Original Article

Effectiveness of a Seamless Hypertensive Care Model: A 5-Year Experience from a University Hospital, Khon Kaen, Thailand

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Background: Hypertension (HT) is a global health problem since it is a cause of fatal and non-fatal cardiovascular events. Despite various therapeutic options available, many patients fail to achieve target blood pressure (BP). A major concern is the discontinuity of care whether it is caused by healthcare systems or patient factors. Quality and seamless care with the intra-institute partnership might lead to a higher rate of BP controlled.

Objective: To assess the effectiveness of a "Seamless Hypertensive Care model" in terms of BP controlled rate.

Materials and Methods: "Seamless Hypertensive Care model" was established in 2013. The hospital's HT workflow was developed by a multidisciplinary team and has been adopted by every department. Once a patient is found to have BP ≥180/110 mmHg, he or she will be sent to the emergency department (ED). After BP was lowered by 20%, they will be discharged home and scheduled for a follow-up in the 1st and 12th weeks. The effectiveness of the care model in terms of BP controlled rate from January 2016 to December 2019 was analyzed.

Results: Total of 1,277 HT patients were sent to the ED. There were 243, 269, 312, and 261 patients who came for a 12th week follow-up in the 4 consecutive years (2016 to 2019). BP control rate (<140/90 mmHg) increased year by year (56.6%, 62.7%, 62.7, and 67.7%, respectively). The complications including strokes and kidney diseases occurred in 0.74% of the total follow-up patients (8/1,085).

Conclusion: The present study demonstrated the effectiveness of a "Seamless Hypertensive Care model" for increasing the BP controlled rate.

Keywords: Hypertensive crisis, Hypertension, Thai, Care process

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Hypertension (HT) has been a global health problem since it is a major cause of death and often leads to fatal and non-fatal cardiovascular events[1]. Despite various therapeutic options available, many patients fail to achieve blood pressure (BP) target[2]. Previous studies have shown that poor HT control is often associated with the discontinuity of HT care[3], poor medication-adherence[4], and unhealthy lifestyles[3]. A holistic approach might improve HT control[5].

An organized system including multidisciplinary team of doctors, nurses, pharmacists, nutritionists, etc., and a seamless and coordination of care was found to improved blood pressure (BP) controlled[5]. Furthermore, a process of care that included thorough physical examinations, proper BP measurements, and evidence-based pharmacological management consistently lead a good BP outcome[6-10]. The authors aimed to evaluate the effectiveness of the "Seamless Hypertensive Care model", which has been established in our hospital with 4 bases; efficient, accessible, seamless, and yielding.

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Objective

To assess the BP controlled (<140/90 mmHg) rate of the 4 consecutive years (2016 to 2019) and to assess achievement rates of the key process indicators (KPIs) and the complication outcome indicators of the Hypertensive Crisis clinic.

Materials and Methods

This was a retrospective cohort study, taken place in a tertiary-level, university hospital in Khon Kaen, Thailand. The data were collected from the hospital computer-based system called Health Object (HO) and the HT registry. Patients in our study were the consecutive patients who walked in or who were sent to the emergency room (ER) by

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any out-patient departments (OPDs) in the hospital due to BP ≥180/110 mmHg. After being treated and patients had their BP lowered by at least 20%, they were then discharged with home medications and were scheduled to the follow-up clinic at the 1st week and 12th week. This study was approved by the ethical committee in human research, Khon Kaen University (HE591508).

