Original Paper

Relationship Between Physician Knowledge of Hypertension and Blood Pressure Control

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*The purpose of this study was to evaluate the cross-sectional relationship between physician knowledge of hypertension guidelines and blood pressure (BP) control. The authors evaluated a sample of primary care faculty (n=32) and a sample of their patients (n=613). When treating patients as independent observations, the authors found an inverse relationship (*r=*–0.524;* p=*0.002) where higher knowledge scores were associated with lower BP control. The authors conducted a multivariate analysis to accommodate the non-independence due to random physician effects and found that there was no longer a significant association between knowledge and BP control, but there was still a trend (odds ratio=0.84;* p=*0.130). This study demonstrates that there is no evidence that high knowledge of hypertension guidelines will improve BP control rates and that higher knowledge may actually be associated with lower BP control. Strategies that are designed only to improve knowledge of hypertension guidelines are insufficient to improve BP control rates. (J Clin Hypertens. 2006;8:481–486)* ©2006 Le Jacq Ltd.

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More than 65 million Americans now have hypertension, and only 31% have achieved adequate blood pressure (BP) control at <140/90 mm Hg.[1,2] There are many patient, physician, and structural factors that contribute to poor BP control. However, clinical inertia and suboptimal treatment regimens are a very common cause for poor BP control.[3–6] There have been numerous evaluations of physician adherence to hypertension guidelines.[7] While many of these studies evaluated only drug prescribing trends, most authors concluded that physicians do not adhere to hypertension guidelines.[7–9] Suboptimal treatment could be due to either intentional nonadherence to hypertension guidelines or an insufficient knowledge of the guidelines. When surveyed, physicians frequently indicate that they are aware of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of Hypertension (JNC) guidelines and that they follow the guidelines.[7]

Studies consistently report either very poor adherence rates to hypertension guidelines or very poor BP control rates.[4,7,10–13] Studies have found adherence to step one drug therapy with JNC I to JNC V ranged from 20% to 42%.[9,12] One study found a 72% adherence rate with the JNC VI guideline recommendations for drug treatment, but goal BP values were achieved in only 43% of the study population and only 16% of the diabetic population.[11] Hill and colleagues[10] reported that 17% of Maryland physicians used JNC III in practice, while Meyers and Steinle[13] found that 27% of primary care physicians could correctly state the goal BP recommendations from JNC V. Clearly, improvement in hypertension guideline adherence is paramount, but little information is available about underlying factors that contribute to poor adherence rates.

One notable example of poor BP control was a study conducted by Berlowitz and coworkers[3] that included 800 men with hypertension. In spite of an average of six hypertension-related visits per year, 40% of patients continued to have BP >160/90 mm Hg, and antihypertensive medications were increased in only 7% of the visits. This study has been frequently cited as evidence that BP is not aggressively treated even when patients are frequently seen by their physicians. In another study, Oliveria and coworkers[4] found that patient factors (adherence, patient acceptance, regimen complexity) were uncommon (9%) barriers cited by physicians or patients. The primary barrier (91% of patient visits) was related to physicians who were satisfied with poorly controlled BPs. These findings might be explained by physicians being unaware of the guidelines or disagreeing with the guidelines. However, all of the physicians stated they were aware of the JNC VI guidelines, and 76% said they agreed with the guidelines. The answers they provided to specific questions and scenarios made it clear, however, that these physicians may not have had a clear understanding of the guidelines.

The purpose of the present study was to evaluate the association between physician knowledge of the JNC 7 hypertension guidelines and BP control in their patients.

METHODS

Phase I: Validation of the Knowledge Survey

The knowledge survey test was a 35-question instrument developed by the principal investigator (BLC) from JNC 7. The knowledge survey was evaluated for face validity by four family medicine faculty physicians, including one of the investigators (GB).

The study was approved by the University of Iowa Institutional Review Board. The knowledge survey was then administered to family medicine faculty, internal medicine faculty, and a group of second-year family medicine residents enrolled in two studies funded by the National Institutes of Health (1 R01 HL069801–01A1 and 1 R01 HL070740–01A1). The knowledge survey was administered at baseline in both studies, and each physician received a packet including a consent form and the knowledge survey. All of the physicians included in this analysis had previously worked with clinical pharmacists. Physicians in both offices involved routinely attended educational noon conferences provided by clinical pharmacists or physicians on a wide variety of therapeutic topics, including hypertension. The clinical pharmacists spent the majority of their time providing patient-specific consultations on medication regimens, medication histories, and monitoring therapeutic response.

