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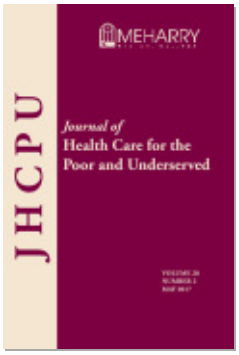

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Assessment of Hypertension Management and Outcomes at an Indianapolis Student-Run Free Clinic

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Abstract: **Purpose**. To characterize the quality of health care at student-run free clinics (SRFCs) by analyzing hypertension management and outcomes at the Indiana University Student Outreach Clinic (IUSOC). **Methods**. A retrospective review of medical records was conducted for hypertensive patients managed at IUSOC over 15 months (N = 64). Indiana University Student Outreach Clinic's hypertension control rate was compared with National Health and Nutrition Examination Survey (NHANES) data. **Results**. Blood pressure control rates increased significantly over the study period. Indiana University Student Outreach Clinic's control rate did not differ significantly with the NHANES national average, but was significantly greater than the NHANES group with no usual source of care. Similarly, IUSOC patients without insurance or with unknown insurance status had greater control rates than an uninsured NHANES group, but did not differ significantly from an insured NHANES group. **Conclusions**. Despite unfavorable demographic characteristics, records for patients with hypertension who used IUSOC as a regular provider of primary care compared favorably with national data.

Key words: Hypertension, student-run free clinic, free clinic, medical students, medical education, retrospective study.

Hypertension is an important modifiable risk factor for vascular disease in the United States and is associated with overall decreased life expectancy.[1,2,3,4] Hypertension affects nearly one third of the United States population[5] and imposes an economic burden of tens of billions of dollars annually.[6] Numerous studies have demonstrated the

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benefit of hypertension control in reducing vascular disease complications.[1,2] Whether a patient with hypertension can achieve and maintain disease control depends on a number of biological, social, and economic factors. As might be expected, access to health insurance and a usual source of health care are associated with increased rates of hypertension control.[5]

Access to health care in the United States remains a challenge for many. It is estimated that 30 million nonelderly Americans and undocumented immigrants will be uninsured in 2016, and this number is not predicted to decline significantly over the next several years.[7] Unmet health care needs are sometimes addressed by a patchwork of charity free clinics, including clinics associated with medical schools. These student-run free clinics (SRFCs) are now present at 75% of Association of American Medical Colleges (AAMC) member institutions, and more than one-half of medical students at these institutions participate in free clinic experiences during medical school.[8] This paper describes hypertension management and outcomes at the Indiana University Student Outreach Clinic (IUSOC), a student-run free clinic based in Indianapolis.

The IUSOC has been serving the Near Eastside neighborhood of Indianapolis since 2009. Located in Neighborhood Fellowship Church, the clinic was originally founded by IU medical students who quickly formed partnerships with student groups from other Indianapolis professional schools. Partnerships now exist with Butler University, Indiana University-Purdue University Indianapolis (IUPUI), and the University of Indianapolis that allow professional students training in pharmacy, law, dentistry, social work, physical therapy, occupational therapy, public health, and nursing to make contributions to patient care and engage in interprofessional education.[9] The IUSOC is open every Saturday and operates as a walk-in clinic. Approximately 35–40 patients are seen each week by teams consisting of medical students, residents, and faculty of the Indiana University School of Medicine. Faculty members examine each patient and supervise all treatment decisions before the patient leaves the clinic. In partnership with Butler College of Pharmacy, most prescriptions written by the medical clinic are filled in-house and are immediately available at no cost to the patient.

