 3 days for individuals with severe HDP improved from 9% to 49%. The unattended visit rate was 26% at baseline with non-Hispanic black individuals 2.3 times more likely to experience an unattended visit than non-Hispanic white counterparts. The unattended visit rate decreased to 15% overall with an elimination of disparity. A need for BP devices at discharge and enhanced education for black individuals was identified through patient feedback.

Conclusion Timely follow-up of postpartum individuals with HDP is challenging and requires modification to our care delivery. A hospital-level quality improvement initiative using birthing individual and frontline feedback is illustrated to improve equitable, person-centred care.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Equitable access to postpartum care is challenging in the USA and hypertensive disorders of pregnancy are a major contributor to morbidity and mortality. Studies on individual interventions such as telehealth and remote blood pressure monitoring have improved access to care, but comprehensive quality improvement projects using patient and frontline engagement to redesign processes are lacking.

WHAT THIS STUDY ADDS

⇒ We demonstrate the power of engaging patients and the frontline in improving care processes and decreasing inequities for postpartum individuals with hypertensive disorders of pregnancy. We add to the literature in describing a quality improvement project with a set of patient-informed and frontline-informed interventions that could be considered in other institutions.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ It is essential to engage individuals receiving care in hospital-level quality improvement work to achieve person-centred, guideline-concordant care. We highlight the need to advocate for blood pressure cuff access and the power of the individuals' voice to inform our improvement efforts and decrease inequities in care.

INTRODUCTION

Hypertensive disorders of pregnancy (HDP) are a leading cause of maternal mortality in the USA[1] and worldwide.[2] These rates have been increasing in the USA, Canada and other countries,[2] despite a decline in deaths due to other causes

such as haemorrhage. Over one-half of all pregnancy-related deaths occur post partum,[3] with HDP being a leading cause, most often from haemorrhagic stroke. Nearly one-half of strokes occur within the first 10 days after discharge with blood pressure (BP) peaking 3–9 days after giving birth.[4–7] Timely BP follow-up after discharge is critical to improve morbidity and mortality associated with HDP.

Multiple organisations worldwide have guidelines for follow-up, including the American College of Obstetricians and Gynecologists (ACOG) that recommends follow-up no later than 7–10 days post partum,[8] and ACOG's Alliance for Innovation on Maternal Health (AIM) that recommends follow-up within 3 days of discharge from birth hospitalisation for those with severe HDP.[9] The National Institute for Health and Care Excellence in the UK recommends BP follow-up every 1–2 days for those with pre-eclampsia.[10] BP follow-up has been noted to be challenging, with low attendance rates for in-person follow-up ranging from 30% to 44%; this is even lower for black individuals.[11 12] Some studies on remote BP monitoring have improved attendance, disparities and adverse events.[12–15]

Quality improvement methodology is an important tool for achieving safe, equitable, person-centred care.[16 17] Studies on timely BP follow-up in individuals with HDP have focused on single interventions, such as remote BP monitoring. A systematic, iterative approach using tools such as the Model for Improvement[17] is lacking. Patient engagement has become the cornerstone of quality and person-centred care. The Institute for Healthcare Improvement (IHI) describes patient and family engagement as at the core of designing safe, reliable and effective care.[18] Varying levels of engagement include: consultative (surveys), low level via unidirectional feedback (feedback, surveys, interviews), involvement (as advisors) and high level (codesign).[19] Grob *et al* describe patient narratives as providing 'actionability' and important to inform quality improvement work.[18]

Our objective was to implement a quality improvement project to ensure timely postpartum BP follow-up for individuals with HDP with a focus on patient-centred and equitable care. We used birthing individual and frontline feedback to help reduce disparities and create efficient workflow.

MATERIALS AND METHODS

Study setting and cohort

This project was undertaken at a large academic tertiary care centre in the USA that serves as a major regional referral centre, with approximately 4000 deliveries per year. The target cohort included individuals ≥20 weeks of gestation at childbirth hospitalisation with HDP. HDP was defined as presence of a billing or problem list diagnosis of chronic hypertension; gestational hypertension; pre-eclampsia; haemolysis, elevated liver enzymes and low platelets syndrome; eclampsia; or a severe hypertensive event. A severe hypertensive event was defined as two or more sustained (15 min or more) BPs of ≥160 mm Hg systolic and/or ≥110 mm Hg diastolic[20] during childbirth hospitalisation. Severe HDP was defined as a severe hypertensive diagnosis or a severe hypertensive event during hospitalisation. The local Institutional Review Board reviewed the project proposal including patient feedback and provided exemption from human subjects research oversight. The report of this work is outlined here, according to the Standards for Quality Improvement Reporting Excellence 2.0 guidelines.[21]

Working group

A multidisciplinary HDP working group was developed. The project team was led by an academic fellow in quality and safety, who was sponsored by physician leaders in quality and safety. Inpatient and outpatient members included a resident physician, an advanced practice provider, case managers, nursing leaders, frontline nurses, healthcare administrators and medical directors.

Measures and aims

Measures, baseline rates and aims are described in table 1. The primary process measure, completed visits within 7 days of discharge, had a baseline rate of 40%. With the absence of national benchmarks, reasonable short-term goals were chosen after examining baseline rates. The scheduled visit measure is in alignment with the AIM severe hypertension bundle data collection plan for individuals with HDP. In order to credit contact between an individual and the healthcare system prior to the universal provision of home BP devices, telehealth visits were counted as completed if nurses were able to connect with individuals and assess symptoms, regardless of whether a BP device was used at home. BP device access was tracked separately as a fidelity measure to understand where improvements were needed. Other fidelity measures were tracked to follow the uptake of our process change. Readmission rate is defined in table 1 and morbidity diagnosis codes are those recommended by the Centers for Disease Control and Prevention for severe maternal morbidity (online supplemental appendix 1).

