Standardization of Blood Pressure Management in Cedro Galán, a Semi-Rural Community in Nicaragua

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***Abstract*—Research supports the use of evidence-based guidelines in the management of hypertension. However, there is limited literature regarding translation of these initiatives to resource-poor settings. Specifically, Nicaragua has no evidence of appropriate treatment or management of hypertension. A team from the University of South Florida Morsani College of Medicine created a community-specific, algorithm-based educational program to standardize management of hypertension in the semi-rural community of Cedro Galán. Patients enrolled had monthly monitoring of systolic and diastolic blood pressures. The launch of the pilot program was followed by evaluation and intervention six months later. Results were analyzed using retrospective chart review, and separated into pre-pilot, post-pilot, and post-intervention data. Primary and secondary outcomes included blood pressure, community adherence, and provider confidence. Mean systolic and diastolic pressures for all patients prior to the pilot (n=10) were 146/78 mmHg, between pilot and intervention (n=16) were 153/83 mmHg, and after intervention (n=17) were 145/81 mmHg. Patient adherence to medications and provider confidence increased, and patient clinic appointment attendance increased from a median of 47% at baseline to a median of 100% post-intervention. Our study suggests that community-specific, evidence-based education programs that include algorithm development can increase community adherence, provider confidence, and also blood pressure. Limitations include lack of similar research to be used for comparison, and we stress the need for continued study in this subject.**

Keywords- Quality improvement; Patient outcomes; Equity in health care; Primary care; Cardiovascular diseases; Developing countries; Patient education; Guidelines

I. INTRODUCTION

Nicaragua is the poorest country in Central America, and the second poorest in the Western Hemisphere, and much of the country lacks access to basic resources [1][2]. Almost 50% of the population lives below the poverty line [3], and individuals face a unique set of risk factors related to barriers in access to care [4]-[6]. As of yet, there has been limited clinical research in Nicaragua, but it is well known that cardiovascular disease (CVD) is a leading cause of death [4][5][7][8], with hypertension being the primary risk factor for development of CVD [7][8]. There have been studies evaluating the prevalence of hypertension in Nicaragua [10], but there is little evidence to suggest appropriate management and treatment of hypertension [4]. Contributing to this is the fact that the majority of clinics in Nicaraguan communities tend to focus on acute conditions, rather than non-communicable disease [11]. Those caring for chronic disease in Nicaragua often rely on guidelines developed in other countries, cost constraints or their own personal experiences. Available guidelines for medical practitioners include the Joint National Committee (JNC) guidelines [12] and the Latin American Society of Hypertension (LASH) guidelines, but there is no good evidence that such guidelines fit the local context of rural communities in Nicaragua [13]. Research in Honduras has shown a positive impact from the formation of a community-based hypertension treatment program, with improved blood pressures, adherence to medications, and political support [14]. The aim of our study is to incorporate a personalized algorithm-based educational program for

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practitioners in a rural Nicaraguan clinic. We sought to assess whether such a program would effectively result in reduced blood pressures and improved adherence to medications. To our knowledge, this is the only study evaluating the incorporation of cost-effective and evidence-based hypertension management into a rural setting in Nicaragua.

In this paper, we will outline our methods, results, and conclusions. Section 2 starts by detailing our patient population, and then discusses the launch of the pilot program, intervention and adjustment, hypotheses, and outcomes measured. Section 3 provides results, divided into primary and secondary outcomes. Finally, Section 3 is a discussion of our findings, conclusions, and recommendations for future projects.

II. PATIENTS AND METHODS

A. Study Design and Setting

We used an observational research design to incorporate an evidence-based and cost-sensitive algorithm into a rural Nicaraguan clinic. We visited the community on multiple trips over a 1 year period to provide education and receive feedback about the program. Institutional Review Board approval was given for this study by the University of South Florida (USF). (Institutional Review Board number: Pro00026167)

This study was completed in Cedro Galán, a semi-rural resource-poor community located on the outskirts of Managua, Nicaragua. This community is home to an estimated 3,500 individuals whose incomes are, on average, $1.32 per person per day. Only 25% of adults in Cedro Galán have completed secondary school [15]. Up until October 2013, this community had extremely limited access to even basic health services and health education. This history of disconnection from the healthcare system combined with low socioeconomic status and low educational levels put this population at extremely high risk for many adverse health outcomes including but not limited to cardiovascular disease [15].