There is considerable evidence that the Near Eastside neighborhood stands to benefit from the medical safety net that a free clinic provides. Data from the U.S. Census Bureau and the Marion County Health Department showed that in 2012, the Near Eastside neighborhood's ZIP code had the county's highest rate of poverty, with 41.9% of Near Eastside residents living below the poverty line.[10] Among people over 25 years old, 29.6% did not have a high school diploma and 26.9% of people under 65 years old had no health insurance.[11]

As SRFCs become a larger part of medical education and contribute more to the health care safety net, these organizations have a responsibility to assure the quality of the services offered to the community. Several studies have been conducted at other SRFCs to characterize quality of care[12,13,14,15] and two have specifically addressed hypertension.[16,17] Hypertension is one of the most common diagnoses seen at SRFCs nationally[8] and is a major focus of care at IUSOC. The clinic had over 1,600 patient visits in 2013, 80% of which were from returning patients. By far the most common chronic disease seen at IUSOC was hypertension, which accounted for 60% of all chronic care visits.[18] For this reason, hypertension is a reasonable starting point for characterizing the care provided

at IUSOC. This study details a retrospective analysis of hypertension management and outcomes at the IUSOC and represents the first known attempt of a student-run free clinic to compare formally its hypertension outcomes with national data.

Methods

Patients. Eligible subjects were defined as those patients who had been treated for hypertension at IUSOC between January 2013 and March 2014 and had more than three visits during this period. Patients were excluded if they had a period of six months or greater when they did not follow-up at clinic. Visits that occurred within a 28-day period were counted as one visit.

Data collection and analysis. Data collection was performed by the authors as well as five other junior and senior medical students. Volunteers received prior training on the clinic's record system and the study's Microsoft Excel data collection tool. The abstracted data included demographic information, comorbidities, dates of all visits in the study period, the use of laboratory tests, all blood pressure readings in the study period, and all medication doses and changes during the study period. The authors assured the consistency of data collection between medical student volunteers and corrected for any inconsistencies in data entry. At IUSOC, medical students receive instruction on proper blood pressure measurement technique as a component of volunteer orientation. To ensure accurate data are collected, it is common practice that these measurements are double-checked by upperclass students, residents, or faculty. Whenever this occurred during a patient visit, the verified blood pressure value was abstracted.

Throughout this study, hypertension control status was assigned to each patient using different criteria and methods depending on how the data were being used. For the purposes of comparing categorical differences in control across the study period, blood pressures from the patient's first and last visit of the study period were used. Because guidelines were updated during the study period, control status was assigned to each patient using both Seventh (JNC-7) and Eighth (JNC-8) Joint National Commission recommendations.[19,20] Hypertension control according to JNC-7 was defined as <140/90 mmHg for nondiabetics and <130/80 mmHg for patients with diabetes or chronic kidney disease.[19] JNC-8 control status was defined as <140/90 mmHg for all patients under 60 years old and <150/90 mmHg for patients over 60 years old.[20]

To approximate IUSOC's rate of control and compare it with national data, methods to assign control status were used that most approximated those used by NHANES surveyors.[5] In situations where more than one blood pressure reading was present since the patient's final medication adjustment, the values were averaged. When this was not possible, the patient's final blood pressure reading of the study period was used. This average value was then classified based on a single criterion that defined control as <140/90 mmHg.

For the purposes of identifying patient characteristics associated with hypertension control, the average blood pressure since final medication adjustment was used when available and the JNC-8 criteria listed above were used to assign control status. Odds ratios for control were generated for the following variables: age, gender, BMI, number

of visits, diagnoses of diabetes or chronic kidney disease, tobacco use, alcohol use, illicit drug use, and insurance status. Insurance status was treated as a binary variable with any form of insurance considered coverage.

Statistical analysis. Statistical analyses were performed using SPSS version 22 (Armonk, NY: IBM Corp.). The proportion of patients in control at the start and at the end of the study period was compared using McNemar's Chi-square test. This was done separately using both the JNC-7 and JNC-8 definitions of control. Shapiro-Wilk tests were used to test the normality of the distribution of the systolic and diastolic pressures at the start and end of the study period. The differences between the distributions of systolic and diastolic pressures at the start and end of the study period were analyzed with Wilcoxon signed-rank test. The IUSOC control rates were compared with NHANES rates of control for various populations using Pearson's Chi-square test. For identifying associations with hypertension control, separate univariate logistic regressions were performed for continuous or discrete variables (age, BMI, and number of visits) to derive odds ratios with 95% confidence intervals. A multivariate logistic regression was also used to examine the interaction between age and number of visits. All other variables were categorical and odds ratios with 95% confidence intervals were generated using contingency tables.

