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Journal of the American Pharmacists Association

journal homepage: www.japha.org

ADVANCES IN PHARMACY PRACTICE

Implementation and barriers to uptake of interactive voice response technology aimed to improve blood pressure control at a large academic medical center

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ARTICLE INFO

Article history:

Received 31 March 2018

Accepted 19 November 2018

Available online 17 January 2019

ABSTRACT

Objectives: Blood pressure control among patients with hypertension is a widely recognized quality metric, but many large health systems fail to reach targets set by the Healthcare Effectiveness Data and Information Set. We developed an interactive voice response (IVR) system called the “Mobile You Blood Pressure Program” at a large academic medical center and linked it to the health system’s electronic health record (EHR). The goal of the program was to capture home blood pressure readings in the EHR and to alert ambulatory care clinical pharmacists automatically of readings below or above clinical thresholds through direct messaging in the EHR. The goal of this report is to describe implementation of IVR, initial patient participation rates, and pharmacist-identified barriers to patient enrollment.

Setting: Ambulatory care clinical pharmacist specialists’ practice in 14 clinics in family medicine and internal medicine at Michigan Medicine, an academic health system serving more than 24,000 patients with a diagnosis of hypertension.

Practice Description: This study describes implementation and initial patient enrollment in IVR linked to the EHR for home blood pressure monitoring.

Evaluation: We tracked the number of hypertensive patients enrolled and IVR call completion rates between September 2017 and February 2018. We also assessed pharmacist-identified barriers to patient enrollment during 2 separate 2-week intervals in January and February 2018.

Results: Between September 1, 2017, and February 28, 2018, a total of 71 patients were enrolled from 14 clinics. Patients were scheduled for 1–3 IVR calls per week focusing on medication adherence and blood pressure control. A total of 936 IVR phone calls were made, with 488 (52%) calls completed. Access to a validated home blood pressure monitor was the largest pharmacist-identified barrier to patient enrollment.

Conclusions: The IVR Mobile You Blood Pressure Program represents a new application of digital technology within our health system. Pharmacist-identified barriers to patient participation included access to a validated home blood pressure monitor.

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Hypertension is one of the most prevalent cardiovascular risk factors in the United States. More than 75 million Americans have a diagnosis of hypertension, and one-third of those with uncontrolled hypertension are unaware of their diagnosis.¹ Of those with diagnosed hypertension, only 53% have blood pressure under control.² Uncontrolled hypertension can lead to severe health consequences, including myocardial infarction and stroke.^{3,4} In addition, hypertension

is the second leading cause of chronic kidney disease in the United States.⁵

Pharmacotherapy is one of the most important approaches to improving blood pressure control; however, adherence remains problematic for those prescribed medications. A study of patients age 65 and older demonstrated that only 20% of patients prescribed antihypertensives had medication possession ratios 80% or greater.⁶ Disparities in medication adherence based on race have also been described, with lower rates of adherence in black, Hispanic, and American Indian/Alaska Native populations.^{7,8} Thus, interventions to promote awareness of hypertension and the importance of medication adherence in preventing cardiovascular morbidity and mortality are of utmost importance. Clinical pharmacists are an

Disclosure: The authors declare no conflicts of interest or financial interests in any product or service mentioned in this article.

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Key Points**Background:**

- Blood pressure control among patients with hypertension is a widely recognized quality metric, but many large health systems fail to reach targets set by the Healthcare Effectiveness Data and Information Set.
- We developed an interactive voice response system (IVR) called the “Mobile You Blood Pressure Program” at a large academic medical center and linked it to the health system’s electronic health record.

Findings:

- A total of 71 patients were enrolled from 14 clinics.
- Patients were scheduled for 1-3 IVR calls per week focusing on medication adherence and blood pressure control.
- A total of 936 IVR phone calls were made, with 488 (52%) calls completed.

effective partner in caring for patients with hypertension and cardiovascular disease, and the 2017 American College of Cardiology/American Heart Association Hypertension Guidelines advocate for a team-based approach to hypertension management.⁹⁻¹¹