Inclusion and exclusion criteria

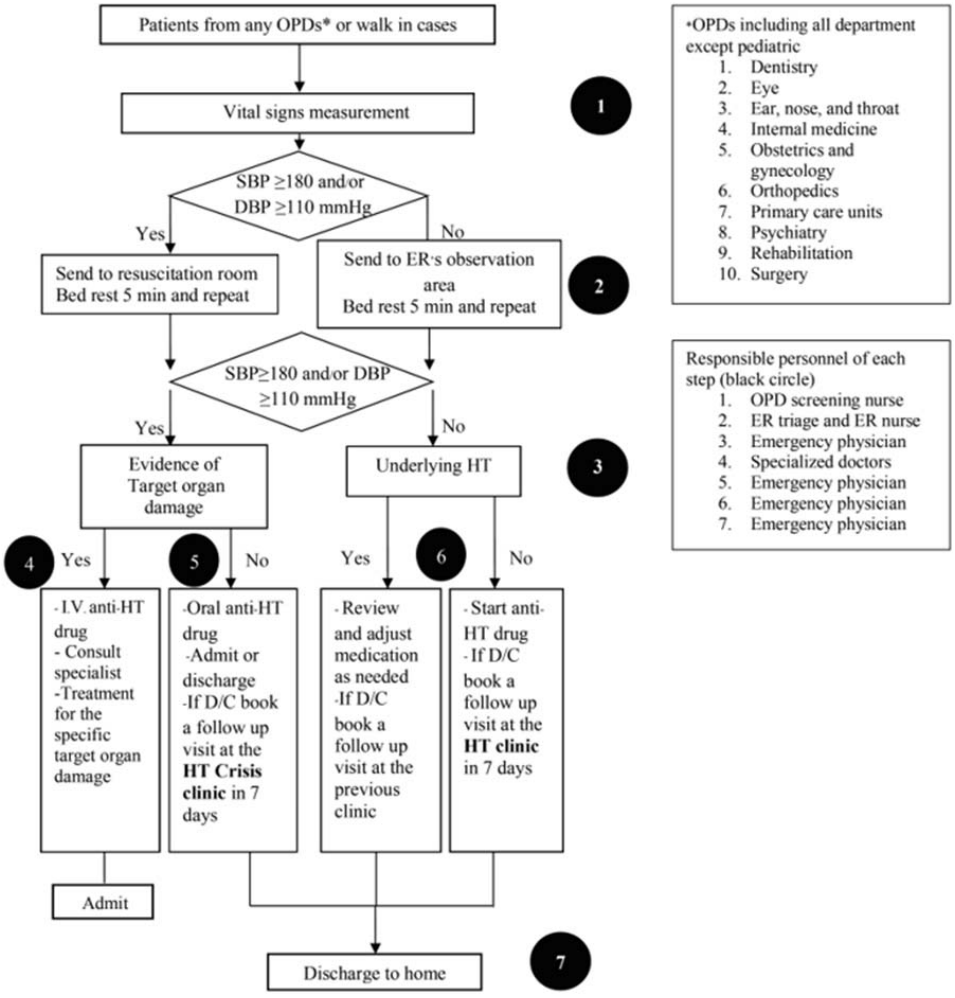
Inclusion criteria included 1) Two or more measures of BP ≥180/110 mmHg in the ER, 2) Aged 18 to 80 years old, 3) Attending a follow-up visit at the follow-up clinic (HT crisis clinic) at 12th week, and 4) On a stable dose of anti-hypertensive drugs for 4 weeks. Patients with secondary causes of HT, chronic alcohol drinking, pregnancy, and lost to follow-up at the 12th week were excluded from the final analysis.

Seamless hypertensive care model

Seamless Hypertensive Care model was developed in year 2013 with 4 bases; efficient, accessible, seamless, and yielding. The model included 1) Hospital HT workflow and 2) Clinics for regular follow-up visits.

The hospital's HT workflow was developed by a multidisciplinary team including general practitioners, emergency physicians, cardiovascular medicine physicians, nurses, pharmacists, and nutritionists to ensure the continuity of care (Figure 1). The workflow was approved and adopted by every department in the hospital.

The flow begins with a patient who walks into the



OPD = outpatient department, BP = blood pressure, SBP = systolic blood pressure, DBP = diastolic blood pressure, ER = emergency room, HT = hypertension, IV = intravenous, D/C = discharge

Figure 1. The Hospital's hypertension workflow.

ER or a patient who is sent to the ER from other OPDs after he/she is found to have BP ≥180/110 mmHg. Emergency physician is responsible for treating hypertensive crisis according to the latest clinical practice guidelines[11]. After BP is lowered by 20% and no target organ damage is detected, the patient will be given health education before being discharged to their home with anti-HT medications. Every patient would be scheduled for a regular follow-up visit at the HT Crisis clinic or HT clinic of the hospital, or their previous clinic if there is one (Figure 1).