Next, we administered the questionnaire to a convenience sample of hypertension specialists and members of the Midwest Regional Chapter of the American Society of Hypertension (ASH) who had passed the specialty examination conducted by ASH.

The knowledge survey was blindly scored by the University of Iowa Evaluation and Examination Service. Each test item was examined for difficulty and discrimination. High discrimination on an item indicated that physicians who scored well on the survey overall were answering this item correctly. Discrimination values of 0.4–1.0 indicate excellent discrimination, while values between 0.20 and 0.39 indicate acceptable discrimination. Internal reliability of the knowledge survey was evaluated with Cronbach's α. Differences in correct responses among residents, primary care faculty, and hypertension specialists were compared with *t* tests and the Wilcoxon rank sum test.

Phase II: Correlation Between Physician Knowledge and BP Control

A sample of physicians included above in Phase I were included in Phase II. This phase of the study was conducted in faculty physicians from two academic primary care clinics. No residents or hypertension specialists were included in Phase II. Both clinics are located within the same family care center and use the same hospital electronic medical record. Each physician received a packet in the spring of 2003 that included a letter explaining the study, a consent form, and the JNC 7 knowledge survey.

We generated computerized lists of all patients with hypertension from the two clinics and matched them with the faculty physician who primarily cared for the patient. Patients assigned to residents were not included in this analysis. From this list, 20 patients who had at least one office visit between July 2003 and January 2004 were randomly selected for each physician. This time period was selected to coincide with the period of time immediately following the completion of the knowledge survey. In a few cases, physicians did not have 20 patients with hypertension in their panel (e.g., physicians who tended to care for obstetric patients). If a physician did not have 20 hypertensive patients in his or her panel, then all patients were selected. BP values were obtained from the electronic medical record. The last three BP values for office visits between July 2003 and January 2004 were recorded. The three systolic BPs

and diastolic BPs were averaged for each physician. If a patient was seen only twice during this period, the two values were averaged. If only a single value was available, it was used for the analysis. This approach was used to favor lower average BPs, since patients with controlled BP may be seen less frequently, whereas those with poorly controlled BP might be seen more frequently. By averaging three values, we were attempting to limit the influence of a single high value for a given patient.

BP control rates for each physician were also calculated. BP control was defined as <140/90 mm Hg for those with uncomplicated hypertension and <130/80 mm Hg for those with diabetes or chronic kidney disease.

Next, we selected a random sample of 334 patients from the initial population for a more in-depth analysis. Case abstracts were constructed by a research nurse that included demographic data (gender, age, race), type of insurance, smoking history, alcohol intake, presence of diabetes, chronic kidney disease, presence of significant psychiatric disorder (major depression, bipolar disease, schizophrenia), and total number of comorbid conditions (excluding hypertension).

To estimate the relationship between physician knowledge scores and BP control, it was imperative to accommodate the random effects due to the likely within-physician clustering and within-clinic clustering. We used the general estimating equation approach available in SAS Proc Genmod (SAS Institute, Inc., Cary, NC) to accommodate these random physician effects, as well as to adjust for the effect of clinic. This enabled us to produce valid odds ratios (OR) and confidence intervals (CI) to assess whether BP control was associated with physician knowledge and/or with other factors such as physician age, patient age, patient gender, race, insurance status, smoking, the number of comorbidities in addition to hypertension, and the presence of diabetes, chronic kidney disease, or significant psychiatric conditions.

RESULTS

Phase I

The mean discrimination for the knowledge survey test items was 0.29 (range, 0.15–0.48). One question was deleted as a poor question, leaving 34 total questions. Several questions with discriminations at the lower end of the range were retained because these were questions directly taken from the JNC 7 guidelines. An analysis of the reliability of the knowledge survey revealed a Cronbach's α of 0.67, suggesting acceptable internal consistency.