One of the 2017 focus measures for the University of Michigan Health System (Michigan Medicine) was to improve blood pressure control. Michigan Medicine currently treats more than 24,000 patients with a diagnosis of hypertension in our primary care clinics. The goal set by the Healthcare Effectiveness Data and Information Set (HEDIS) is for 74% of patients in our hypertension registry to have adequate blood pressure control. Each clinic is evaluated independently on its ability to achieve this goal. Our current metric includes all patients between the ages of 18 and 85 years whose blood pressure is controlled according to the most recent blood pressure measurement in an ambulatory care setting in the past year. Per HEDIS specifications, blood pressure control is defined as less than 140/90 mm Hg for patients 18 to 59 years old, less than 140/90 mm Hg for patients 60-85 years old with diabetes, and less than 150/90 mm Hg for patients 60-85 years old without diabetes.¹² Each clinic has access to monthly data with the goal of obtaining blood pressure control at the 75th and 90th percentiles to be eligible for reimbursement based on pay for performance models.

Home blood pressure monitoring is recommended by the American Heart Association and American Society of Hypertension as a strategy to improve blood pressure control.¹³ Reporting of home blood pressures allows for improved follow-up of elevated readings and titration of medications between regularly scheduled office visits. This can allow for a greater number of patients to reach their blood pressure goal at a faster rate than if blood pressure were measured only during office visits. Home blood pressure readings can provide positive reinforcement for patients who begin to see the

effects of lifestyle changes and medication adherence firsthand. In addition, home monitoring allows for confirmation and more appropriate management of patients suspected to have white coat hypertension, avoiding potentially unnecessary treatment for patients with controlled blood pressure outside of the clinic setting.¹¹

Advances in technology have allowed for greater connectivity between patients and providers between face-to-face encounters. Portal access to the electronic health record (EHR), mobile health applications, telehealth, and web-based systems allow patients to access information and to communicate directly with health professionals between ambulatory care visits. Studies have described models using telehealth for hypertension management. This approach increases patient involvement, reduces the need for office visits, and can incorporate pharmacists, nurses, and nurse practitioners to support care, potentially increasing physician access for evaluation and management of more complex illnesses. However, additional studies evaluating the feasibility and long-term effectiveness of telehealth-based hypertension management are needed.¹⁴

One particularly common technology for promoting more effective cardiovascular disease management is interactive voice response (IVR), which has been used to reduce blood pressure, assist patients with weight loss, address diabetes treatment goals, and achieve other health benefits.¹⁵ However, to our knowledge, the implementation and barriers to uptake of an IVR system led by clinical pharmacists for patients with hypertension across multiple clinic sites affiliated with a large academic health system has not been described. In this article, we describe our experience with the creation and initial implementation of an IVR system to allow for home blood pressure reporting and direct messaging of low or elevated blood pressure readings to ambulatory care clinical pharmacist specialists. The overall goal of the program was to create a system for efficient collection of home blood pressure readings and ultimately to assist with achieving progress toward our institutional goal of improving blood pressure control.

Objectives

In consideration of extensive prior work by a member of our team and active collaboration with clinical pharmacist specialists, an IVR system (“Mobile You Blood Pressure Program”) was developed and integrated into the EHR to allow for monitoring of patient-reported home blood pressure readings and medication adherence across 14 ambulatory care clinics affiliated with Michigan Medicine.¹⁵⁻¹⁹ The objectives of this study were to describe implementation of IVR, initial patient participation rates, and pharmacist-identified barriers to patient enrollment.

Setting

The IVR Mobile You Blood Pressure Program was piloted by 11 ambulatory care clinical pharmacist specialists and 2 postgraduate year 2 ambulatory care pharmacy residents practicing in 14 ambulatory care clinics in family medicine and internal medicine.