There are two clinics providing care and regular follow-ups for HT patients in our hospital based on the level of BPs and HT treatment status: 1) The "Hypertensive Crisis clinic" is responsible for untreated patients who visit ER with BP ≥180/110 mmHg, and 2) "Hypertension clinic", which provide a treatment for known HT cases who already have their regular follow-up visit. During the follow-up visit, physical examinations, BP measurements, serum chemistry tests, metabolic syndrome criteria and any unhealthy lifestyles check will be performed. The clinics have 4 principles including 1) Stage of change theory, 2) Health education, 3) Home BP monitoring (HBPM), and 4) Multidisciplinary approach. There is a health education session by a well-trained HT nurse, which is presented through PowerPoint slides and a Q and A session (30 minutes) before the treatment is started. Every patient is free to ask questions about his/her health with adequate time spent with the doctor. Patients are encouraged to have HBPM and a BP notebook. If they cannot afford HBPM, the clinic will provide a BP machine for short or long-term usage. Patients are motivated to modify their lifestyle including regular exercise, salt restriction, losing weight, and medication adherence by using the stage of change theory[12] (Figure 2).

The clinic also has integrative approaches such as music therapy[13], Buddhist praying, and foot reflexology to help reducing stress and BP, based on the patient's preference in conjunction with the pharmacological treatments. Patients are scheduled for follow-up every 8 to 12 weeks and have to test for diabetes mellitus (DM), dyslipidemia, hyperuricemia, and other target organ damage in accordance with the latest recommendations in standard HT guidelines[11]. We arrange a multidisciplinary team meeting with the patients two times per year or more for providing health educations. The care process of the HT Crisis clinic is showed in Figure 3.

Outcome measurement

Office BPs (systolic BP (SBP) and diastolic BP (DBP)) were measured using a Thai-FDA approved oscillometric BP device, two times measurement (5 minutes apart) in an upright position in a quiet room. The average numbers of 2 measured SBPs and DBPs were used for the analysis. The performance of HT care indicators such as physical examination, BP measurement, and serum chemistry tests were collected from the Hypertensive Crisis clinic, as well as the KPIs including 1) HT data perception rate, 2) Accurate individual health data perception rate, and the outcome indicators including 1) Cardiovascular complications, 2) Strokes, 3) Kidney complications, and 4) ER re-visit due to HT urgency.

Statistical analysis

Data are shown as mean ± standard deviation (SD) for continuous variables or percentage (%) for categorical variables. All statistical analyses were performed with SPSS for Mac version 20.0, registered to Khon Kaen University.

Results

Baseline characteristics

A total of 1,277 HT patients was sent to the ER between 2016 and 2019. There were 243, 269, 312, and 261 patients who came for the 12th week follow-up in the 4 consecutive years. Of the total follow-up cases, 44.2% were male. Mean age was 61.7±12.5 years old. Mean BMI was 26.0±6.5 kg/m^2 and mean waist circumference was 88.7±10.8 cm, 65.3% had underlying HT. The other underlying diseases were diabetes mellitus, dyslipidemia, and chronic kidney disease (CKD); 23.2, 9.5 and 2.6%, respectively. Forty percent of the patients were sent to the ER from the other outpatient departments. Initial SBP and DBP values were 198.6±18.2 and 110.2±15.7 mmHg, respectively (Table 1).

BP outcome, complications, and KPIs of the hypertensive crisis clinic

BP control rate (<140/90 mmHg) was 56.6%, 62.7%, 62.7, and 67.7%, in 2016 to 2019 respectively (Figure 4) 2% of patients could sustainably stop anti-HT drugs (data not shown). Complications, strokes and kidney complications occurred in 0.46% and 0.28% of total patients during the study period (Table 2).

The performance of HT care indicators such as physical examination, BP measurement, and serum chemistry tests were 100% achieved during the study period. The HT data perception rate was 100% in four consecutive years. The accurate individual health data perception rate was 93.7%, 95%, 95.5%, and 95.8% in 2016 to 2019, respectively. There was no patient who had ER re-visit due to HT urgency (Table 2).