Racial disparities in our baseline data were examined a priori with a goal of incorporating equity into our aims. A disparity in baseline unattended visit rates among non-Hispanic black individuals was noted with non-Hispanic black individuals having an unattended visit rate of 31.7%, compared with 16.7%, 15.4% and 17.7% for Asian, Hispanic and non-Hispanic white individuals, respectively.

Table 1 Project measures with definitions

Type	Measure	Operational definition	Baseline rate (%)	SMART aim
Primary process	Completed BP check within 7 days of discharge in all individuals with HDP	N: number of individuals with HDP completing BP check visit or a single reviewed BP in remote monitoring within 7 days after discharge D: total individuals with HDP discharged after childbirth	40	To increase from 40% to 70% within 6 months (6 October 2022 to 6 April 2023)
Secondary process	Scheduled BP check within 7 days in all individuals with HDP	N: number of individuals with HDP discharged with scheduled follow-up visit within 7 days after discharge or order placed for remote monitoring D: total individuals with HDP discharged after childbirth	61	To increase the rate of visits scheduled within 7 days from 61% to 85% within 6 months
Secondary process	Unattended visit rate	N: number of individuals in denominator that do not attend visit or without a BP entered in flow sheets D: number of individuals with HDP with scheduled follow-up visit within 7 days after discharge or order placed for remote monitoring	26	To reduce the unattended visit rate from 26% to 12% within 6 months
Secondary process	Completed BP check within 3 days of discharge in individuals with severe HDP	N: number of individuals with severe HDP completing BP check visit or a single reviewed BP in remote monitoring within 3 days after discharge D: total individuals with severe HDP discharged after childbirth	9	
Balancing	Readmission rate	N: number of individuals in HDP cohort with inpatient readmission within 6 weeks with the admitting diagnosis of hypertensive grouper (+O15), puerperal cerebral disorder, eclampsia, cardiomyopathy, pulmonary oedema/acute heart failure or discharge diagnosis of puerperal cerebral disorders, eclampsia, cardiomyopathy, pulmonary oedema/acute heart failure D: total individuals with HDP discharged after childbirth	3	
Outcome	Morbidity rate	N: number of individuals in HDP cohort with inpatient readmission with diagnosis of eclampsia, cardiomyopathy, pulmonary oedema/acute heart failure or any hypertensive admitting diagnosis who go to ICU during readmission within 6 weeks after discharge D: total individuals with HDP discharged after childbirth	0.13	

BP, blood pressure; D, denominator; HDP, hypertensive disorder of pregnancy; ICU, intensive care unit; N, numerator; SMART, specific, measurable, achievable, relevant, time-bound.

Our goal was to reduce this disparity in unattended visits with significance determined using ORs.

Preintervention state

The project lead (KZ) shadowed frontline teams to create a current state process map from postpartum to the BP visit (online supplemental appendix 2). The process of scheduling visits was wasteful and complex. A Pareto chart (figure 1) identified the three most common causes of failures in BP checks: BP visits not scheduled, unattended visits and individuals without a home BP device. Discharge days when case managers were unavailable had higher failures as well. Highly variable practice patterns were discovered through review of the electronic medical record (EMR; Epic, Verona, Wisconsin). Within the EMR, BP check visit 'types', nursing documentation of visits and location of BP documentation were inconsistent. There was no provider consensus on whether the 1-week BP visit standard was measured from date of parturition or discharge, and it was common not to schedule individuals with chronic hypertension for BP checks.

