Implementing a Mobile Technology-Based System for Physician-Directed Remote Management of Hypertension: A Pilot Study

1. PURPOSE OF THE STUDY

a. Brief Summary

This is a pilot, single-site, cohort study at Stanford. The purpose of this pilot study is to assess the feasibility and effectiveness of a mobile technology-based system to assist Providers in managing hypertension remotely using a platform that integrates an FDA-approved home blood pressure monitor with a dashboard that displays patient blood pressure data. Hypertension is a major public health burden and hypertension is often undertreated despite the availability of numerous antihypertensive agents. There is a strong need to promote optimal hypertension management across populations, including timely and effective medication titration to achieve optimal control and prevent future complications including cardiovascular and renal events.

b. Objectives

We aim to assess whether a novel mobile technology-based system will be feasible and effective in helping Providers manage hypertension remotely using a platform that integrates an FDA-approved home blood pressure monitor. Specifically, through this pilot study, we hope to assess how much providers and patients are utilizing the system after implementation, whether antihypertensive medication titration is being effectively performed, and whether blood pressure control is being achieved. This study will generate preliminary feasibility and effectiveness data which will be used to iterate the mobile technology system and will serve as the basis for a subsequent large randomized clinical trial to evaluate the efficacy of this system for remote blood pressure management.

c. Rationale for Research in Humans

The purpose of this study is to test the feasibility and effectiveness of a mobile technology-based system for hypertension management in outpatients with essential hypertension.

2. STUDY PROCEDURES

a. Procedures

Prespecified Stanford clinics (Internal Medicine, Family Practice, Cardiology, and Hypertension) will undergo implementation of a mobile- technology based system that utilizes a remote home blood pressure cuff system integrated with a physician/APP (advanced practice provider)- facing platform.

First, these clinics will be verbally informed of the study by the study investigators. Treating providers within these clinics will identify potentially eligible patients and will first inform patients and then the study team. The study team will screen the patient for

eligibility by phone and obtain informed consent from the patient and provider if the patient is eligible. The provider will begin use of the mobile technology system for hypertension management for the patient. When enrolling the patient, the provider will indicate the desired future sequence of antihypertensive medication for escalation if needed. Patients will be provided a commercially available, FDA-approved home blood pressure (BP) monitoring cuff (HEM 9200T or HEM 9210T, Omron HealthCare, Inc). These FDA- approved cuffs are used commercially with a mobile application (Omron HeartAdvisor) that stores the patient's raw blood pressure readings from the blood pressure cuffs. Patients will be asked to download this application along with receiving the cuff. Blood pressure cuffs will be purchased by the research team. Patients will be asked to measure their blood pressure twice a week for a total of 12 weeks. Providers will be instructed to see remote BP data through the MyHealth Tracking kit on Epic per current practice. The BP data will also be stored on a dashboard created securely in REDcap. During the study, patients will receive secure messages on a weekly basis through the REDCap system to provide blood pressure measurement reminders, record medication adherence, and record the presence/absence of adverse effects to medications. During the study, the dashboard presents to the physician/APP the changes in medications that the physician/APP has previously decided upon enrollment. Treating providers may use BP data to modify the patient's blood pressure management, act in accordance with these previously selected changes, or make other decisions regarding medications. The study coordinators will maintain a list of participating patients in the secure REDcap system. The pilot study will aim to recruit a total of 50 patients and 10 providers. We will administer surveys to the patients and providers at the end of the study. Prespecified data regarding feasibility and effectiveness will be collected over a followup period of 12 weeks and will be stored in the secure REDcap system for analysis.

Data collected at start of study period: Age, race/ethnicity, Body-mass index, baseline blood pressure, medications, comorbidities (including laboratory results related to comorbidities, such as serum creatinine related to renal dysfunction), treating provider, treating clinic.

Data during and at the end study period: Blood pressure medication changes, reason for medication changes, adherence to medications, and anonymous patient and provider surveys.