Discussion

The present study emphasized the effectiveness of the "Seamless Hypertensive Care" model in terms of BP outcome. After the model had been adopted in the hospital, the BP controlled rate was more than 50% in four consecutive years, which was higher than the world's average BP controlled rate[14]. Furthermore, when looked into details, the KPIs were all achieved and the complication rates were low. It has been known that fragmented care often leads to unfavorable outcome in treating non-communicating diseases (NCDs)[15,16]. Therefore, we developed a model that promoted continuity of care. The authors focused on the joint between OPDs and ER, since it had been a major problem in our hospital. In the past, patients who visited OPDs who had BP above 180/110 mmHg were sent to ER. However, after the treatment in ER was done, they were discharged without

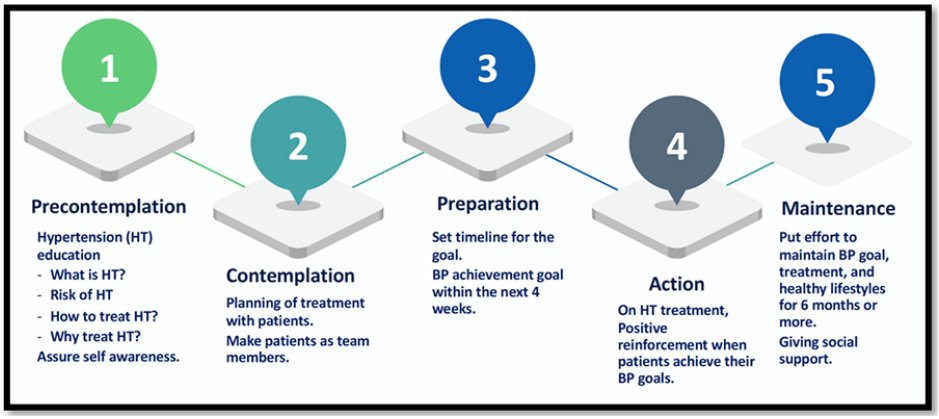


Figure 2. Stage of change theory.

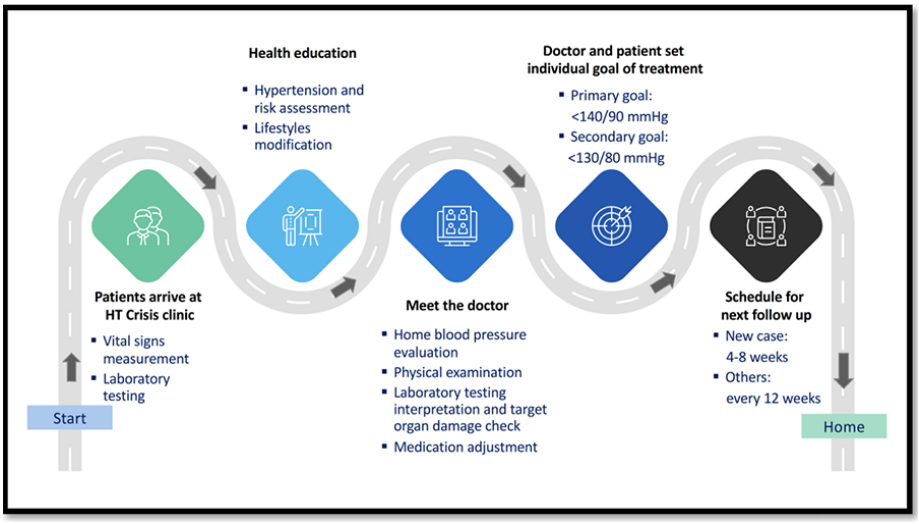


Figure 3. The care process of the HT Crisis clinic.

having any follow-up schedule. Some of them had poor compliance and adherence and had unhealthy lifestyles. The consequence was multiple re-visits due to HT crises. Some of them even had acute myocardial infarction, heart failure, and strokes as complications. The fragmented care also was reported as a problem in treating HT in rural China[17]. The integrated HT care model in China was later developed by Zhang Y. et al and was reported as an effective model for lowering BP and reducing hospitalization. Their model was similar to the model the authors used in the present study. The key important feature was to combine treatment and prevention care with a multidisciplinary team. However, Zhang Y. et al made it to the larger scale, they also provided a continuous care across all tiers of delivery system (village-town-county)[18], which we plan to do in the future.

The authors adopted KPIs included detailed physical examinations, BP measurement, serum chemistry tests, which were proposed by Asch Sm. et al as a quality of hypertensive care in the United States[19], as well as the data perception rate in both of our HT follow-up clinics. Our study confirmed results of Busse R. et al about the impact of the quality care process for the favorable BP outcome[19].

However, we were aware of potential limitations that might affect the study results. First, this was a retrospective study; therefore, information bias might be presented. Second, there were some possible confounding factors that the authors could not control e.g. diets, exercise, stress, and choices of anti-HT medications that varied based on the physician's experience and preference.