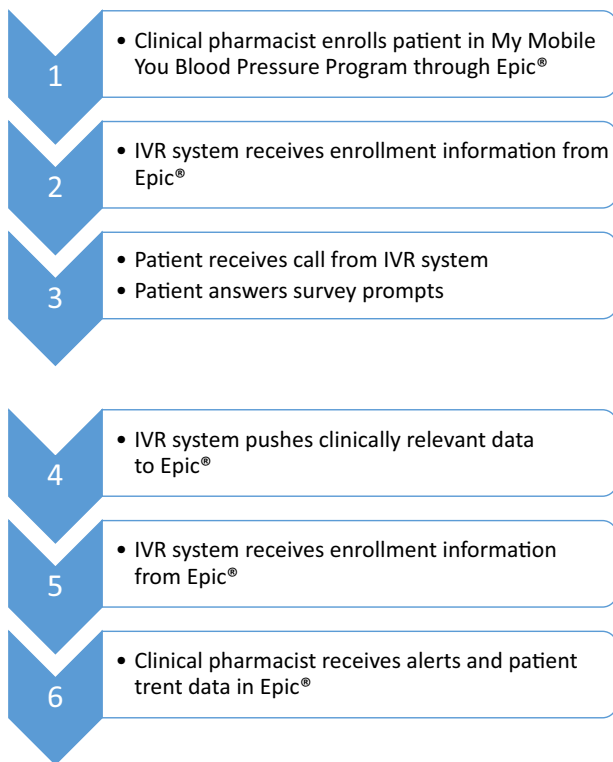


Figure 1. Interactive voice response (IVR) system integration into the Epic-based electronic health record.

Inclusion criteria

Patients age 18 years or older seen by a clinical pharmacist specialist in an ambulatory care clinic at Michigan Medicine found to have elevated blood pressure or hypertension were eligible to participate. Although studies show that IVR can improve blood pressure control for Spanish speakers, fluency in English was required for participation because the IVR system we developed is currently not available in other languages. Hypertension was defined by AHA JNC8 criteria.^{19,20} Participation required patients to own or to have access to a home blood pressure monitor that pharmacists validated in the office before enrollment in IVR. Having a consistent telephone number was also required.

Practice description

Ambulatory care clinical pharmacist specialists are embedded in each ambulatory care clinic and practice under a collaborative practice agreement that allows them to initiate, adjust, or discontinue therapy related to the patient's diagnosis of diabetes, hypertension, or hyperlipidemia. As part of the clinical pharmacist specialist onboarding process, proper blood pressure technique is reviewed and assessed by the clinic medical director after initial hiring. Patients are referred to the pharmacist by their primary care physician.

Practice innovation

This project is a collaboration between the University of Michigan School of Public Health Center for the Management

of Chronic Disease (CMCD) and the University of Michigan Medical Group Pharmacy Innovations and Partnerships program. CMCD programmers used the Aspect Patient Engagement Solution and Microsoft Dynamics 365 platforms to develop the IVR system call scheduler and communication tools integrated with the Epic-based EHR (Figure 1). The system allows for enrollment management, generation of outbound calls, collection of survey results from patients, data review over dashboards, and automated notifications being sent to clinicians.

IVR interaction content, call flow, and alert thresholds were based on prior work and collaboration between CMCD and the clinical pharmacist leadership team. During IVR calls, patients are prompted to enter their blood pressure and heart rate readings and to answer questions regarding medication adherence and worrisome symptoms, such as chest pain or shortness of breath. The system calls at times selected by the patient. Patients can request to be called as few as 1 day per week or as often as 6 days per week. If patients are not available at their scheduled time, the system automatically calls back 15 minutes later. Patient responses (blood pressure, heart rate, and medication adherence) are then transferred into the EHR for pharmacist review via patient-entered flowsheets within Epic.

Before implementation, clinical pharmacist specialists were provided with an overview of the program using group presentations, written program materials including the process for enrolling patients in the program using the EHR, and suggested patient education materials on hypertension (Appendix 1). Two project managers within the health system assisted with technical support, troubleshooting, and data management.

Process of enrolling patients

To initiate the process, patients seen in a clinic by their physician were triaged by the clinic medical assistant. If blood pressure was elevated when the medical assistant entered the vital signs into the EHR, an automatic flag was generated indicating that the patient was out of range. Medical assistants have been taught to dismiss this alert, wait 5 minutes, and recheck blood pressure. If blood pressure was elevated on recheck, an order was generated referring the patient for blood pressure follow-up with the clinical pharmacist specialist. During the provider visit with the patient, the order for blood pressure follow-up was signed, and the patient was advised to schedule a follow-up appointment with the clinical pharmacist specialist within the next 2–4 weeks unless the degree of blood pressure elevation required more expedient follow-up.