Research was conducted in the primary care clinic that opened in Cedro Galán in 2013. This clinic was created by and is managed though a collaboration USF and Manna Project International (MPI) [16], a non-profit organization that offers holistic community development. A Nicaraguan general practitioner physician and nurse staff the clinic three times weekly. Since the clinic has opened, it has provided two to three thousand consultations annually. USF Internal medicine physicians visit bi-annually to provide continuing medical education as well as patient consults.

B. Pilot: Algorithm Development and Provider Education

The USF Health team offered chronic disease management education to our partner Nicaraguan health care providers in two steps. The first occurred during an initial capacity building trip in March 2015. Internal Medicine physicians from USF Health started by presenting the JNC 8 guidelines (including changes from JNC 7) to the Nicaraguan providers. Next, they held individual meetings with the Nicaraguan providers to discuss their thoughts on the guidelines and perceived limitations with respect to implementation. Table I illustrates the questions that were asked during these individual meetings. Using the JNC guidelines as a foundation, with local practitioner input, a one-page algorithm was developed for practitioners to follow when managing hypertension. USF physicians also discussed potential side effects and recommended monitoring for each drug. All meetings were held and education provided in the local providers' native language.

TABLE I. QUESTIONS NECESSARY FOR COMMUNITY-SPECIFIC ALGORITHM DEVELOPMENT

How are the current prescribing practices of providers in the area determined? Are there any guidelines already followed?	What is the currently recommendation by the appropriate governing body for the management of the disease targeted?
What are the major comorbidities of the targeted population?	What medications in those recommendations are not accessible in the targeted population?
What is the level of control currently of the disease targeted? What medications is the population currently taking for management of the targeted disease?	What is the data for medications that can be utilized as a substitute for those medications that are not readily accessible? Has that data been shown to apply to the targeted population?
What medications are readily accessible in the region?	Is there repeated education established for providers, with adequate follow up in between education sessions?
What are the limitations in accessing those medications that are available?	Is there a method for providers to ask questions should the algorithm become difficult to follow?
What is the cost of available medications?	

C. Intervention: Algorithm Adjustment & Further Provider Education

Analysis of treatment patterns and overall blood pressure control following the first capacity building trip indicated that the proposed guidelines were not being consistently followed. We completed a root cause analysis in collaboration with the health providers and our partner MPI to determine why this was the case and came up with

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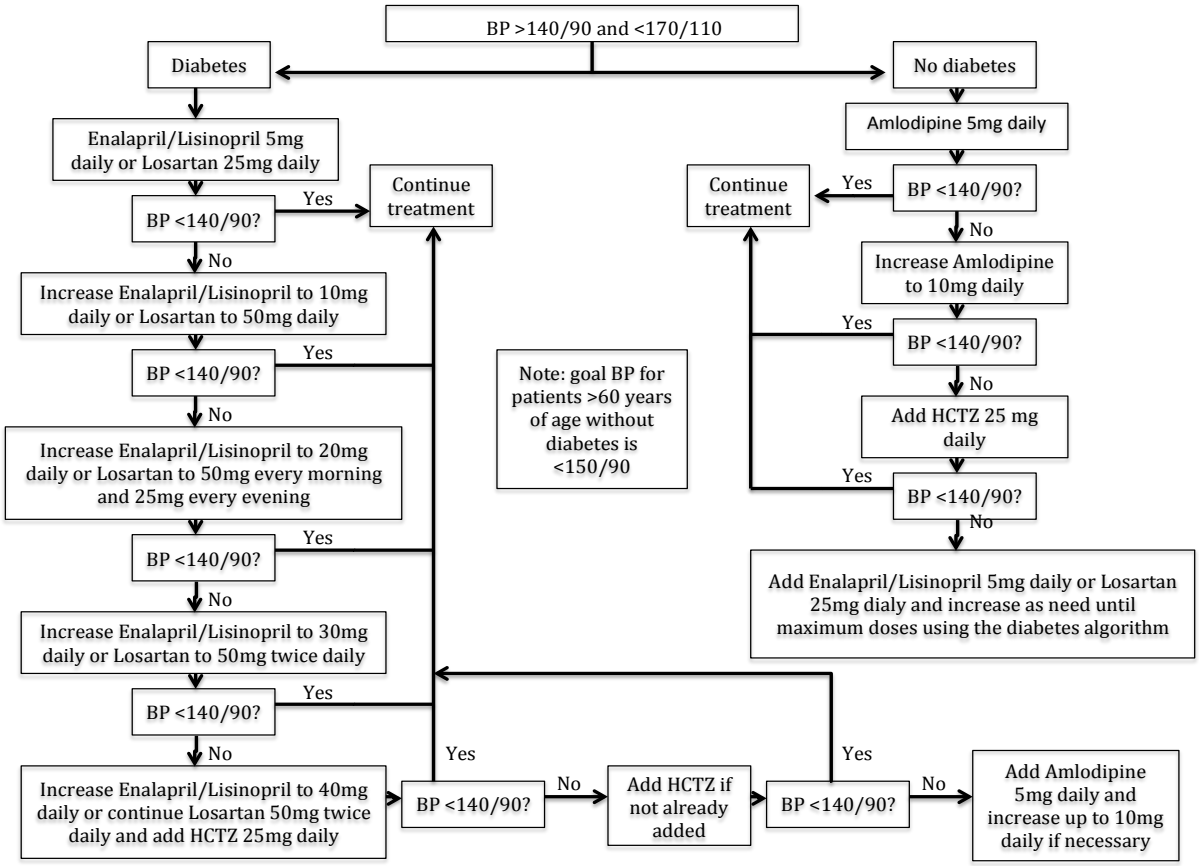