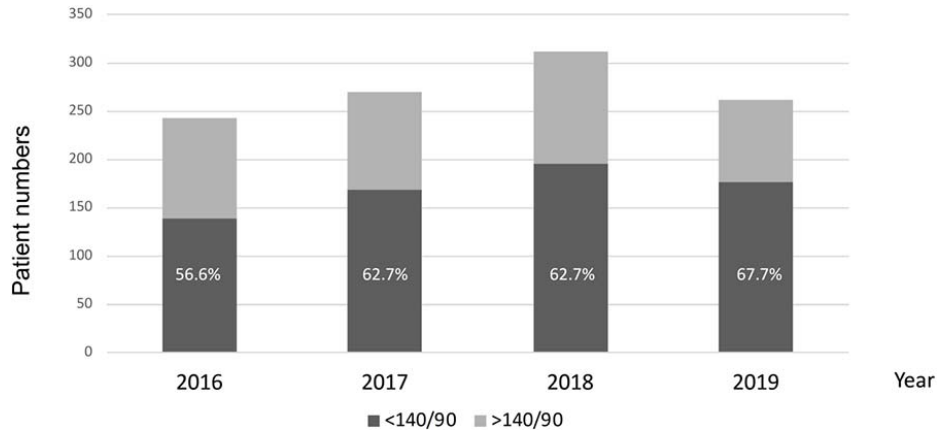


Figure 4. Blood pressure (BP) outcome; controlled BP (<140/90 mmHg) and uncontrolled BP rate between year 2016 to 2019.

Table 1. Baseline characteristics

Characters	n = 1,085
Age, year (mean ± SD)	61.7±12.5
Male, %	44.2%
BMI, kg/m^2 (mean ± SD)	26.0±6.5
Waist circumference, cm (mean ± SD)	88.7±10.8
Known HT, %	65.3
Known CAD, %	1.2
Diabetes, %	23.2
Hyperlipidemia, %	9.5
Chronic kidney disease, %	2.6
Initial blood pressure (BP) in ER (mean ± SD)	
Systolic BP, mmHg	198±18.2
Diastolic BP, mmHg	110±15.7
No. of anti-hypertensive prescriped as home medication, %	
0	149 (13.7)
1	602 (55.5)
2	274 (25.3)
≥3	60 (5.5)
ED time	
<4 hours, %	873 (80.5)
≥4 hours, %	212 (19.5)
Discharge from ED, %	1,052 (97)
Admit, %	33 (3)

Conclusion

The Seamless Hypertensive Care model was effective for achieving not only the BP outcome, but also the KPIs and complication outcome indicators. Hospitals should establish their own workflows and treatment models that promote the continuity of care for hypertensive patients by multidisciplinary team. The HT clinic that reinforces teamwork between medical team and patients is recommended, since it will lead to the achievement of BP target and lowering possible complications.

What is already known for this topic?

Hypertensive patients often experience fragmented medical care in the current healthcare system for non-communicating diseases (NCDs). This has been a challenge for many countries.

What this study adds?

A Seamless Hypertensive Care model proved its effectiveness and feasibility to be developed in the context of multidisciplinary team with a promising outcome.

Acknowledgements

The authors would like to thank all members of Patient Care Team Hypertension (PCT HT) of Srinagarind Hospital, Faculty of Medicine, Khon Kaen University for their contribution in the workflow and the care process that we have used for taking care of our HT patients.

Potential conflicts of interest

The authors declare no conflicts of interest.

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Table 2. Key process indicators and complication outcome indicators of the Hypertensive Crisis clinic between 2016-2019

Indicators	Expected goals	Years			
		2016	2017	2018	2019
Key process indicators					
Physical examinations (every visit), BP measurement (every visit), serum chemistry tests (every 12 weeks)	100%	100	100	100	100
HT data perception rate	100%	100	100	100	100
Accurate individual's health data perception rate	≥85%	93.7	95	95.5	95.8
Complication outcome indicators					
Cardiovascular complications (myocardial infarction, heart failure, aortic disease), %	<1%	0	0	0	0
Strokes, %	<1%	0	0	0.46	0
Kidney complications (acute and chronic kidney injury, end stage renal disease)	<1%	0	0	0	0.28
ER re-visit due to HT urgency	<1%	0	0	0	0