During the follow-up appointment, a manual blood pressure measurement was taken by the clinical pharmacist specialist. If the initial blood pressure was elevated, another blood pressure was repeated at least once. Home blood pressure monitors were validated by comparing the average of the last 2 of 3 readings obtained by the home monitor to the average of 2 readings taken manually during the appointment. If the patient needed to purchase a home blood pressure monitor, an automated monitor with an upper arm cuff was recommended. If the patient failed to bring their home monitor to the visit, enrollment in IVR was deferred and patients were instructed to bring their monitor to their next

Table 1

Call completion rates for patients enrolled in the interactive voice response system (August 2017 to February 2018)

Number of telephone calls	Patients, n (%) N = 71
0	18 (25.4)
1-10	36 (50.7)
11-20	13 (18.3)
21-30	2 (2.8)
31-40	2 (2.8)
≥ 41	0 (0)

clinic visit for validation. Once the home monitor was validated, the clinical pharmacist explained the program and offered enrollment to the patient. Patients could also be offered enrollment during a telephone encounter as long as their home blood pressure monitor had been validated.

Patients were scheduled for follow-up clinic visits at the discretion of the clinical pharmacist specialist based on any medication changes made during the visit and the need for follow-up for other chronic disease states that the pharmacist was also actively managing.

After enrollment, the patient received automated IVR phone calls on the days and times they initially selected. Alerts were sent from IVR automatically to the pharmacist in-basket within Epic for low blood pressure (systolic less than 100 mm Hg or diastolic less than 55 mm Hg) or elevated blood pressure (systolic greater than 160 mm Hg or diastolic greater than 110 mm Hg). Alerts were also sent for bradycardia or tachycardia (heart rate less than 50 beats/min or greater than 100 beats/min).

Patients were unenrolled at the discretion of the clinical pharmacist specialist and the patient, which typically occurred when the blood pressure was at goal or when they were discharged from the pharmacist clinical service. However, patients could request to be unenrolled at any time. IVR could also be programmed to pause calls during patient travel.

Initial assessment of patient participation and barriers to enrollment

Assessment of patient participation was completed by each clinical pharmacist specialist during 2 separate 2-week intervals (January 8-19, 2018, and February 5-16, 2018) after implementation of IVR. Each clinical pharmacist specialist was asked to track the number of patients with elevated blood pressure, whether enrollment in IVR was offered, and whether

the patient elected to participate. If enrollment was not offered, pharmacists tracked the reasons why. If the patient declined participation, pharmacists tracked patient reported reasons for declining.

Evaluation (impact of innovation)

Descriptive statistics were used to evaluate overall patient participation rates and barriers to patient enrollment.

Results

Between August 2017 and February 2018, 71 patients were enrolled in the IVR Mobile You Blood Pressure Program at 14 clinics. Call completion rates for this time period are shown in [Table 1](#). A total of 936 IVR phone calls were made with 488 (52%) calls completed. Of the 71 patients enrolled, 75% completed at least 1 IVR phone call. Among participants (those who completed at least one IVR phone call), 68% of calls were completed. The average length of enrollment in the program was 70 days, with an average of 68 days for patients who completed at least 1 call and 72 days for patients who completed no calls and were subsequently unenrolled. A total of 18 alerts were prompted during this pilot phase of the project.

Pharmacist-collected data on patient enrollment in IVR over 2 separate 10-day periods is described in [Table 2](#). During these periods, 70 patients with elevated blood pressure were found to be ineligible for participation in IVR. The majority of ineligible patients did not have a home blood pressure monitor or needed to have their home blood pressure monitor validated before enrollment. Pharmacist-identified reasons that patients were inappropriate for enrollment included patients who did not speak English, patients with cognitive impairment, and patients with anxiety at baseline.

Among patients who were eligible for enrollment, 40 of 53 (75%) were offered participation in IVR during the two 10-day data collection periods. The remaining patients were not offered enrollment because of the clinical pharmacist specialist not having adequate time to address patient care issues and to complete the enrollment process. Of the patients offered participation in IVR, 40% elected to enroll ([Table 3](#)). Not wanting to receive telephone calls was the most common reason patients declined enrollment. Other frequent reasons included anxiety associated with home blood pressure monitoring, poor vision or dexterity, and preference for report home blood pressure readings at follow-up visits ([Table 4](#)).