Figure 1. Community-specific evidence-based treatment algorithm

the following issues:

1. Insufficient funding to pay for complete supply of medications
2. Insufficient funding to pay for monitoring labs (ie creatinine, potassium)
3. Minimal clinic time to practice putting guidelines in place with real patients
4. Confusion regarding quantities of medications to be distributed to patients

Between March and October of 2015, we worked in collaboration with the Nicaraguan providers and MPI to combat these issues. First, we reviewed the JNC guidelines taking into close consideration the cost of each medication at the local pharmacy and costs of monitoring labs. Using that information, we adjusted the one-page algorithm for the most cost effective treatment of hypertension in that specific community (Figure 1). Some of these substitutions included specifying with medication within a category to use. Making simple substitutions such as Enalapril instead of Lisinopril dramatically decreased the cost of treatment for many patients simply due to local pricing. In the customized algorithm, we included conservative but safe laboratory monitoring schedule. Clinic scheduling was changed to having a dedicated day for patients with hypertension to visit, as their appointments often required more time. Discussion with local practitioners revealed concerns regarding dispensing greater than a one month supply to patients, related to issues with theft, and it was decided that patients would visit once monthly to receive their blood pressure checks and to receive their medications. Lastly, during the October 2015 capacity building trip, USF Health attending physicians saw each chronic patient with the local physician and worked with her to create six-month plans based on the algorithm for every patient. Patients continued to come to clinic monthly, and those six-month plans required minimal adjustment by the Nicaraguan providers. Nicaraguan providers were also informed that they could make remote consults to USF providers as needed via the electronic community health records system. These changes were intended to encourage more consistent implementation

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of the guidelines in the Cedro Galán Clinic and of the improve blood pressure control.

D. Outcomes and Hypothesis

The primary outcome was blood pressure management, which was evaluated using the electronic community health record. Secondary outcomes included medication and treatment adherence, evaluated by adherence to clinic appointments and reported adherence to medications, as well as provider confidence. Provider confidence was evaluated subjectively, in discussions with local practitioners, as well as in use of the guidelines independently to adjust patient treatment plans. We hypothesized that patient blood pressure, patient adherence, and provider confidence would all improve with our community-specific algorithm-based educational program.

E. Data Analysis

Although this is an observational study based on sharing our experience to help others undergoing similar endeavors, we also collected some basic data about our patients with hypertension impacted by the program. All data was obtained from retrospective chart review. The data was examined in three different time intervals, outlined below.