Results

Initial screening using clinic records identified 88 possible patients. Of these, a total of 64 patients met the study's inclusion criteria. The remaining 24 patients that failed to qualify for the study either had insufficient number of visits (n = 14), no diagnosis of hypertension (n = 2), their hypertension was not being managed at IUSOC (n = 2), or their chart did not contain a sufficient amount of information for use in the study (n = 6).

Patient demographics and associations with hypertension control are displayed in Table 1. A total of 419 blood pressure readings were collected throughout the study period (range per patient 3–13). A total of 152 medication adjustments were made during the study period (range per patient 1–9). Over one-half of the patients were female (52%). Most patients were under the age of 60 (64%), had no insurance (61%), or had a BMI of over 30 (60%). Two patient characteristics were positively associated with increased control rates: age (OR 1.084, 95% CI 1.015–1.158, p = .017) and number of clinic visits (OR 1.243, 95% CI 1.007–1.534, p = .043). When both age and number of visits were analyzed in a multivariate logistic regression, the correlation with age was maintained (OR 1.071, 95% CI 1.001–1.147, p = .047) but the correlation with number of visits was not (OR 1.183, 95% CI 0.947–1.478, p = .139). Body mass index, gender, insurance status, tobacco use, alcohol use, illicit drug use, and diabetes diagnosis failed to correlate significantly with rates of control.

Table 2 shows the antihypertensive medication usage at IUSOC. Although medication data across the study period was collected, only the patient's medication regimen at the end of the study period was compiled in order to characterize medication usage. Thiazides were the most prescribed antihypertensive agent. The majority (83%) of thiazides were used in multi-drug regimens as opposed to monotherapy. Relative to

Table 1.

DEMOGRAPHIC CHARACTERISTICS AND ASSOCIATIONS WITH HYPERTENSION CONTROL[a]

	Total No. (%) of patients (N = 64)	Hypertension control at end of study (N = 31)		
Categorical variables[b]		**No. (%)**	**OR (95% CI)**	**p-value**
Gender				
Male	31 (48%)	16 (52%)	1 (reference)	. . .
Female	33 (52%)	15 (48%)	0.78 (0.29–2.09)	.62
Health Insurance				
No insurance/unknown status	48 (75%)	24 (77%)	1 (reference)	. . .
Any form of insurance	16 (25%)	7 (23%)	0.78 (0.25–2.43)	.67
Comorbidities				
DM	18 (28%)	11 (35%)	2.04 (0.67–6.22)	.20
CAD equivalent	29 (45%)	14 (45%)	2.13 (0.78–5.79)	.14
CKD	2 (3%)	1 (3%)	. . .	. . .
Prior MI	1 (2%)	1 (3%)	. . .	. . .
Social history				
Tobacco use	32 (50%)	12 (39%)	0.41 (0.15–1.12)	.08
Alcohol use	41 (64%)	19 (61%)	0.79 (0.29–2.20)	.65
Illicit drug use	13 (20%)	9 (29%)	2.97 (0.81–10.90)	.09
Continuous variables[c]	**Mean (SD)**	**Mean (SD)**	**OR (95% CI)**	**p-value**
Age	54.5 (8.5)	57.3 (7.0)	1.08 (1.02–1.16)	.017
Minimum	35			
Maximum	70			
Number of clinic visits	6.5 (2.5)	7.2 (2.5)	1.24 (1.01–1.53)	.043
Minimum	3			
Maximum	13			
Body Mass Index	32.1 (7.6)	30.8 (8.0)	0.95 (0.89–1.02)	.18
Minimum	19.1			
Maximum	56.5			