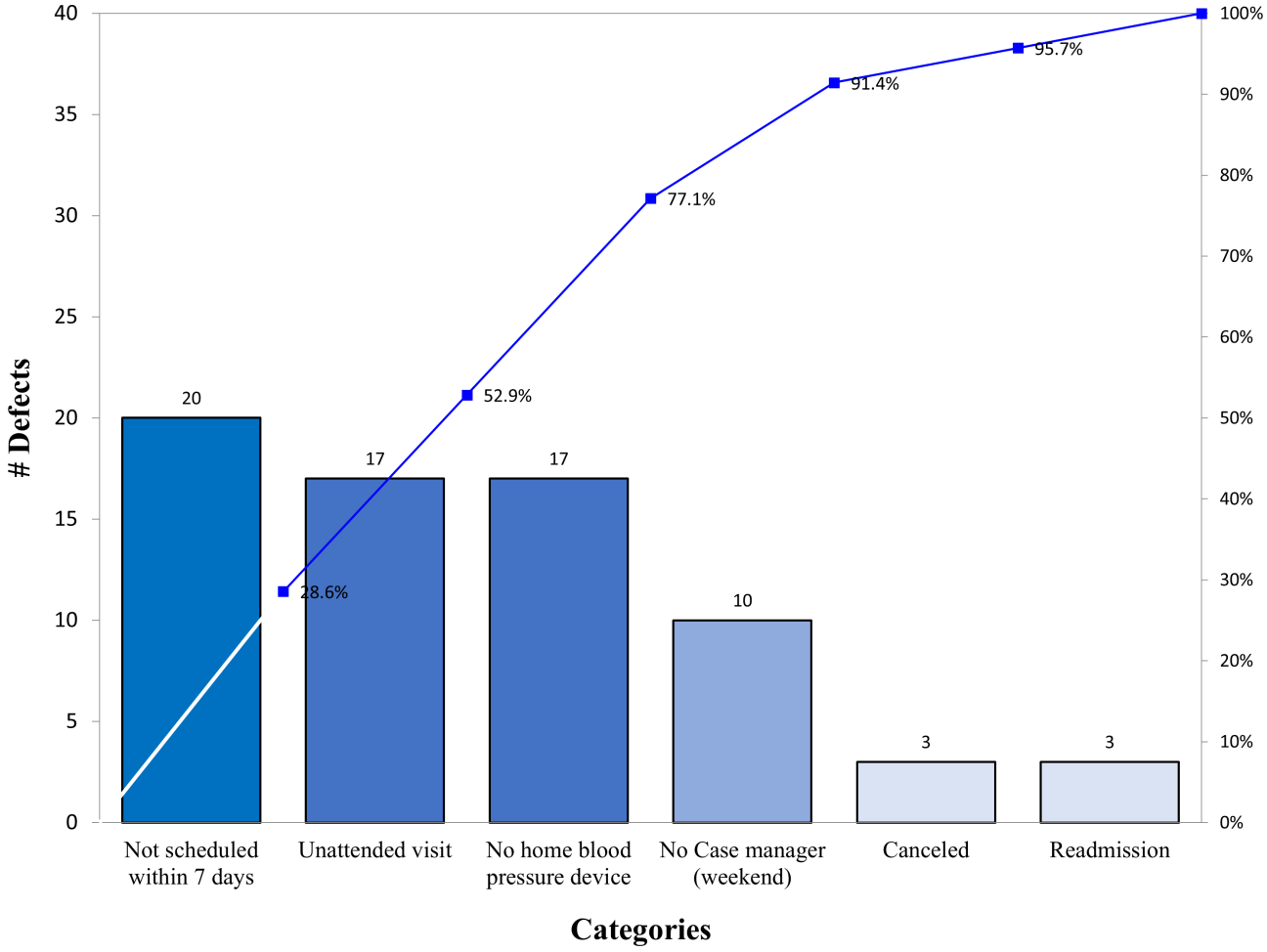

Figure 1 Pareto chart of reasons for failing to complete a blood pressure (BP) follow-up visit. The three main causes of failure to complete a BP follow-up visit include (1) visits not scheduled within 7 days of discharge, (2) unattended visit and (3) individuals not obtaining BP devices by the time of their BP visit. Data were compiled during preintervention state.

Interventions

To simplify the ACOG guidance on follow-up and streamline workflow, a single departmental standard of a BP check within 3 days of discharge for all individuals with HDP was chosen by our departmental quality and safety committee. A failure modes and effect analysis (online supplemental appendix 3) and key driver diagram (figure 2) were created to develop change ideas.

Primary interventions included:

1. Launch of initiative: Presentations were made to ambulatory and inpatient teams of providers, nurses, case managers and leaders on 6–12 October 2022, regarding the new departmental guidelines for BP follow-up. A visionary theme and elevator pitch were used to establish the 'why' of the project, entitled 'Let their voices be heard', telling the story of two women who died from complications of pre-eclampsia and highlighting racial disparities.[22 23]
2. Telehealth: A telehealth visit, defined as a phone or video visit conducted by a nurse or provider that addresses hypertension, was offered to all individuals with HDP. Patient feedback on this process was obtained after attended and unattended visits to understand the patient experience.
3. Standard work: Recommendation for 3-day follow-up and a prompt for choosing virtual or in-person visits were added to pre-existing discharge provider progress note templates on 12 October 2022. Feedback from individuals with HDP informed us that the reason for visit was confusing. Moreover, visit tracking required manual review to identify visits that were BP checks. To improve this, unique EMR visit types of 'BP check' and 'BP check (telephone)' were implemented at the primary office, then scaled to all offices (online supplemental appendix 4). After uptake of telehealth, the unattended visit rate appeared falsely low in comparison to manual chart review; a standardised process was therefore developed to accurately record unattended telehealth visits. Feedback regarding this follow-up was also obtained by calling individuals with HDP who attended and did not attend these visits to understand how the process was working from their perspective.
4. Education: Education from the Preeclampsia Foundation[24] and quick response (QR) code links to videos in English and Spanish, for attachment to discharge instruc-