1. Prior to Pilot
2. Between Pilot and Intervention
3. After Intervention

Charts reviewed were determined by inclusion criteria of diagnosis of hypertension, defined as blood pressure greater than 140/90, age greater than 18 years, and enrollment in "USF Health Nicaragua Chronic Patient Program." Baseline characteristics of all patients were obtained. For each of the patients, monthly systolic and diastolic blood pressures (mmHg) were collected by chart review to obtain data from October 2014 to April 2016. Averages of systolic and diastolic pressures were calculated separately, and displayed in a run chart for each month. Finally, trends in blood pressure were evaluated by obtaining averages in systolic and diastolic pressures for all patients in each of the three time intervals outlined above.

III. RESULTS

Among those meeting inclusion criteria (N = 17) patient baseline characteristics showed a mean age of 58 years (SD 14) and mean weight of 70 kg (SD 11). Four of the patients were male, while 13 were female. Eight of the patients had coexisting Type 2 Diabetes Mellitus (Table II).

A. Primary Outcome: Blood pressure

Figure 2 shows the run chart of blood pressure averages. Table III illustrates overall mean blood pressures prior to the pilot, between the pilot and intervention, and after the intervention. The mean systolic and diastolic pressure for all patients was 146/78 mm Hg at baseline, compared to 153/83 mm Hg (systolic SD 30.8, diastolic SD 12.7) between the pilot and the intervention, and145/81 mm Hg after the intervention. Both systolic and diastolic pressure averages showed an increase in between the pilot and the intervention, but then a decline, more prominently in systolic pressures, after the intervention. It must be taken into account that, prior to the pilot, there were only ten patients that were identified as meeting inclusion criteria. All additional patients were added in between the pilot and intervention. Of note, there were more than double the number of diabetics in the post-pilot compared to before the pilot, which could explain the absence of large decline in blood pressures. All patients appeared to be more stable following the intervention.

TABLE II. BASELINE PATIENT CHARACTERISTICS (N=17)

	Mean (SD) or N (%)
Age (years)	58 (14)
Sex	
Male	4
Female	13
Weight (kg)	70 (11)
Diabetic	8

TABLE III. MEAN BLOOD PRESSURE VALUES

	Mean Blood Pressure (mm Hg)
Prior to Pilot	146/78
Between Pilot & Intervention	153/83
After Intervention	145/81

Pilot date started 3/7/15. Intervention date started 10/10/15. Blood pressures before Pilot, between Pilot and Intervention, and 6 months following Intervention.

B. Secondary Outcomes: Community and Local Provider Effects

Local providers self-reported increased confidence in prescribing practices, and followed the algorithms more consistently, making changes when needed, after the intervention. Community members also self-reported increased medication adherence and understanding of management of their hypertension. Median and average number of kept appointments for medication refills and blood pressure checks increased, most prominently after the intervention, and is shown in Figure 3 below. The