Table 2

Barriers to patient enrollment

Barriers	January 8-19, 2018		February 5-16, 2018	
	No. patients	Percentage of patients	No. patients	Percentage of patients
Elevated BP	61	N/A	62	N/A
Not eligible for enrollment	30	49.2	40	64.5
Did not have a home monitor	14	46.7	13	32.5
Need to validate BP monitor	9	29.0	13	32.5
Patients already enrolled	4	13.3	7	17.5
Patient not appropriate for IVR	3	10.0	7	17.5
Eligible for enrollment	31	50.8	22	35.5
Offered IVR program	27	87.1	13	59.1
Pharmacist did not have time	4	12.9	9	40.9

Abbreviations used: BP, blood pressure; IVR, interactive voice response system.

Table 3
Patient enrollment

Enrollment	January 8-19, 2018		February 5-16, 2018	
	No. patients (n = 27)	Percentage of patients	No. patients (n = 13)	Percentage of patients
Offered IVR program	27	N/A	13	N/A
Enrolled	12	44.4	4	30.8
Declined	15	55.6	9	69.2

Abbreviation used: IVR, interactive voice response system.

Discussion and practice implications

Implementation of IVR by clinical pharmacist specialists in ambulatory care clinics within our health system provided a new method for patients to report home blood pressures. However, our initial enrollment was lower than expected. There were several pharmacist-identified reasons why patients were ineligible for enrollment during the initial implementation phase. The most common reason identified was the patient not having a home blood pressure monitor. The majority of patients who lacked a home monitor were financially limited and unable to purchase a monitor, or they declined to purchase one at the time of their clinic visit. A clinic program for loaning home blood pressure monitors to patients is currently being developed; this might facilitate enrollment of patients who were previously unable to participate in IVR.

The second most common reason patients were ineligible was the need to validate the home blood pressure monitor before enrolling the patient into IVR. In this case, the pharmacist instructed patients to bring their monitor to their next clinic visit for validation. However, this was sometimes difficult in settings where patients forgot to bring their monitor on a second occasion or did not show up for their subsequent appointment.

Other factors limiting enrollment included patients identified by their clinic pharmacist as inappropriate for participation in IVR. IVR is currently programmed in English only, creating a barrier to enrollment for patients with another preferred language. While developing non-English versions of the IVR system is an area of expertise in our development team, this was not undertaken for initial implementation. In addition, patients with cognitive impairment or anxiety at baseline were identified as poor candidates for IVR.

Table 4
Reasons patients declined to participate in the interactive voice response system

Reasons	January 8-19, 2018		February 5-16, 2018	
	No. patients (n = 15)	Percentage of patients	No. patients (n = 9)	Percentage of patients
Did not want to receive telephone calls	6	40.0	4	44.4
Anxiety associated with home blood pressure monitoring	3	20.0	0	0
Poor vision or dexterity	2	13.3	0	0
Prefer to report readings at follow-up visits	1	6.7	2	22.2
Refuse to purchase home blood pressure monitor	1	6.7	0	0
(It is) "not for me"	1	6.7	0	0
Frequent travel for work	1	6.7	0	0
Difficulty hearing on the telephone	0	0	1	11.1
Prefer not to monitor blood pressure at home	0	0	1	11.1
Prefer to enter readings into the MiChart patient-entered flowsheet	0	0	1	11.1

A number of reasons were cited by patients eligible for IVR who declined participation, the most frequent being that patients did not want to receive telephone calls (reason cited by 42% of patients who declined over our 2 separate 2-week follow-up periods). Perhaps the use of text messaging or an automated e-mail system in which patients can enter their home blood pressure readings without being disrupted by a telephone call would increase uptake and reporting of home blood pressures.

In addition, other means of communicating with providers at our health system currently compete with the IVR Mobile You Blood Pressure Program for patient enrollment. Providers are able to enroll patients in Patient Portal Entered Flowsheets, an EHR reporting system that is accessible through the patient portal. This program is preferred by some patients because they are not required to receive automated telephone calls, and they can enter multiple blood pressure readings during the same login. Patients can also upload a scanned copy of their home blood pressure log through the patient portal and send it to their provider. However, the patient blood pressure data reported using these methods does not populate directly into the patient-reported vitals section of the chart. In addition, because some patients elect to report readings only a few times per month or when they remember, elevated or low readings can go unaddressed until the patient enters them into the EHR. However, IVR during our pilot phase had a higher uptake, as only one-third of patients within our system have participated in using the portal or patient-entered flowsheets in the past.