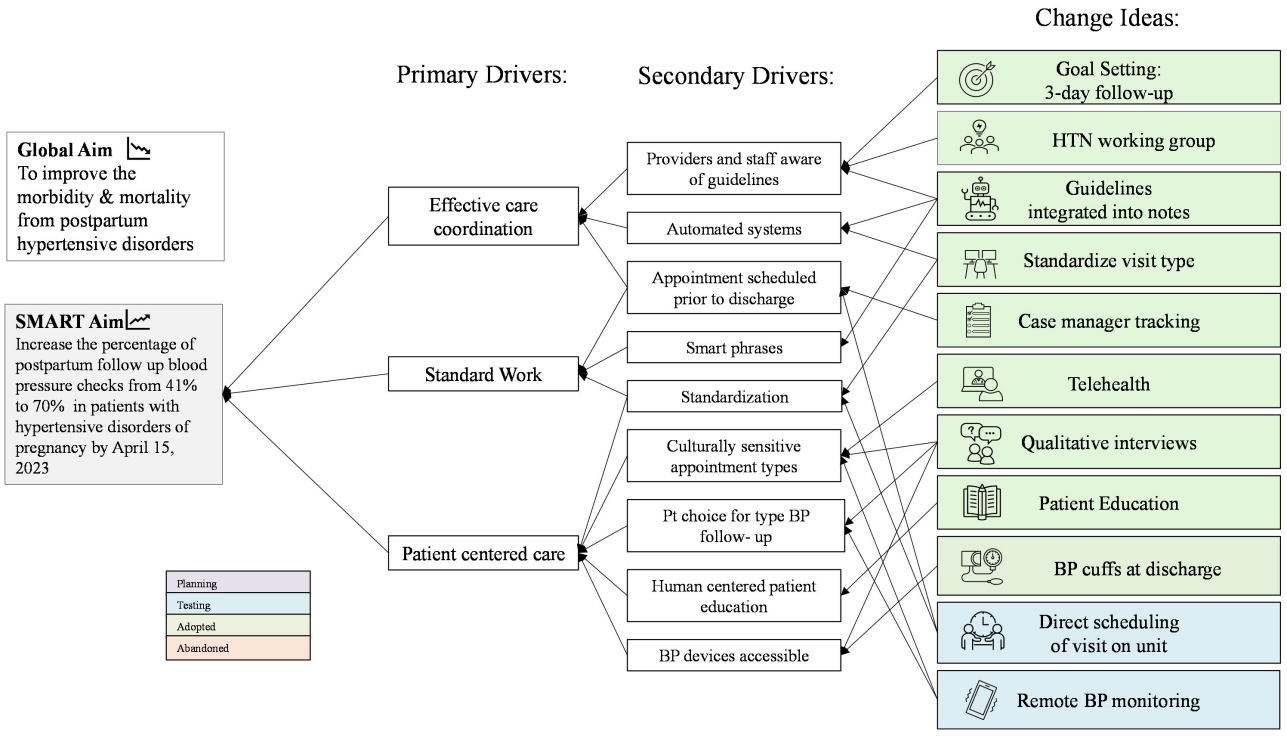

Figure 2 Key driver diagram. Current state of interventions is shown in the legend and colour coded. BP, blood pressure; Pt, patient; SMART, specific, measurable, achievable, relevant, time-bound. HTN, hypertension.

tions, were available beginning 6 October 2022. Videos were available in English and Spanish and information on the Preeclampsia Foundation website in all other languages spoken by individuals in our population. Dissemination was tracked as a fidelity measure and audit and feedback performed, with improvements from 24% to 65% (online supplemental appendix 4). QR code stickers were placed on BP devices to assist in nursing education at discharge to improve this further.

5. Case manager tracking: Inpatient hospital case managers (with nursing or social work degrees) initiated a detailed log of discharge needs for individuals with HDP, including status of scheduled follow-up, BP device and follow-up visit on discharge paperwork to promote completion.
6. Remote BP monitoring: We initiated the build of a patient platform, 'Care Companion' (Epic), into our institution's EMR to create daily smartphone notifications to individuals to upload BPs to their chart. Online supplemental appendix 5 depicts the process map and online supplemental appendix 6 shows screenshots of the patient platform. This system was piloted with one individual and slowly scaled up to our current state of all individuals with HDP at one office location on 29 April 2023, while obtaining direct feedback from patients, providers and nurses to develop the optimal process and identify errors. We plan to individualise follow-up with individual choice for remote, virtual or in person once testing is completed, and a high proportion of individuals report at least one BP in 7 days.
7. BP device provision: A nurse-driven protocol was implemented in February 2023 for the concurrent prescription of BP devices and baby aspirin during antepartum nurse intake visits for individuals at high risk for preeclampsia.[25] Additionally, by presenting postpartum BP follow-up as essential for safe discharge, approval was obtained from hospital leaders to provide BP devices to all discharged individuals with HDP at cost to the hospital. A low-cost semiautomatic BP monitor (American Diagnostic Advantage 6012N, sizes adult and large) was identified, a new workflow developed, nursing education completed and BP device provision began on 6 May 2023 (online supplemental appendix 7).
8. Scheduling of BP visits by inpatient staff: A process was created for BP check scheduling to be done by hospital staff at discharge (online supplemental appendix 7) to eliminate waste, improve efficiency and have appointments made prior to discharge with the ability to schedule on weekends/holidays. This was to overcome the failures found on days when case managers were not present. This system was codesigned with the frontline staff. Training is currently occurring with implementation in the near future.
9. Dashboard: An automated dashboard was built for use in displaying performance in postpartum units for discussion at huddles during the start of BP device provision (online supplemental appendix 8).

Engagement of individuals receiving care with a focus on equity to understand successes and failures was obtained throughout the initiative. Direct feedback from individuals with HDP was obtained via phone calls by the project lead (KZ) and a medical student (KMW) to those scheduled for BP follow-up

as either in person, telehealth or through remote BP monitoring. The discussion script for questioning is provided in online supplemental appendix 9. Individuals were identified by randomly selecting those on the outpatient nurse schedule for a given day as well as those signed up for remote BP monitoring at discharge. Feedback was recorded in written form to identify barriers and create actionable person-centred interventions. On recognising a disparity in unattended visits, a focus on black individual experience was performed by calling black women who had an unattended BP visit to understand what barriers these individuals faced. Feedback was organised into themes to identify trends. We also engaged the frontline for the design and assessment of interventions to ensure we created an efficient and easy process.

Analysis

Statistical process control charts (p-charts) were used to track key measures over time. Special cause variation was defined following the IHI rules.[26 27] The outcome measures of morbidity and mortality were reported as baseline versus postintervention percentiles and not in a time series, given low occurrence of cases. Each morbidity was reviewed for learning opportunities and to explore the impact of this project on the individual's care. Baseline data were audited by manual chart review for creation of an automated dashboard. A 6-month baseline period was defined from 1 April to 5 October 2022, and an 8.8-month intervention period from 6 October 2022 through 30 June 2023. Readmission and morbidity/mortality were followed through 15 May 2023 discharge to capture all events within 6 weeks of discharge. Data were analysed using Microsoft Excel QI Macros 2022.[2]

RESULTS

Baseline and demographic data

The institutional rate of HDP was 37% (1786 individuals with HDP/4865 deliveries) during the study period. Table 2 displays demographics in the baseline versus postintervention time periods with individuals similar in terms of age, race and ethnicity, type of HDP and primary language. Telehealth visits comprised 37.5% (183/304) of BP checks at baseline.