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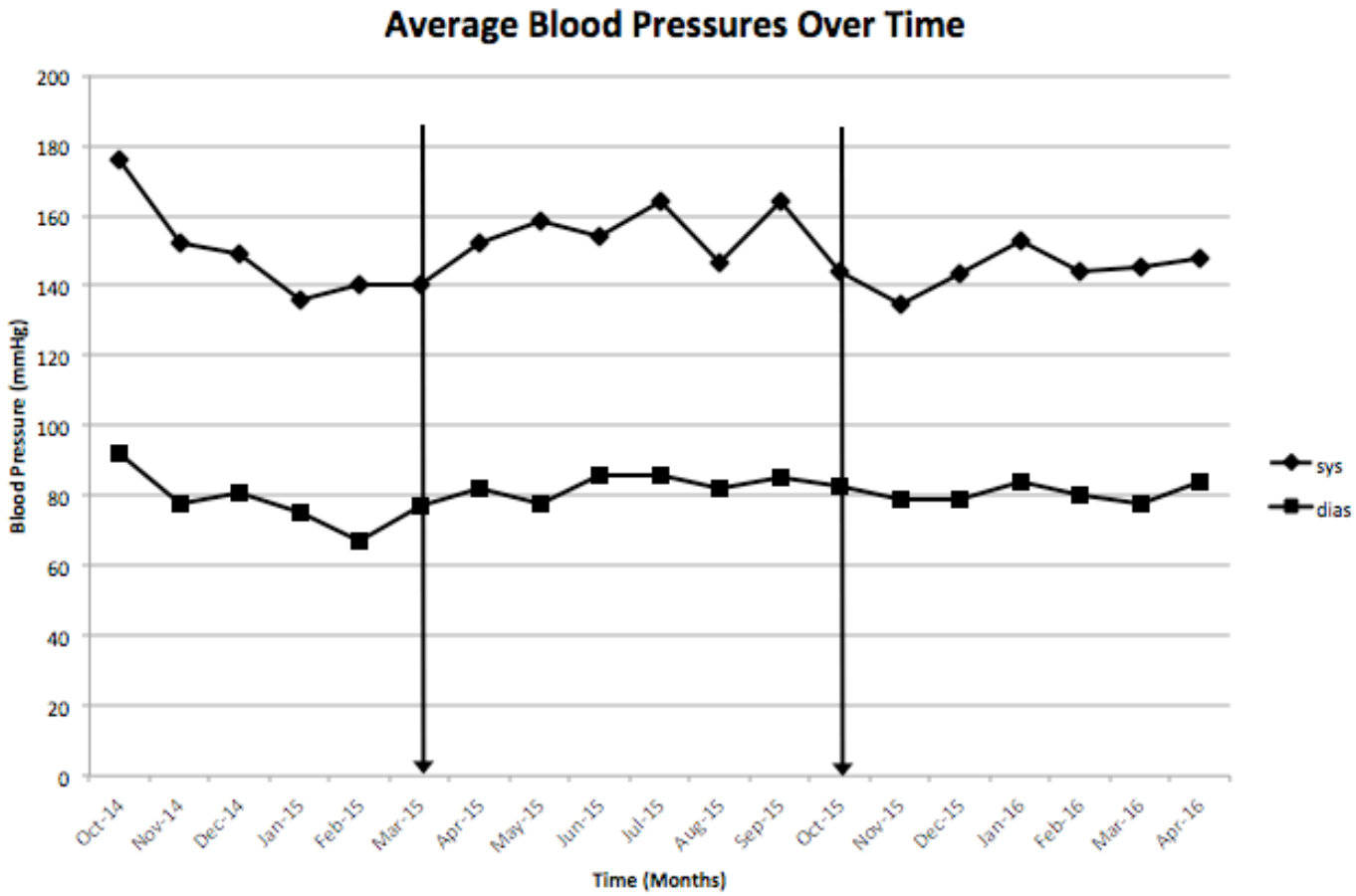

Figure 2. Average blood pressures over time, with arrows indicating pilot and intervention