[a]Each patient was treated for hypertension at least three times between January 2013 and March of 2014. Gender, age, insurance status, and social history were all self-reported. Height, weight, comorbidities, and clinic utilization data were gathered from IUSOC's records. If multiple blood pressure values since the patient's last medication adjustment were available, these were averaged and this value was used to determine the patient's control status using JNC-8 blood pressure targets. Ellipses indicate statistical test not performed.
[b]OR, 95% CI, and p-values were generated using contingency tables.
[c]OR, 95% CI, and p-values were generated using univariate logistic regressions.
DM = Diabetes Mellitus
CAD = Coronary Artery Disease
CKD = Chronic Kidney Disease
MI = Myocardial Infarction

Table 2.

MEDICATION USE AT IUSOC[a]

Medication	No. (%)
Monotherapy	
Total	28 (44%)
Thiazide	6 (9%)
CCB	10 (16%)
ACE-I	10 (16%)
B-blocker	2 (3%)
Multi-drug therapy	
2 agents	26 (41%)
Thiazide + ACE-I	7 (11%)
Thiazide + CCB	7 (11%)
Thiazide + B-blocker	5 (8%)
ACE-I + CCB	2 (3%)
ACE-I + B-blocker	4 (6%)
CCB + B-blocker	1 (2%)
3 or more agents	10 (16%)
Thiazide, ACE-I, CCB	2 (3%)
Thiazide, ACE-I, B-blocker	5 (8%)
Thiazide, CCB, B-blocker	2 (3%)
Thiazide, CCB, B-blocker, spironolactone	1 (2%)

Overall medication utilization	No. (%)	% use in monotherapy	% use in multi-drug therapy
Thiazide	35 (55%)	17%	83%
CCB	25 (39%)	40%	60%
ACE-I	30 (47%)	33%	67%
B-blocker	20 (31%)	10%	90%

[a]End of study medication regimens were compiled and summarized. At IUSOC, hydrochlorothiazide, amlodipine, lisinopril, and metoprolol are all on formulary at the in-house pharmacy that is operated in a partnership with Butler University College of Pharmacy. These medications are offered to patients at no cost.
IUSOC = Indiana University Student Outreach Clinic

total number of prescriptions, calcium channel blockers were the most likely agent to be used in monotherapy (40%). Beta-blockers were the least prescribed agent and the most likely to be used in multi-drug therapy (90%). Fourteen of the 18 diabetic patients (78%) were on an ACE-inhibitor. One of the diabetic patients not on an ACE-inhibitor reported a history of angioedema. Forty of the 51 patients (78%) on thiazide or ACE-inhibitor had at least one basic metabolic panel drawn at IUSOC during the study period. One of the two patients with chronic kidney disease was on an ACE-inhibitor.

Only one instance of a non-formulary drug, spironolactone, was recorded at the end of the study period. It was noted that spironolactone was added because the patient was uncontrolled on three agents and found to be hypokalemic.

Figure 1 displays distributions of both systolic and diastolic pressures before and after the study period. Significant categorical differences in blood pressure control between the start and end of study were found whether JNC-7 or JNC-8 guidelines were used to define control. Using JNC-7 criteria, seven patients were considered controlled at the start of the study period and 17 were controlled at the end (McNemar's test; $p = .006$). Using JNC-8 criteria, 12 patients were controlled at the start of the study period and 23 were controlled at the end (McNemar's test; $p = .027$). The distributions before and after the study period also differed significantly for both systolic and diastolic blood pressures (Wilcoxon's signed rank test; $p = .011$ and .001, respectively).

Figure 2 summarizes IUSOC's control rates as compared with various NHANES populations.[5] With staff using methods closely approximating those of NHANES surveyors, the rate of control at IUSOC was 45.3%. This rate did not differ significantly from the NHANES national average (46.5%, $p = .85$) or the NHANES subset of patients with a usual source of care (48.9%, $p = .57$). This control rate did differ significantly from the NHANES population with no usual source of care (12.6%, $p < .01$). The control rate for the subset of patients with no insurance or an unknown insurance status ($n = 47$) was 46.8%. This did not statistically differ from the NHANES population with insurance (48.8%, $p = .79$) but did differ significantly from the NHANES population with no insurance (28.2%, $p < .01$).