The primary outcomes of the study will comprise of the following:
• Blood pressure at 12 weeks compared to baseline blood pressure
• Ease of using the home blood pressure cuff system by patients (through anonymous survey)
• Ease of use of the system by providers (through anonymous survey)

b. Procedure Risks

Providers will retain the ability to make all final decisions regarding management thus avoiding inadvertent patient risk and deviations from standard of care.

c. Use of Deception in the Study

Deception will not be used.

d. Use of Audio and Video Recordings

No audio or video recording will be used.

e. Alternative Procedures or Courses of Treatment

All patients will continue to receive standard of care treatment during the study. Providers will make all final treatment decisions based on clinical judgement.

f. Will it be possible to continue the more (most) appropriate therapy for the participant(s) after the conclusion of the study?

Yes, as we anticipate that patients will continue to receive standard of care therapy, as outlined above.

g. Study Endpoints/Analysis Plan

The study outcomes will be assessed at the end of 12 weeks of follow-up in all patients. This is a single-arm, single center, pilot study to assess feasibility and effectiveness. No standard of care therapy will be withheld during the study. The primary outcomes of the study will comprise of the following:
• Blood pressure at 12 weeks compared to baseline blood pressure
• Ease of using the home blood pressure cuff system by patients (through anonymous survey)
• Ease of use of the system by providers (through anonymous survey)
No power calculation is used for the study.

3. BACKGROUND

a. Past Experimental and/or Clinical Findings

No prior experimental or clinical work has been performed at Stanford. This pilot study aims to generate preliminary data to prompt future studies.

b. Findings from Past Animal Experiments

N/A

4. RADIOISOTOPES OR RADIATION MACHINES

N/A

5. DEVICES USED IN THE STUDY

a. Investigational Devices (Including Commercial Devices Used Off-Label)

N/A

b. IDE-Exempt Devices

IND-Exempt Device 1	
Name:	HEM-9200T Blood Pressure Monitor
Description:	The device is a remote blood pressure monitor.
IND-Exempt Device 2	
Name:	HEM-9210T Blood Pressure Monitor
Description:	The device is a remote blood pressure monitor.

6. DRUGS, BIOLOGICS, REAGENTS, OR CHEMICALS USED IN THE STUDY

N/A

7. DISINFECTION PROCEDURES FOR MEDICAL EQUIPMENT USED ON BOTH HUMANS AND ANIMALS

N/A

8. PARTICIPANT POPULATION

a. Planned Enrollment

We expect 10 providers and 50 patients to be enrolled across the following Stanford clinics: Internal Medicine, Family Practice, Cardiology, and Hypertension.

b. Age, Gender, and Ethnic Background

Patients who are 18 years of age or older with essential hypertension who meet medical inclusion/exclusion criteria will be enrolled, with no gender or race/ethnicity criteria.

c. Vulnerable Populations

Children and pregnant women will not be enrolled in this study. For other potentially vulnerable populations who may be enrolled, such as economically disadvantaged populations, this study minimizes risk as it is not anticipated to affect standard of care therapy and care will continue to be directed by their Providers. No additional research-based physical visits or costs to the participants are expected either. In addition, potential benefits for vulnerable populations include a reduced need for participants to visit clinical offices to manage hypertension, thus minimizing financial costs and disruption to daily lives that can be associated with Provider visits.

d. Rationale for Exclusion of Certain Populations

Children are not included because hypertension management in adults is treated differently in clinical practice from hypertension in children. Adult hypertension management may not be appropriate for children. Hypertension management in children usually requires pediatric expertise, which is beyond the scope of adult hypertension guidelines and beyond the scope of practice for adult Providers in primary care, nephrology and cardiology, including the study investigators.

