Perceived Susceptibility to Chronic Kidney Disease among High-risk Patients Seen in Primary Care Practices

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BACKGROUND: Patients' views of their risk for the development or progression of chronic kidney disease (CKD) are poorly characterized.

OBJECTIVE: To assess perceived risk and concern regarding CKD development or progression among high-risk patients seen in primary care, identify predictors of perceptions, and correlate perceptions with adherence to high blood pressure management.

DESIGN AND PARTICIPANTS: Cross-sectional study of 195 patients enrolled in a randomized controlled trial on hypertension management in 40 Maryland primary care practices.

MEASUREMENTS: We assessed independent predictors (sociodemographics, health literacy, clinical presence of CKD, co-morbid conditions, and health behaviors) of perceived susceptibility (assessed via questionnaire) and adherence (assessed via Hill-Bone blood pressure adherence scale) in multivariable analyses.

MAIN RESULTS: In this hypertensive majority African American (63%) population, many participants had uncontrolled blood pressure (44%) or diabetes (42%). Few (20%) felt "very likely" to develop CKD and one third (33%) were "very concerned" about developing CKD. Participants who were female and had low health literacy had lower perceived susceptibility to CKD compared to males and those with higher health literacy. Race and diabetes were also associated with perceived susceptibility. Greater perceived susceptibility was associated with poorer blood pressure management adherence scores.

CONCLUSIONS: Many high-risk patients have low perceived susceptibility to CKD. Poor blood pressure therapy adherence scores among those with greatest perceived susceptibility suggest fatalistic attitudes about CKD. If our findings are confirmed in larger studies, interventions targeting patient perceptions of CKD risk and other attitudes associated with these

perceptions could impact adherence to therapies and health outcomes.

KEY WORDS: chronic kidney disease; attitudes; perceived susceptibility; adherence; primary care.

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INTRODUCTION

Chronic kidney disease (CKD) is a growing epidemic, with over 20 million persons having some kidney damage.¹ The presence of estimated glomerular filtration rate (GFR) less than 60 ml/min/1.73 m² is associated with increased risk of progression toward end stage renal disease, hospitalization, cardiovascular disease events, heart failure, and death.^{2,3} Hypertension and diabetes are the most common risk factors for CKD, with even mild forms of these conditions conferring several-fold increased risks of CKD incidence or progression.^{4,5} Heightened awareness of the growing health burden of CKD has led to the launch of national educational campaigns intended to enhance patient and physician awareness of CKD as an important medical condition, including the National Institute of Health's Kidney Disease Education Program.⁶ These campaigns emphasize targeting 'high-risk' patients (with hypertension, diabetes or a family history of kidney disease) and primary care physicians (who care for a majority of patients at greatest risk for CKD development or progression).⁷

Awareness raising campaigns ultimately hope to facilitate patients' adherence to behaviors (including medication adherence, diet, and exercise) that will help them control traditional CKD risk factors and decrease their risks for CKD development or progression.^{6,8} Patients' perceptions of their risks for CKD development or progression relative to their risks of developing other chronic illnesses are poorly characterized, however, and factors affecting patients' perceived risk of CKD development or progression have not been well studied.⁹ In addition, little evidence exists to link patients' perceptions of CKD risk with adherence behaviors.

Characterizing patients' perceptions regarding their susceptibility to CKD and predictors of inaccurate perceptions could aid efforts to thwart CKD development or progression in primary care settings. We studied patients' attitudes regarding their susceptibility to CKD, predictors of attitudes, and the

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association between attitudes and adherence behaviors among individuals at high-risk for CKD cared for by primary care physicians in Maryland.¹⁰

METHODS

Study Design and Participants

The Patient-Physician Partnership to Improve High Blood Pressure Adherence (Triple P) study was a randomized controlled trial performed in 15 primary care practices seeing a diverse population of patients with hypertension in Maryland. The study utilized a two-by-two factorial design to test the effectiveness of a physician communication skills training intervention and a patient-centered activation and education intervention to enhance patient high-blood pressure treatment adherence among 40 physicians and 279 of their patients. To be eligible, patient participants had to be 18 years or older, have a diagnosis of hypertension (based on ICD-9 codes in the preceding year), and report that they had been told by their doctor that they were hypertensive. Physicians (enrolled from January 2002 through January 2003) participated in a one-time communication skills training program with self-assessment at baseline. Patients were seen at enrollment (from September 2003 through August 2005), 3 month and 12 month follow-up visits.¹¹ This protocol was approved by the Institutional Review Board at Johns Hopkins Medical Institutions.

For this analysis, we sought to assess patient participants' (from here on referred to as 'participants') perceived susceptibility to CKD relative to other chronic illnesses and to identify predictors of low perceived susceptibility (including demographics, health literacy, and health behaviors). We also assessed the relation between perceived susceptibility to CKD and self-reported adherence to high blood pressure therapy. Because measurements of perceived susceptibility to CKD were obtained at 12 months follow-up, we limited our analysis to 195 participants with assessments of perceived susceptibility to CKD available at this follow-up visit.