Discussion

The most important findings of this study are the favorable comparisons of hypertension control rates at IUSOC with national data. Patients at IUSOC achieved blood pressure control at a rate that did not significantly differ from the national average. This occurred despite demographic characteristics of the Near Eastside neighborhood, namely poverty and lack of insurance, that are typically associated with lower rates of blood pressure control.[5,21,22] This study also demonstrated that rates of blood pressure control increased during the treatment period at IUSOC. Thus, it is reasonable to conclude that IUSOC's hypertension management is responsible for at least some portion of the study population's increased control rate as compared with NHANES groups without insurance or a usual source of care.

These findings have broader implications for the roles of SRFCs in medically underserved communities. Few would argue against the benefit of providing medical trainees with clinical experiences that increase their familiarity with the health care issues facing vulnerable populations. It is essential that these learning experiences are a byproduct of improving community health and do not occur at its expense. Student-run free clinics have a responsibility to the people they serve to ensure the quality of their services. This study serves as an example of the objective assessments that must be done as a part of responsibly operating an SRFC in an underserved neighborhood.

The data gathered on medications are useful for making generalizations about prescribing habits at IUSOC. That calcium channel blockers were the most often used

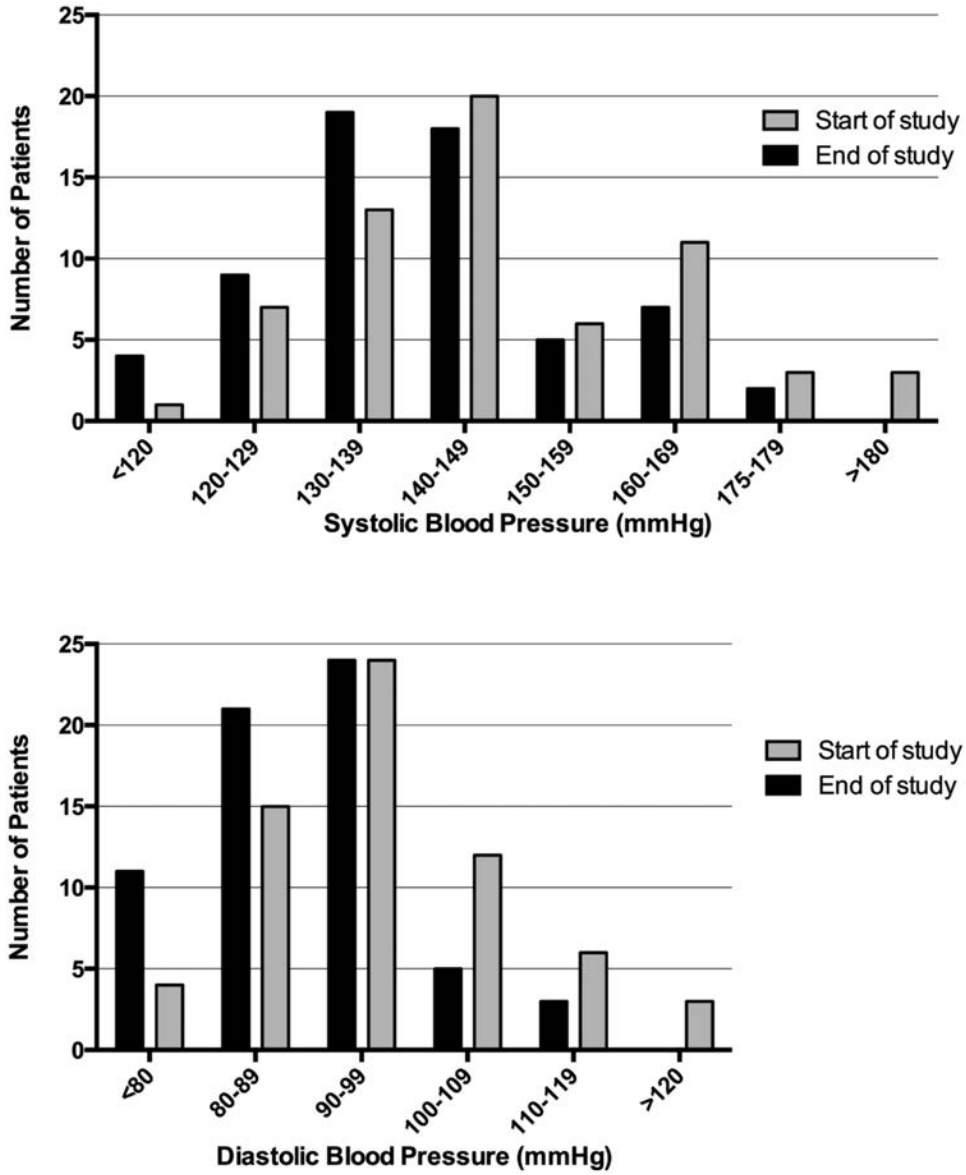

Figure 1. Start and end of study blood pressure values.[a]

[a]Start and end of study period blood pressures are displayed together. Between the start and end of the study period, there were statistically significant differences for both categorical rates of patient control as well as the distributions of systolic and diastolic pressures.

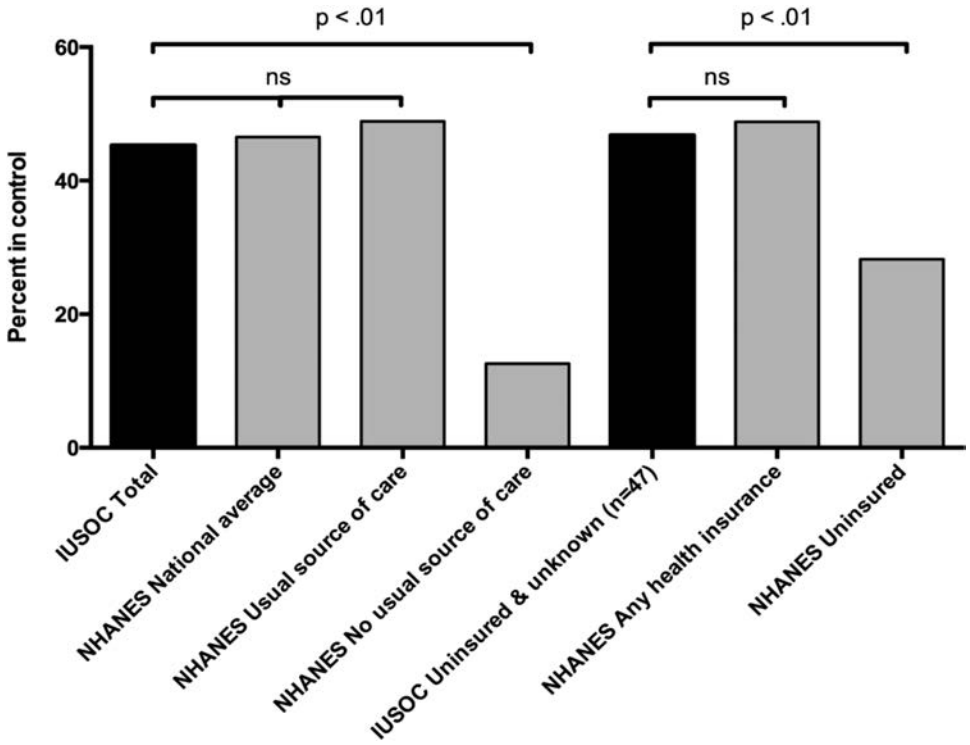

Figure 2. IUSOC rates of blood pressure control and comparisons with National Health and Nutrition Examiner Survey data.[a]
[a]To estimate IUSOC's rates of blood pressure control and to make meaningful comparisons with national data, methods approximated those used by NHANES surveyors. End of study blood pressure was analyzed and controlled blood pressure was defined as <140/90 mmHg. If multiple blood pressure values since the patient's last medication adjustment were available, these were averaged and this value was used to determine the patient's control status. Populations were compared using chi-square tests.
IUSOC = Indiana University Student Outreach Clinic
ns = Not Significant