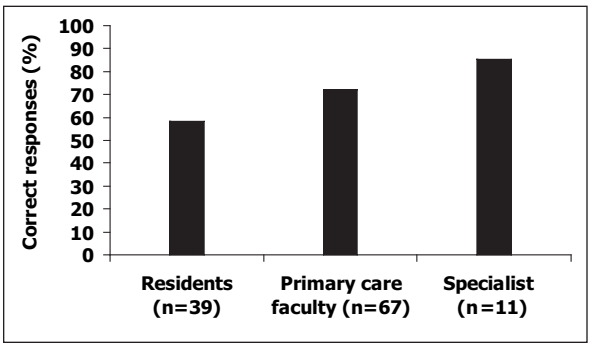

Figure. Percentage of correct responses on the knowledge survey. p<*0.0001 between all groups using either a* t *test or Wilcoxon rank sum test*

Table I. Blood Pressure (BP) Control Achieved by 32 Physicians Treating 613 Patients

Mean systolic BP (mm Hg)	140.9±5.6
Overall BP control rates for specific physicians	43.2±17.0 (20–80)
BP control rates for patients with uncomplicated hypertension (<140/90 mm Hg)	47.4±17.2 (20–76)
BP control rates for patients with diabetes or chronic kidney disease (<130/80 mm Hg)	19.2±25.6 (0–100)

Control rates are presented as mean % ± SD (range). Ranges refer to the BP control rates for each physician.

There was a strong relationship between physician experience or expertise and correct responses on the knowledge survey (Figure). The mean correct responses for each physician group were: residents, 58.3±11.5%; primary care faculty, 71.9±9.3%; and hypertension specialists, 85.3±7.2%. The comparisons between groups were all statistically significant with both a *t* test and Wilcoxon rank sum test ($p<0.0001$).

Phase II

A total of 32 primary care faculty physicians and 613 patients were included in this analysis of BP control. The mean age of the physicians was 41.0±10.9 years; 66% were men, and they had been in practice an average of 12.9±8.5 years. All were board certified in either family medicine or internal medicine. The percentage of correct responses on the knowledge survey for this sample of physicians averaged 72.9±9.8% (range, 53%–94%). BP control rates are shown in Table I.

There was a strong inverse relationship between BP control rates for these 613 patients and correct responses by their physicians on the knowledge survey ($r=-0.524$; $p=0.002$). There was also a strong correlation between correct responses on

Table II. Associations Between Predictor Variables and Blood Pressure Control, Controlling for Physician and Clinic Effect in GEE Models

	Individual Models		Reduced Multivariate Model*	
Predictor Variable	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Knowledge score (5-unit increase)	0.81 (0.64–1.03)	0.090	0.84 (0.67–1.05)	0.130
Physician age (10-year increase)	1.13 (0.92–1.38)	0.235		
Patient age (10-year increase)	0.84 (0.72–0.99)	0.034	0.84 (0.71–0.99)	0.040
Gender (male vs. female)	0.87 (0.51–1.48)	0.600		
Race (Caucasian vs. other)	1.16 (0.68–1.99)	0.588		
Insurance (private vs. other)	1.53 (1.00–2.34)	0.052		
Current smoker (vs. nonsmoker)	0.86 (0.44–1.72)	0.677		
Former smoker (vs. nonsmoker)	0.60 (0.26–1.37)	0.223		
Diabetes	0.36 (0.19–0.71)	0.003	0.36 (0.19–0.69)	0.002
Chronic kidney disease	0.35 (0.06–1.88)	0.219		
Psychiatric disorder	1.16 (0.71–1.89)	0.557		
No. of comorbidities (1-unit increase)	0.95 (0.88–1.03)	0.229		

GEE=general estimating equation; OR=odds ratio; CI=confidence interval; *adjusted only for the terms shown; all other potential predictors have *p* values >0.25

the knowledge survey and a *higher* mean systolic BP (r=0.453; p=0.009).