Table 2 Characteristics of cohort of individuals with hypertensive disorders of pregnancy

Patient characteristics	Pre-intervention 1 April 2022 to 5 October 2022	Post-intervention 6 October 2022 to 30 June 2023
Total individuals with HDP	785	991
Race and ethnicity, n (%)		
Asian	30 (3.8)	44 (4.4)
Hispanic	136 (17.3)	205 (20.3)
Non-Hispanic black	324 (41.3)	383 (37.9)
Non-Hispanic white	266 (33.9)	320 (31.7)
Other	14 (1.8)	17 (1.7)
Not reported/ declined	15 (1.9)	41 (4.1)
Age at parturition, mean	30.6	30.2
Insurance, n (%)		
Medicaid or other government	376 (48)	455 (51)
Private	401 (51)	423 (48)
Type of HDP, n (%)		
Chronic hypertension	192 (24.5)	186 (21)
Chronic hypertension with superimposed pre-eclampsia	43 (5.5)	71 (8.0)
Gestational hypertension	295 (37.6)	350 (39.5)
Pre-eclampsia	91 (11.6)	104 (11.7)
Severe pre-eclampsia	146 (18.6)	174 (19.6)
Unspecified hypertension	18 (2.3)	18 (2.0)
Primary language, n (%)		
English	700 (89)	782 (88)
Spanish	75 (10)	107 (12)
Other	10 (1.3)	14 (1.6)

No significant difference between populations at baseline and post-intervention.
HDP, hypertensive disorder of pregnancy.

Interventions

A total of 24 PDSA (Plan-Do-Study-Act) cycles were performed following fidelity and process measures with adjustments of interventions and creation of standard work (online supplemental appendix 4).

Process measures

All process measures showed improvements, meeting criteria for special cause variation based on 8 or more points above or below the mean (figure 3). The primary process measure of completed BP visits within 7 days improved after the roll-out and telehealth intervention from 40% to 70% and a second improvement to 76% after case managers kept a detailed log, meeting our SMART (specific, measurable, achievable, relevant, time-bound) aim (figure 3A). Scheduled visits within 7 days also met our goal with two process positive shifts. The first process shift from 61% to 77% was associated with the project launch and telehealth interventions and the second shift to 90% was associated with a detailed case manager log of BP discharge needs (figure 3B). Higher reliability of performance during the last 11 weeks was associated with remote home BP monitoring. Completed visits within 3 days for individuals with severe HDP improved from 9% at baseline to 49% (online supplemental appendix 10). The unattended visit rate improved from 26% to 15% (figure 3C) after individual feedback was obtained and

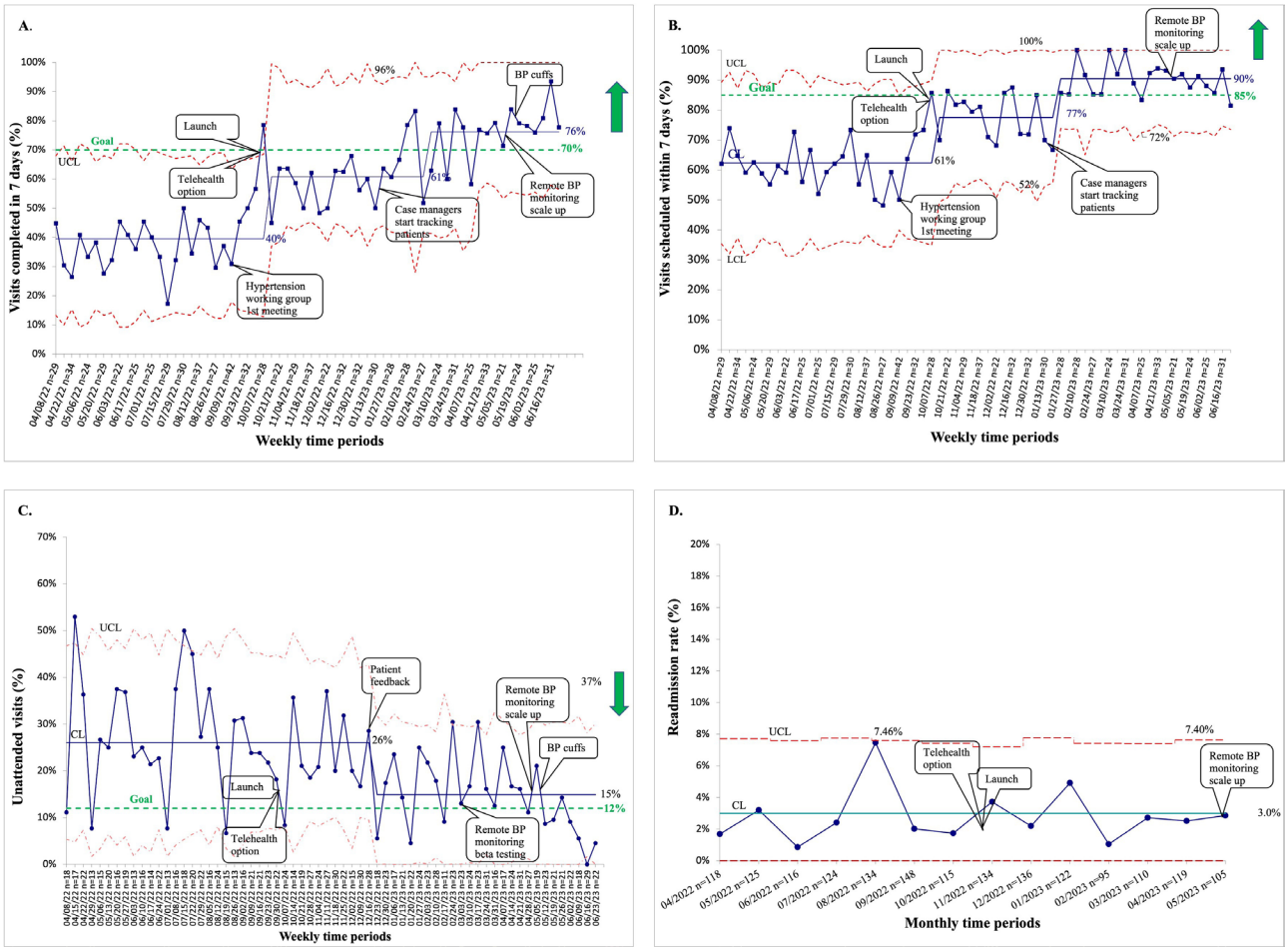

Figure 3 Statistical process control charts (p-charts) for process and balancing measures for individuals with hypertensive disorders of pregnancy (HDP). UCL= Upper control limit; LCL= Lower control limit; CL= Center line. (A) Completed visits within 7 days of discharge in all individuals with HDP. (B) Scheduled visits within 7 days of discharge for all individuals with HDP. (C) Unattended visits for all individuals with HDP. (D) Readmission rate for individuals with HDP. BP, blood pressure.

on track for another shift after BP cuff provision with 7 points below the mean.