Pregnant women are excluded to minimize harm, because pregnancy-related hypertensive disorders such as pre-eclampsia require specialized assessment and management protocols (including potentially high-risk obstetric and maternal-fetal medicine evaluation) that are beyond the scope of general adult hypertension management guidelines. Several commonly used antihypertensive agents that are core aspects of hypertension guidelines (such as ACE inhibitors) may be harmful in pregnancy.

e. Stanford Populations

We do not anticipate laboratory personnel or students as participants. Enrolled providers who may be employees will undergo informed consent.

f. Healthy Volunteers

Only patients with essential hypertension will be included and no healthy patients will be enrolled. The enrolled providers (10) will be healthy volunteers.

g. Recruitment Details

Pre-specified Stanford clinics (Internal Medicine, Family Practice, Cardiology, and Hypertension) will be eligible and will be informed of the study verbally by the study investigators. Treating providers will identify potentially eligible patients and will first inform patients and then notify the Study Protocol director about eligible participants.

h. Eligibility Criteria

i. Inclusion Criteria

Patients aged 18 years or older with an established diagnosis of essential hypertension at the following Stanford clinics: Internal Medicine, Family Practice, Cardiology, and Hypertension.

ii. Exclusion Criteria

Patients who meet the following criteria will be excluded:

- Patients on more than 2 antihypertensives at time of enrollment
- Clinical diagnosis of secondary hypertension, that is, hypertension due to a secondary cause, including but not limited to the following:
  - Renal artery stenosis
  - o Primary hyperaldosteronism
  - o Cushing syndrome
  - o Coarctation of the aorta
  - o Drug-induced hypertension
  - o Pheochromocytoma
  - o Obstructive sleep apnea
- Hospitalization for malignant hypertension or severe hypertension (including stroke, cardiac events, acute kidney injury) in the preceding 6 months
- Hospitalization for unstable angina or myocardial infarction in the preceding 6 months
- Prior diagnosis of heart failure or cardiomyopathy
- Stroke or transient ischemic attack within prior 6 months

- Prior organ transplantation
- Failure to obtain informed consent
- Pregnant or currently trying to become pregnant
- Patients who are enrolled in other research studies

i. Screening Procedures

Treating Providers will identify eligible patients for recruitment based on inclusion and exclusion criteria. Treating providers will inform patients and then will contact the study team. Patients will be contacted by telephone for screening to confirm eligibility. We will request a waiver of authorization for recruitment.

j. Participation in Multiple Protocols

Patients enrolled in other studies are excluded from our current study.

k. Payments to Participants

There is no participant reimbursement.

l. Costs to Participants

There are no participant costs.

m. Planned Duration of the Study

The probable duration of the study will be 24 months, including 12 weeks of active participation in study per participant.

9. RISKS

a. Potential Risks

i. Investigational devices

N/A

ii. Investigational drugs

N/A

iii. Commercially available drugs, biologics, reagents or chemicals

N/A

iv. Procedures

We will use an FDA-approved home blood pressure monitoring system and do not anticipate additional risks.

v. Radioisotopes/radiation-producing machines

We will use an FDA-approved home blood pressure monitoring system and do not anticipate additional risks.

vi. Physical well-being

We will use an FDA-approved home blood pressure monitoring system and do not anticipate additional risks.

vii. Psychological well-being

We will use an FDA-approved home blood pressure monitoring system and do not anticipate additional risks.

viii. Economic well-being

We will use an FDA-approved home blood pressure monitoring system and do not anticipate additional risks.

ix. Social well-being

We will use an FDA-approved home blood pressure monitoring system and do not anticipate additional risks.

b. International Research Risk Procedures

N/A

c. Procedures to Minimize Risk

During the study, the participants will continue to receive standard of care management through their regular provider who will make all final treatment decisions, and thus potential risks will be minimized.

d. Study Conclusion

The study will terminate after obtaining 12 weeks of follow-up data per participant. As participants will receive standard of care therapy from their provider who will make all final treatment decisions during the study, no additional risks from the study are anticipated.

10. BENEFITS

Potential benefits for participants include assessing the utility of a remote hypertension management system with their regular providers, which will reduce the need for participants to visit clinical offices to manage hypertension, thus minimizing financial costs and disruption to daily lives that can be associated with provider visits to control hypertension.

11. PRIVACY AND CONFIDENTIALITY

All participant information and specimens are handled in compliance with the Health Insurance Portability and Accountability Act (HIPAA) and privacy policies of Stanford University, Stanford Health Care, and Stanford Children's Health.