Data Collection

Participant demographics, self-reported medical history, and health literacy were assessed via interview at enrollment. All other assessments were obtained during the 12-month follow-up visit, including participant perceived susceptibility to CKD and other illnesses, hypertension therapy adherence, a brief physical examination (including assessment of blood pressure, height and weight), and laboratory studies (including serum creatinine and urine quantitative microalbumin).

Assessment of Demographics, Health History, Health Literacy and Adherence

Participants' demographics (age, gender, race, education, and annual household income), self-reported medical history (history of diabetes and current smoking status) and health literacy (assessed using the Rapid Estimate of Adult Literacy in Medicine, a validated instrument questionnaire designed to be used in public health and primary care settings to identify patients with low reading levels¹²) were assessed at baseline. We administered the validated 15-item Hill-Bone Compliance

to High Blood Pressure Therapy Scale¹³ at 12 months follow-up to assess participants' adherence to recommended reduced sodium intake, appointment keeping and medication taking for high blood pressure therapy. Scale scores range from 14–56 points, with higher scores indicating poorer adherence.

Clinical and Laboratory Assessments

Blood pressures were assessed based on the average of three blood pressure measurements using an automatic oscillometric upper arm blood pressure monitor (Omron HEM907) in participant physician practices (at baseline) or our research facility (at follow-up). Blood pressures less than 140/90 mmHg or less than 130/80 for participants with diabetes or CKD in accordance with JNC-7 guidelines were considered controlled; at 12 months, 9 participants had blood pressures taken at home.¹⁴ Body mass index was calculated from participants' height and weight in accordance with clinical guidelines; at 12 months, 25 participants self-reported the weight recorded at their last doctor's visit via telephone.¹⁵ Serum creatinine was measured using an enzymatic method (Roche/Hitachi analyzer, coefficient of variation (CV) 2.1%); urine microalbumin was measured using a photometric method (Roche/Hitachi Modular P analyzer, CV 4.3%). We considered participants to have clinical evidence of CKD if their estimated GFR (estimated using the Modification of Diet in Renal Disease Equation) was less than 60 ml/min/1.73 m² or if participants had proteinuria (urine albumin-to-creatinine ratio greater than 30 mg albumin/gm creatinine).

Assessment of Perceived Susceptibility to CKD and Other Chronic Illnesses

We assessed participants' perceived susceptibility to CKD and other chronic illnesses via in-person or telephone questionnaire by assessing both their perceived likelihood and their concern regarding the development of "kidney problems or kidney failure," "heart attack or heart failure," "eye or vision problems," "stroke," and "cancer" in the next 10 years. To assess participants' perceived likelihood of developing conditions, we asked participants, "How likely do you think it is that you could develop [CKD or other condition] in the next 10 years?" Answers could be "not likely", "slightly likely", "moderately likely" or "very likely." To assess participants' level of concern regarding developing conditions, we asked participants, "How concerned are you about developing [CKD or other condition] in the next 10 years?" Answers could be "not concerned", "slightly concerned", "moderately concerned" or "very concerned."

Data Analysis

We performed descriptive analysis to report participants' perceptions of their likelihood and concern regarding CKD development or progression or other conditions in the next 10 years. We used the Wilcoxon signed-ranks test for paired data to compare participants' responses between conditions, and we applied the Bonferroni correction for multiple pair wise comparisons, considering differences in distributions of responses between conditions to be statistically significant at $p < 0.0125$. We used the Friedman Analysis of Variance test for

paired data to assess differences in the distribution of responses across all conditions. We performed similar analyses among participants with clinical evidence of CKD.

We performed multivariable logistic regression to assess the independent relation of each participant characteristic (demographic characteristics, clinical and laboratory assessments, and health literacy) with participant low perceived susceptibility to CKD (defined as answers of “not likely” to experience CKD development or progression (versus “slightly likely” or more) and “not concerned” (versus “slightly concerned” or more) about CKD development or progression) while adjusting for all other characteristics simultaneously on participants with complete data for all variables. Because preliminary analyses uncovered a qualitative interaction in attitudes according to race and diabetes status, we reported findings for race and diabetes status in a stratified manner. We converted adjusted odds ratios to absolute probabilities and their corresponding 95% confidence intervals.¹⁶ We used multivariable linear regression models to assess differences in the Hill-Bone Compliance to High Blood Pressure Therapy Scale according to level of perceived likelihood or concern regarding developing CKD in the next 10 years while adjusting for participant demographics. Multivariable analyses controlled for the intervention status of all patient participants and their physicians in the parent study as well as for clustering of patient participants among physicians (using the Huber/White/sandwich estimate of variance).^{17–20} We assessed the effect of missing data (for blood pressure, kidney function, or BMI at 12 months) on multivariable analyses in two sensitivity analyses (one analysis replacing missing data at 12 months with participants' baseline values for blood pressure, kidney function and BMI and one analysis employing multiple imputation of missing data for these variables).