Balancing measure

The readmission rate was 3% at baseline, without change after interventions (figure 3D). The median readmission duration was 1.0 days and the time from discharge to readmission was 5.0 days.

Outcome measures

Morbidity and mortality rates had no significant change and were 0.13% (1/785 individuals with HDP) and 0% at baseline and 0.20% (2/991 individuals with HDP) and 0% post-intervention. There were two cases of cardiomyopathy in the setting of pre-pregnancy cardiomyopathy, with one each at baseline and post-intervention; and one case of acute pulmonary oedema post-intervention.

Fidelity measures

Several fidelity measures were followed and are described in PDSA cycles (online supplemental appendix 4), including BP device attainment, telehealth uptake and remote BP reporting. Patient feedback with changes to our interventions was essential in improving fidelity of measures. For remote BP monitoring, the percentage of individuals entering at least one BP value within 7 days of discharge improved from 42% (5/12) in March 2023 to 54% (65/120) during the scaling up phase. Several issues of remote monitoring were identified through parturient, nurse and provider feedback. Current challenges are the barrier of downloading the EMR application onto smartphones and the relative frequency of blocked banner notifications. Our planned change ideas include escalating efforts to enrol individuals in remote monitoring antepartum and encouraging the electronic portal application download for individuals prior to hospital admission.

Disparity in unattended visit rate

There was a disparity in unattended visit rate at baseline, with non-Hispanic black individuals being 2.3 times more likely than non-Hispanic white individuals to have an unattended visit (OR 2.3, 95% CI 1.33 to 3.53, p=0.002); the disparity was not present post-intervention (OR 1.29, 95% CI 0.68

to 3.27, p=0.314). We documented feedback from black individuals with HDP and summarised feedback into themes (online supplemental appendix 11). The understanding helped obtain buy-in from leadership regarding process changes that were important to birthing individuals.

DISCUSSION

This quality improvement project engaged individuals receiving care and the frontline in the redesign of care processes to achieve safe and equitable discharge for women with HDP. We observed statistically significant improvement in completed and scheduled BP visits within 7 days of discharge from 40% to 76% and 61% to 90%, respectively, exceeding our goals. Completed visits within 3 days of discharge for parturients with severe HDP did show significant improvement from 9% to 49% but was more challenging and has not yet reached a high level of performance. The unattended visit rate improved from 26% to 15% with elimination of disparity for black individuals with use of individuals' suggestions and feedback to inform interventions. This feedback helped to understand barriers and bring in the patient voice which led to the subsequent provision of BP cuffs to all parturients with HDP. The most impactful interventions included the project launch and establishing the 'why' of the project, telehealth, engaging case managers and remote BP monitoring. We achieved success through an iterative quality improvement process using patient-informed interventions with a focus on inequities not only to meet national guidelines for individuals with HDP but to improve inequities in care.

Lessons learnt

Engage individuals receiving care. Obtaining feedback from women with HDP was an invaluable component for making effective, equitable care. Furthermore, by focusing on populations that experienced inequities in access to care, we learnt directly how best to serve them. The tracking of fidelity measures of interventions and subsequent use of patient feedback on the barriers to improvement allowed us to iteratively improve and create a process that works for those we aimed to help. Access to BP monitors was a significant concern for the black women in our population and using their voice helped obtain buy-in from leadership on the importance of providing BP machines at discharge. Following individuals closely during the implementation of remote BP monitoring allowed us to address any technical or patient experience concerns swiftly. In implementing telehealth, we learnt directly from those receiving care that they were unaware of the appointments. Further, we were able to identify the root causes through feedback and direct observation that the appointments were not being made prior to discharge and the reason for visit was unclear.

Engage frontline staff. To create an efficient and sustainable process that avoids failure, engaging the frontline staff is vital. With the tracking of fidelity measures related to frontline workflow, obtaining feedback from the frontline helped understand the barriers to improvement. Our fidelity measure of providing education at discharge was low and failed to improve with reminders to providers. Suggestions from frontline nurses are what improved this measure. Nurses proposed QR code stickers on BP devices with educational videos, which provided valuable education with less work, was built into standard work and was more valuable form to those receiving care. Our frontline staff was also involved in creating lean processes for distributing BP cuffs and processes for efficient nursing workflow for telehealth and remote BP monitoring.

Data collection. Data collection is complex and a barrier to identifying gaps in measures. The Society for Maternal-Fetal Medicine (SMFM) Special Statement acknowledges this and proposes using claims data or manual auditing of cases[28]; however, these methods can be unreliable and unsustainable. Developing specific EMR BP visit types ('BP check') allowed for the creation of reliable data and clarity on discharge paperwork, which might be adopted at other institutions.