drugs in monotherapy (compared with multi-drug regimens) likely reflects the fact that they do not require laboratory monitoring. Thus they are particularly useful as a first-line agent for the IUSOC population, whose ability reliably to return for follow-up laboratory testing is a concern. Despite this, IUSOC was appropriately able to monitor electrolytes in most patients taking ACE-inhibitors or thiazide diuretics. ACE inhibitors were appropriately utilized for their renoprotective effects in most patients with diabetes.[19] That beta-blockers were used sparingly as monotherapy and more likely added as a second or third-line agent is consistent with JNC8 recommendations on beta-blocker use.[20] One limitation of the analysis of medication use is the fact that ethnicity was not recorded on IUSOC's intake forms during the study period. Thus, IUSOC's adherence to JNC8 recommendations on medication use as it relates to ethnicity could not be evaluated.

This study attempted to identify IUSOC patient characteristics associated with hypertension control. While patient age and number of clinic visits both correlated positively with blood pressure control when analyzed separately, only age remained significant when both variables were analyzed in the same regression. This is a somewhat surprising finding given that the disease's natural progression is to worsen with age. A possible explanation for this finding is that medication adherence, something not directly measured in this study, may be increased in older patients. The association of age and improved antihypertensive medication adherence has been observed in previous studies.[23,24] A larger sample size and a better characterization of medication adherence and pharmacy usage are needed to draw valid conclusions on factors contributing to blood pressure control in this population.

The criteria used to classify blood pressure control varied slightly depending on the use of the data. Methods to assign control status were chosen to produce valid results in comparisons and to approximate the reality of each patient's blood pressure control. It was assumed that when more than one blood pressure value existed after the patient's final medication adjustment of the study period, averaging the values better estimated the patient's blood pressure by accounting for variation. Aside from natural variation, blood pressure may have varied in this population due to short periods of medication non-adherence, white coat hypertension, or imperfect measurement techniques. The method of averaging blood pressures was utilized by NHANES surveyors which, when combined with the use of the same NHANES criteria for control, adds validity to comparisons with IUSOC values.[5] JNC-8 cutoffs were utilized for determining associations with hypertension control because staff physicians were likely utilizing these updated guidelines by the end of the study period. Generating averaged values for the start of the study period was not feasible. For this reason, using each patient's final blood pressure instead of averaged values was necessary to make valid comparisons between the start and the end of the study.

Of the study's limitations not already mentioned, it is worth noting that by requiring a certain number of visits within the study period, the inclusion criteria eliminated a high-risk fraction of patients with hypertension from the study group. The control rate and comparisons should be interpreted accordingly. Patients who were unable to return to clinic for follow-up or to the pharmacy for medication refills were unlikely to have controlled disease, regardless of the quality of care available to them. Including such patients in the analysis would make understanding the quality of care at IUSOC more difficult.

Indiana University Student Outreach Clinic improves access to medical and pharmacy services that are not affordable to many in Indianapolis's Near Eastside neighborhood. The access to care that IUSOC provides is likely responsible for the favorable control rates observed in this study. Although rates of control are low among populations without sufficient access to health care, almost 90% of the patients with uncontrolled hypertension in the United States have health insurance and a usual source of care.[5] Although IUSOC improved blood pressure control in this population by improving access to care, access is the first of many barriers to disease control that should be addressed in this patient population.

This study provides an opportunity to advance the understanding of the quality of

care at IUSOC from the anecdotal to evidence-based. It contributes to a growing collection of evidence that SRFCs provide quality services that achieve or exceed nationally defined goals of care.[12,13,15,16] As SRFCs become a more integrated component of medical education, studies of patient outcomes must continue to take place to appraise the quality of care available to the underserved populations.

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