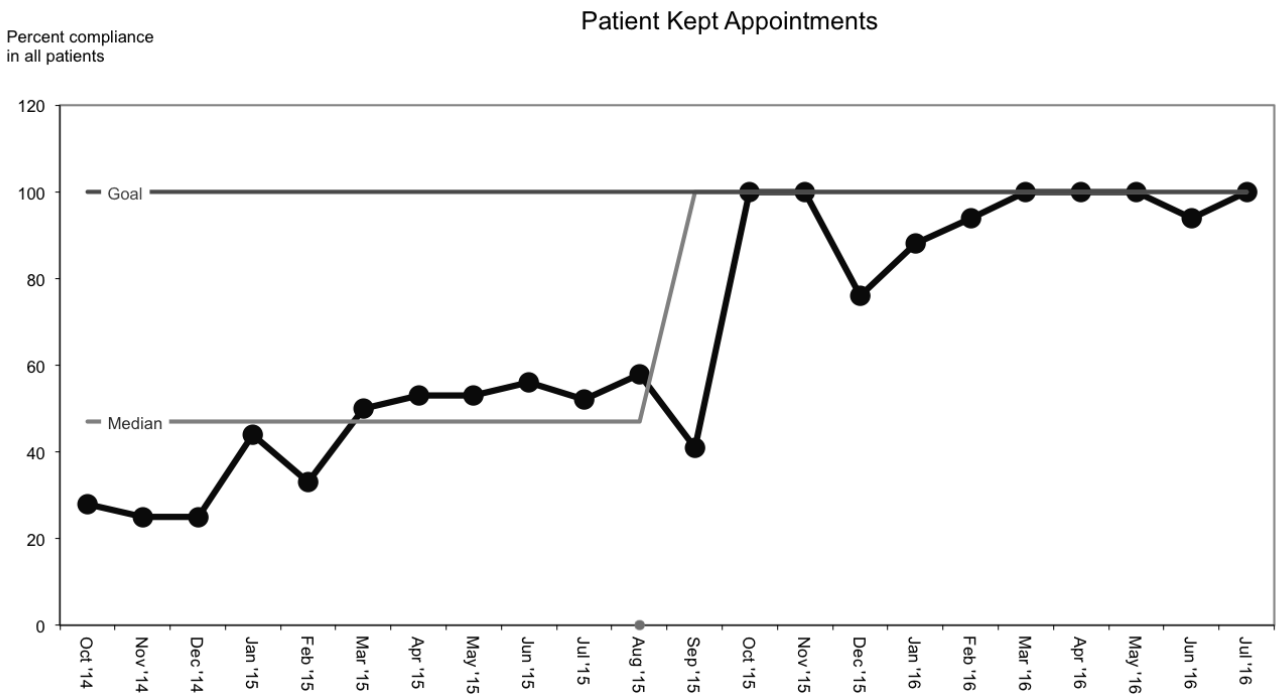

Figure 3. Percent of patients presenting to clinic for monthly blood pressure checks and medication refills

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appointment compliance median was 47% at baseline, compared to 100% after the intervention.

IV. DISCUSSION

This study revealed an increase in mean systolic and diastolic pressures after the Pilot, and a subsequent decline in both systolic and diastolic pressures after the Intervention.

As discussed earlier, there proved to be confusion after the Pilot and initial presentation of the algorithm. Evaluation of the electronic medical record, coupled with discussion with local providers, indicated a number of issues. These issues were addressed via root cause analysis, detailed in Algorithm Development. Many of the problems identified fell into the categories that have been presented in prior reviews as barriers in guideline applications, those being knowledge, attitude, and behavior [17]. The addition of the Intervention to our strategy allowed us to address and correct upon the limitations in each of those categories. Improvement of blood pressure values post-Intervention suggests that those techniques improved upon the organization, understanding, and cost efficiency of the algorithms, and ultimately created a successful algorithm-based educational program. Considering the difficulty in implanting clinical guidelines, we recommend a similar approach for future studies, with regular follow-up intervals and planned Intervention.

It would be necessary to follow-up current pressures to determine whether the decline in blood pressures can be definitively attributed to our methods. We would hypothesize that blood pressures have continued to improve since our retrospective data review.

Effect on the community and local providers was noted to correlate with the improvement in blood pressure post-Intervention. The collaborative process of adjusting the algorithm with local providers built trust with the Nicaraguan health care providers. This phenomenon aligns with recommendations from experts in global health that have emphasized the need for partnership with host countries [18]. The addition of the option for remote consults with physicians in Tampa, Florida, also seemed in to increase prescriber confidence. Treatment plans were more consistently followed.

Community adherence and dedication to self-improvement also seemed to increase over the course of our study. Community members became more active participants in their health care, traveling to clinic monthly to check their blood pressures and refill their medications. This is compatible with models of hypertension management that have been recognized by the American Heart Association, American College of Cardiology, and the CDC, which describes improved clinical outcomes with active involvement and monitoring by both the patient and his/her medical professionals [19]. We highlight a strong need for an educational foundation.

Limitations include the addition of many participants after the Pilot. Our study is limited by small sample size. Finally, we are limited in comparison of our findings with similar initiatives, as there is not current outcomes-based literature regarding the standardization of management of non-communicable disease in resource-poor areas of Nicaragua. However, similar projects in rural areas of Honduras and China have also demonstrated success in creation of community-specific programs [14][20].

V. CONCLUSION

Our evaluation suggests that there could be a benefit to the establishment of community-specific algorithms for the management of hypertension. We stress the need for continued study in this subject, given the significant morbidity and mortality associated with uncontrolled hypertension. However, we suggest that taking the time to develop a community-specific algorithm-based educational program using methods similar to those we have prescribed above can result in improved provider confidence, improved community

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