The 3-day metric is challenging. While we observed a significant improvement in this metric, performance was substantially lower than for 7-day follow-up. We made this practice guideline change for all individuals being discharged at the launch of this project without realising the nuances and challenges of this change. We quickly learnt the importance of starting small and slowly scaling up, which we then applied to other interventions. Barriers to the 3-day follow-up included access to BP cuffs, patient awareness of the visit and scheduling done by outpatient (as opposed to inpatient) staff. Prior studies using remote monitoring provided BP devices to individuals.[12 13 29] Access to BP devices at the time of hospital discharge is essential to meet this metric. We agree with the SMFM statement on the importance of scheduling ability after-hours and on weekends.[28] This metric was a struggle even in our integrated healthcare system, where the same providers and EMR exist in the office as the hospital. Non-integrated health systems may encounter even more challenges in coordinating follow-up. BP cuff access for all individuals with HDP, remote home BP monitoring and care coordination through case managers (or nurse navigators) need to be priorities and are vital for improving inequities and access to care.

Remote BP monitoring has a learning curve. Implementing a new remote monitoring system requires prompt feedback from individuals receiving care and the frontline for optimisation. Barriers to our EMR-based system included: need for individuals to

download the application and activate notifications, password requirements and notification fatigue. Incorporating home monitoring systems during antepartum care would help familiarise individuals with these systems for success in the postpartum period. Another barrier was the inability to notify the clinical team by means other than EMR messages. Text-based platforms[13] have incorporated texts to physicians for prompt contact with individuals during non-business hours. It is important to recognise that remote monitoring systems are complex and require continuous improvement strategies tailored to the institution.

The IHI's White Paper, *Achieving Health Equity: A Guide for Health Care Organizations*,[30] acknowledges the lagging progress on incorporating equity as one of the six aims from the Institute of Medicine's 2001 report, *Crossing the Quality Chasm*, describing equity as the forgotten aim. They describe a framework for organisations to strive for health equity and specific strategies to have a direct impact, including analysing data for disparities, tailoring quality improvement efforts to meet the needs of marginalised populations and the use of focus groups to build trust in communities. We add to this framework by giving practical means of using the patient voice in an iterative way throughout an improvement project to address inequities. Although there is a body of literature on using patient narratives to guide improvement, there is little on the power of patient engagement to reduce inequities. Green *et al* give support to this approach in which they use an iterative process with focus groups and interviews of black birthing individuals to create a framework to address maternal health disparities.[31] A limitation of our work is that we waited until finding a disparity in unattended visits to address inequities. Beginning improvement work with considering the needs faced by populations with worse health outcomes, which is advised by the IHI—in our case black women with higher maternal mortality—should be considered, without needing to first find disparities in local data.

Engagement by those receiving care enhanced our work and helped create processes that worked best for them. In the future, engagement by those experiencing inequities at a higher level (within improvement committees for example) to allow for the codesign of processes would enhance our improvement work to achieve higher reliability and sustainability. Other limitations of our work include not yet achieving similarly high-level BP remote reporting by individuals as seen in text-based programmes that have achieved 97% entering at least one BP in 10 days.[32] One reason may be that we manage severe BPs with hospital admission, while others[15 33] have used an algorithm of home management of severe range BPs, which helped reduce readmissions while observing lower adverse events. Evidence also suggests that tighter BP control (BP goal less than systolic 140 and diastolic 90) compared with our algorithm may decrease postpartum readmissions.[34] Similar algorithms for outpatient management of severe BPs and tighter BP control could be a reasonable next step for our institution.

Timely follow-up of individuals with HDP requires an iterative approach. We used quality improvement methodology to develop a set of interventions using patient feedback with a focus on reducing inequities to ensure safe, patient-centred and equitable discharge.

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Contributors KMZ was the guarentor, project lead and contributed to the design, analysis and interpretation of data. ECS was a principal advisor for the design, analysis and interpretation of data. BLH was the sponsor of the project involved in the design, analysis and interpretation of data. KMW was the lead medical student in the project involved with the design, analysis and interpretation of data. JT-W was the lead data analyst involved in the analysis and interpretation of data. STB was an advisor of the project involved in the design, analysis and interpretation of data. HCT was the nursing lead on the project involved in the design, analysis and interpretation of data. LJH was the senior author and advisor to the design, analysis and interpretation of data. ECS, BLH, JT-W, STB, HCT and LJH were involved in critical review of the work; final approval of the version to be published; and agreement to be accountable for the work. KMZ and KMW were involved in drafting the work; final approval of the version to be published; and agreement to be accountable for the work.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Deidentified data analysis is available upon request for all figures, tables and supplementary material.