We theorized that the results from these simple correlations may have been due to selection bias. For instance, perhaps patients with the most difficult hypertension or coexisting conditions are treated by physicians with the most knowledge of hypertension, leading to a spurious finding with respect to BP control. We then analyzed the sample of 334 patients, controlling for the covariables physician cluster, clinic cluster, patient age, race, smoking, number of comorbidities in addition to hypertension, and presence of diabetes, chronic kidney disease, or significant psychiatric conditions. The presence of diabetes and increasing age were both negative predictors of BP control. When these two covariables were added to the model, there was no longer a significant association between physician knowledge and BP control (OR=0.84; p=0.13). However, the correlation was still in the same direction: for every 5 points better on the knowledge test, there was a 16% decrease in the rate of BP control in the multivariate model (Table II). Likewise, for every 10-year increase in patient age there was a 16% decrease in BP control (OR=0.84; p=0.04). When we added the demographic, insurance, and coexisting disease variables into the model, the p value ranged from 0.07 to 0.12, depending on which covariables are included in the model. Thus, while no longer statistically significant, there was still a negative (inverse) trend between higher physician knowledge and lower BP control.

DISCUSSION

The findings from this study suggest that higher knowledge of JNC 7 guidelines, as measured by this tool, is associated with poorer BP control. When we controlled for several covariables that might make BP control more difficult, we found a similar trend, although it was not statistically significant. The latter analysis suggests that there is some evidence that physicians with higher knowledge may have been treating patients with more difficult-to-control hypertension. The most conservative interpretation of our data would suggest that there is no association between physician knowledge and BP control. This finding sheds doubt on the usual strategies to disseminate the JNC guidelines, including lectures and other strategies that impart knowledge alone.

The fact that there was still a trend toward an inverse association between knowledge and BP control in the multivariate analyses suggests that there may be a relationship between these variables. It may seem counterintuitive that a given physician would achieve poorer BP control because he or she has higher levels of knowledge of JNC 7 guidelines; however, this association may not be spurious. Outcomes of chronic disease are improved with more patient participation, and physician communication styles can impact patient engagement.[14–19] Perhaps physicians with higher levels of knowledge of hypertension guidelines are less willing to negotiate treatment plans and engage patients in their own care. In these cases, it is conceivable that higher levels of physician knowledge might actually reduce BP control if patients become frustrated with physician communication styles. While this may appear to be a stretch in logic, one study found that physicians with higher knowledge on the American Board of Family Practice credentialing examination had higher

malpractice suits.[20] Since the decision to engage in litigation is often due to breakdowns in communication, it is therefore possible that physicians with high levels of knowledge may not communicate as well with patients and they may not seek patient participation in chronic disease management.

If these findings are correct, then educational strategies alone to improve physician knowledge of the hypertension guidelines are not sufficient to ensure good BP control rates. Other strategies that overcome clinical inertia, engage the patient in treatment decisions, and empower patients to participate in their own care may be more effective strategies to improve BP control.

It is interesting to note that both clinics had several clinical pharmacists whose job it is, in part, to provide physician and patient education on hypertension and other guidelines. The effectiveness of organizational interventions, including interdisciplinary teams, in controlling BP was noted in a recent AHRQ evaluation.[21] This and other analyses have found that educational interventions such as patient education (8 mm Hg in systolic BP), provider reminders (2–7 mm Hg), provider education (3 mm Hg), and audit and feedback (1 mm Hg) had modest effects on BP control.[21,22] These findings also suggest that knowledge alone is insufficient to improve BP control. Achieving high BP control rates also requires extensive and systematic organizational changes that support the physician and the patient. One of the most effective strategies includes interdisciplinary management of hypertensive patients, which can lead to the highest reductions in BP achieved in the AHRQ analysis (average reductions in systolic BP of 10 mm Hg),[21] while some studies have found even greater reductions.[23–28] Ongoing studies are examining structural changes in care to include physician/pharmacist collaborative models or nurse case management as strategies to overcome poor BP control.

It appears that our knowledge survey was a valid measure of physician knowledge. The item discriminations were acceptable and the reliability was good. All of the items on the knowledge survey were generated from JNC 7 by an investigator who was on the JNC 7 guidelines writing panel. There was no time limit imposed on the physicians when taking this knowledge survey; physicians were not pressured to complete the test quickly. Finally, and most importantly, there was a direct and highly significant relationship between the level of physician training or expertise and the percentage of correct answers on the knowledge survey.

Based on our findings and the other research cited above, we suggest that multidisciplinary care models are likely to be more effective than educational strategies alone to increase physician knowledge. Clearly, the relationship between physician knowledge and performance is very complex and requires additional study. Strategies to improve BP control will likely require more comprehensive approaches than simply increasing physician knowledge of the hypertension guidelines.

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