Overall, the results of our pilot study identified key details that are important to consider before initiating widespread implementation of the IVR blood pressure program. Reminding patients to bring their home blood pressure monitor to the clinic and providing information regarding selecting a home blood pressure monitor as part of their appointment scheduling could assist in increasing the number of patients whose home blood pressure monitor is validated and who are able to be enrolled in IVR at their first visit.

Despite the limitations seen in patient enrollment and participation, successful implementation of the IVR Mobile You Blood Pressure Program across our academic health system has the potential to lead to faster follow-up for out-of-range blood pressure readings for participants. This could lead to a greater number of patients with blood pressure at goal and, in turn, improved performance in achieving national quality measures.

Conclusion

The IVR Mobile You Blood Pressure Program represents a new application of digital technology within our health system. The results of our pilot study present an opportunity for continued refinement of the program to allow for increased patient enrollment and participation. Additional areas for investigation include time to provider follow-up for out-of-range blood pressure results and any change in the time required for patients to reach their blood pressure goal.

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Appendix 1. Interactive voice response system enrollment checklist

Mobile You Blood Pressure Program patient enrollment checklist

- Open the Patient Education Folder and remove the 5 handouts to review with patient
 - Hypertension flyer (home blood pressure log on back)
 - “The Salty Six”
 - “Checking Your Blood Pressure at Home”
 - Mobile You Blood Pressure Program information sheet
 - Frequently asked questions sheet
- Educate the patient about hypertension by reviewing the hypertension flyer and “The Salty Six” handout
- Emphasize importance of home blood pressure technique. Refer to the “Checking your blood pressure at home” handout in the patient packet.

Scripting

- “As I mentioned before, please make sure that you sit and relax for about 5 minutes before checking your blood pressure. Our goal is to see what your blood pressure is when you are at rest. Please always check blood pressure at least twice, if not three times in a row, separating each reading by 30–60 seconds.”
- Explain the program to the patient using the Mobile You Blood Pressure Program information sheet.

Introduction to program

- “To make things easier, I’d like to sign you up for our Michigan Medicine Mobile You Blood Pressure Program. This will allow you to conveniently report your home blood pressure readings to both myself and your doctor at times that work well for you.”

Information regarding calls and response

- Through this program you will receive several automated phone calls each week asking you to enter the blood pressure readings you take at home. We can set up the calls to come at times that work well for you. The readings are then sent here to the clinic so that Dr. [physician’s name] and I can review them.

Frequently asked questions

- “I have included an FAQ sheet in your packet for commonly asked questions about the program.”

Enrollment

Enroll the patient in the *Mobile You Blood Pressure Program* using the IVR enrollment visit navigator tab during your clinic visit (or flowsheet). Six fields are required fields for enrollment:

1. Establish days of the week with patient: On which days of the week do you think you would be able to check your blood pressure at home?
2. Establish time of call: At what time should the system call you? It will be the same time for each day you have chosen
 - a. Reminder to patient to write down readings: “If you would like to write them down so that you do not have to flip through your machine’s memory later on, I have a log sheet here that might be helpful. We can also time the Mobile You Blood Pressure phone calls to come shortly after you are finished checking, if that helps. Would around 7 AM work for the calls?”
 - b. Use 24-hour time format (e.g., 1700 hours instead of 5:00 PM).
3. Consent: “This program enrolls you to receive multiple calls per week from Michigan Medicine related to your blood pressure management.”
4. Patient telephone number: Enter the patient’s telephone number.
5. Pharmacist telephone number: Choose the pharmacist or clinic telephone number.
6. Establish start date: Mostly likely the start date will be “t” for today.

End/cancel and vacation dates section

This section will be used *only* when ending or pausing enrollment.

1. End/cancel date: No calls will be received after this date.
2. Vacation start date: No calls will be received on this date through the vacation end date.
3. Vacation end date: This indicates the last day of no calls/paused program.

Final steps

- Schedule a 2-week follow-up telephone call to check in on IVR and blood pressure.
- Attach to the “IVR HTN PHARM D SUP” pool to receive InBasket messages with blood pressure alerts.