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REFERENCES

1 Main EK, McCain CL, Morton CH, *et al*. Pregnancy-related mortality in California: causes, characteristics,

and improvement opportunities. *Obstet Gynecol* 2015;125:938–47.
2 Belizán JM, Gibbons L, Cormick G. Maternal mortality reduction: A need to focus actions on the prevention of hypertensive disorders of pregnancy. *Int J Equity Health* 2021;20:194.
3 Petersen EE, Davis NL, Goodman D, *et al*. Vital signs: pregnancy-related deaths, United States, 2011–2015, and strategies for prevention, 13 States, 2013–2017. *MMWR Morb Mortal Wkly Rep* 2019;68:423–9.
4 Palatnik A, Mukhtarova N, Hetzel SJ, *et al*. Blood pressure changes in gestational hypertension, Preeclampsia, and chronic hypertension from Preconception to 42-day postpartum. *Pregnancy Hypertens* 2023;31:S2210-7789(22)00129-5:25–31:.
5 Hauspurg A, Lemon L, Cabrera C, *et al*. Racial differences in postpartum blood pressure Trajectories among women after a hypertensive disorder of pregnancy. *JAMA Netw Open* 2020;3:e2030815.
6 Lopes Perdigao J, Hirshberg A, Koelper N, *et al*. Postpartum blood pressure trends are impacted by race and BMI. *Pregnancy Hypertens* 2020;20:S2210-7789(20)30026-X:14–8:.
7 Walters BN, Walters T. Hypertension in the Puerperium. *Lancet* 1987;2:330.
8 Optimizing postpartum care. ACOG committee opinion No.736. American college of Obstetricians and gynecologists. *Obstet Gynecol* 2018;131:e140–50.
9 Alliance for Innovation on Maternal Health. Severe Hypetension in pregnancy patient safety bundles. Available: https://saferbirth.org/psbs/severe-hypertension-in-pregnancy/ [Accessed 27 Jan 2023].
10 National Institute for health and care excellence. Nice clinical guideline 107: hypertension and pregnancy: the management of hypertensive disorders during pregnancy.
11 Suresh S, Amegashie C, Patel E, *et al*. Racial disparities in diagnosis, management, and outcomes in Preeclampsia. *Curr Hypertens Rep* 2022;24:87–93.
12 Hirshberg A, Sammel MD, Srinivas SK. Text message remote monitoring reduced racial disparities in postpartum blood pressure attainment. *Am J Obstet Gynecol* 2019;221:S0002-9378(19)30669-6:283–5:.
13 Hirshberg A, Downes K, Srinivas S. Comparing standard office-based follow-up with text-based remote monitoring in the management of postpartum hypertension: A randomised clinical trial. *BMJ Qual Saf* 2018;27:871–7.
14 Hoppe KK, Thomas N, Zernick M, *et al*. Telehealth with remote blood pressure monitoring compared with standard care for postpartum hypertension. *Am J Obstet Gynecol* 2020;223:S0002-9378(20)30554-8:585–8:.
15 Hirshberg A, Zhu Y, Smith-McLallen A, *et al*. Association of a remote blood pressure monitoring program with postpartum adverse outcomes. *Obstet Gynecol* 2023;141:1163–70.
16 Frankel A, Haraden C, Federico F, *et al*. A Framework for Safe, Reliable, and Effective Care. White Paper. Cambridge, MA: Institute for Healthcare Improvement and Safe & Reliable Healthcare, 2017.
17 Langley GL, Nolan KM, Nolan TW, *et al*. The Improvement Guide: A Practical Approach to Enhancing Organizational PerformanceSecond Edition. San Francisco, CA: Jossey-Bass Publishers, 2009.
18 Grob R, Schlesinger M, Barre LR, *et al*. What words convey: the potential for patient narratives to inform quality improvement. *Milbank Q* 2019;97:176–227.
19 Bombard Y, Baker GR, Orlando E, *et al*. Engaging patients to improve quality of care: A systematic review. *Implement Sci* 2018;13:98.
20 ACOG Practice Bulletin No. 222: American College of Obstetricians and Gynecologists. Gestational hypertension and Preeclampsia. *Obstet Gynecol* 2020;135:e237–60.
21 Ogrinc G, Davies L, Goodman D, *et al*. Squire 2.0 (standards for quality improvement reporting excellence): revised publication guidelines from a detailed consensus process. *BMJ Qual Saf* 2016;25:986–92.
22 Radio NPR. All things considered. Martin N,Propublica,Montagne R.Lost mothers: maternal mortality in the U.S. black mothers keep dying after giving birth. *Shalon Irving's Story Explains Why*,
23 Voices of impact: Irving family's story. In: *Council on Patient Safety in Women's Health Care*. Available: https://www.youtube.com/watch?v=yRgAF5MQ5LE [accessed 18 Aug 2023].
24 Preeclampsia Foundation. Blood pressure: check. Know. Share, Available: https://www.preeclampsia.org/blood-pressure
25 ACOG committee opinion No.743: low-dose aspirin use during pregnancy. *Obstetrics & Gynecology* 2018;132:e44–52.
26 Institute for Healthcare Improvement. Control charts (part 2) from Video library. Available: https://www.ihi.org/education/IHIOpenSchool/resources/Pages/AudioandVideo/Whiteboard14.aspx [Accessed 18 Aug 2023].
27 Sigma QMacrosS, Add-in SPC. Healthcare Rules, Available: https://www.qimacros.com/control-chart/healthcare-rules/ [Accessed 18 Aug 2023].
28 Society for Maternal-Fetal Medicine (SMFM), Combs CA, Allbert JR, *et al*. Society for maternal-fetal medicine special statement: A quality metric for evaluating timely treatment of severe hypertension. *Am J Obstet Gynecol* 2022;226:S0002-9378(21)01108-X:B2–9:.
29 Hoppe KK, Williams M, Thomas N, *et al*. Telehealth with remote blood pressure monitoring for postpartum hypertension: A prospective single-cohort feasibility study. *Pregnancy Hypertens* 2019;15:S2210-7789(18)30180-6:171–6:.
30 Wyatt R, Laderman M, Botwinick L, *et al*. Achieving health equity: A guide for health care organizations. In: *IHI White Paper*. Cambridge, Massachusetts: Institute for Healthcare Improvement, 2016. Available: ihi.org
31 Green CL, Perez SL, Walker A, *et al*. The cycle to respectful care: A qualitative approach to the creation of an actionable framework to address maternal outcome disparities. *Int J Environ Res Public Health* 2021;18:4933.
32 Janssen MK, Demers S, Srinivas SK, *et al*. Implementation of a text-based postpartum monitoring program at 3 different academic sites. *Am J Obstet Gynecol MFM* 2021;3:S2589-9333(21)00141-5:100446:.
33 Triebwasser JE, Janssen MK, Hirshberg A, *et al*. Successful implementation of text-based blood pressure monitoring for postpartum hypertension. *Pregnancy Hypertension* 2020;22:156–9.
34 Mukhtarova N, Alagoz O, Chen Y-H, *et al*. Evaluation of different blood pressure assessment strategies and cutoff values to predict postpartum hypertension-related Readmissions: a retrospective cohort study. *Am J Obstet Gynecol MFM* 2021;3:S2589-9333(20)30220-2:100252:.