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ประสิทธิผลของโมเดลการรักษาโรคความดันโลหิตสูงแบบไร้รอยต่อ: ประสบการณ์ 5 ปีจากโรงพยาบาลมหาวิทยาลัย จังหวัดขอนแก่น ประเทศไทย

แพรว โคตรุฉิน, ฐปนวงศ์ มิตรสูงเนิน, สุภาพ อิ่มอ้วน

ภูมิหลัง: ความดันโลหิตสูงเป็นปัญหาของสาธารณสุขทั่วโลกเนื่องจากเป็นต้นเหตุของโรคทางหัวใจและหลอดเลือดทั้งชนิดไม่รุนแรงและชนิดที่รุนแรงถึงชีวิต ถึงแม้ในปัจจุบันจะมีทางเลือกในการรักษามากมายแต่ก็พบว่าผู้ป่วยจำนวนมากความดันโลหิตยังไม่ถึงเป้าหมาย ปัญหาส่วนใหญ่มักเกิดจากความไม่ต่อเนื่องในการรักษาไม่ว่าจะเกิดจากระบบบริการสุขภาพ หรือมีสาเหตุมาจากตัวผู้ป่วยเอง การดูแลรักษาที่มีคุณภาพและไร้รอยต่อระหว่างผู้ให้บริการอาจจะมีส่วนช่วยให้ผู้ป่วยมีการติดตามต่อเนื่องในการรักษาและนำมาสู่การควบคุมความดันได้สำเร็จ

วัตถุประสงค์: เพื่อวัดประสิทธิผลของโมเดลการรักษาความดันโลหิตสูงแบบไร้รอยต่อโดยวัดจากอัตราการควบคุมความดันโลหิตได้ตามเป้าหมาย

วัสดุและวิธีการ: โมเดลการรักษาความดันโลหิตสูงแบบไร้รอยต่อได้ถูกสร้างขึ้นเมื่อพ.ศ. 2556 โดยมีหลักการพื้นฐาน 4 ประการคือ คุ้มค่า เข้าถึงได้ ไร้รอยต่อ และก่อผลสำเร็จ โดยทีมสหสาขาวิชาชีพได้ร่วมกันสร้างผังการไหลของการดูแลผู้ป่วยความดันโลหิตสูงและต่อมาได้ยอมรับและใช้งานทั้งโรงพยาบาล โดยเริ่มต้นเมื่อผู้ป่วยที่มีความดันเกิน 180/110 มม.ปรอท จะถูกส่งมาที่แผนกฉุกเฉินจากนั้นหลังจากรักษาจนความดันโลหิตลดลงร้อยละ 20 แล้วจะให้กลับบ้านและมีการนัดเข้าสู่คลินิกความดันที่ 1 และ 12 สัปดาห์ ประสิทธิผลของโมเดลการรักษาความดันโลหิตสูงแบบไร้รอยต่อ วัดจากอัตราการควบคุมความดันโลหิตตั้งแต่ พ.ศ. 2559 ถึง พ.ศ. 2562

ผลการศึกษา: ตลอดระยะเวลาการศึกษาผู้ป่วยความดันโลหิตสูงทั้งหมด 1,277 รายถูกส่งมาที่แผนกฉุกเฉิน มีผู้ป่วยที่มาตามนัดที่ 12 สัปดาห์จำนวน 243, 269, 312 และ 261 ราย ในปี พ.ศ. 2559 ถึง พ.ศ. 2562 ตามลำดับ อัตราการควบคุมความดันโลหิตได้ตามเป้าหมายเพิ่มขึ้นทุกปีตลอดระยะเวลา 4 ปี (ร้อยละ 56.6, 62.7, 62.7, 67.7, ตามลำดับ) มีผู้ป่วยร้อยละ 2 ที่สามารถหยุดรับประทานยาได้ในระยะยาว ภาวะแทรกซ้อน ได้แก่ โรคหลอดเลือดสมองและโรคไตเกิดขึ้นกับผู้ป่วยร้อยละ 0.74 (8/1,085 คน)

สรุป: การศึกษานี้แสดงให้เห็นว่าโมเดลการรักษาความดันโลหิตสูงแบบไร้รอยต่อมีประสิทธิผลในการเพิ่มอัตราการควบคุมความดันโลหิตได้ตามเป้าหมาย