RESULTS

Participant Enrollment, Characteristics and Perceived Susceptibility to CKD and other Chronic Illnesses

Among 279 participants enrolled at baseline, 195 attended the 12-month follow-up visit and answered both questions regarding perceived susceptibility to CKD. Completion of questions regarding adherence to high blood pressure therapy as well as various aspects of the 12-month physical examination varied; 173 participants completed questions regarding adherence, while 150 participants had blood pressure measurements, 133 had blood and urine collected, and 175 had assessment of height and weight at the 12-month visit. Participants had diverse demographic characteristics with a high proportion of participants who were age 60 years or older, female, and African American or Black. Among 133 participants who provided blood and urine specimens, 28% had clinical evidence of CKD. Few (20%) participants considered themselves “very likely” to develop CKD and one-third (33%) (although a statistically significantly greater proportion) were “very concerned” about CKD ($p < 0.001$) (Table 1).

Participants were less likely to consider themselves “very likely” to develop CKD compared to all other conditions with the exception of cancer (20% for kidney problems or failure versus 22% for cancer, 28% stroke, 31% heart attack or heart

Table 1. Characteristics of Study Participants

		Participants (N=195) n (%)*
Age	30–44 years	31 (16)
	45–59 years	64 (33)
	60 plus years	99 (51)
Gender	Female	123 (63)
	Male	72 (35)
Race	White	69 (35)
	African American or Black	123 (63)
	Other	3 (2)
Education	Less than college	138 (71)
	College	57 (29)
Annual household income	Less than \$35,000	116 (60)
	Greater than \$35,000	51 (26)
Diabetes	Present	81 (42)
	Absent	111 (57)
Blood pressure control	Controlled	86 (44)
	Uncontrolled	64 (33)
Chronic kidney disease	Present	54 (28)
	Absent	79 (41)
	Unknown†	62 (32)
Body mass index	Less than 18.5 kg/m ²	1 (0.5)
	18.5–24.9 kg/m ²	14 (7)
	25–29.9 kg/m ²	52 (27)
	30 kg/m ² or greater	108 (55)
Current smoking status	Smoker	42 (22)
	Non-smoker	146 (75)
Health literacy	3rd grade or less	7 (4)
	4th to 6th grade	10 (5)
	7th to 8th grade	38 (20)
	9th grade or greater	127 (65)
Hill-Bone compliance scale score	Mean, (SD)	17.8 (2.6)
	Range	14–26
Perceived likelihood of CKD	Not likely	49 (25)
	Slightly likely	71 (36)
	Moderately likely	36 (19)
	Very likely	39 (20)
Perceived concern regarding CKD	Not concerned	43 (22)
	Slightly concerned	52 (27)
	Moderately concerned	36 (19)
	Very concerned	63 (33)

*Percentages may not add to 100% due to missing values; † blood and urine obtained on subset of 133 patients only

failure, 37% eye or vision problems, $p < 0.001$ for all pair-wise comparisons except for cancer; p for overall trend < 0.001) or “very concerned” about developing CKD in the future (33% for kidney problems or failure versus 40% for cancer, 41% eye or vision problems, 44% heart attack or heart failure, 45% stroke, $p < 0.001$ for all pair-wise comparisons except for cancer; p for overall trend < 0.001). Among 54 participants with clinical evidence of CKD, 32 (59%) had microalbuminuria only with normal GFR, and 22 (41%) had GFR < 60 ml/min/1.73 m². In pair-wise comparisons, participants' with CKD perceived likelihood of CKD development or progression was not statistically significantly different from their perceived likelihood of other illnesses with the exception of heart attack or failure, but there was a trend of lower perceived likelihood of CKD versus other conditions (28% considered themselves “very likely” to develop kidney failure or problems versus 26% for cancer, 32% for stroke, 39% for heart attack or failure, 43% for eye or vision problems, $p > 0.0125$ for all pair-wise comparisons except for heart attack or failure, $p < 0.001$ for overall trend). Similarly, participants' with CKD perceived concern regarding CKD development or progression

was not statistically significantly different from their concern regarding other conditions, but there was a trend of lower concern regarding CKD versus other conditions (44% considered themselves "very concerned" about developing CKD versus 37% for cancer, 43% for eye or vision problems, 48% for heart attack or failure, 53% for stroke, $p > 0.0125$ for all pair-wise comparisons, $p < 0.001$ for overall trend). Perceived likelihood of CKD was greater among persons having micro-albuminuria only with normal GFR compared to perceptions among persons with abnormal GFR (41% versus 14% considering themselves "very likely" to develop CKD, $p = 0.03$), but concern about CKD did not statistically significantly vary according to the level of participants' estimated GFR.

Participant Characteristics Associated with Low Perceived Susceptibility to CKD

In multivariable analyses performed on 108 participants with complete data on all variables, race and diabetes status and low health literacy were independently associated with low

perceived likelihood of CKD development or progression. In similar multivariable analyses, female gender and low health literacy were independent predictors of low concern regarding CKD development or progression (Table 2). Sensitivity analyses incorporating imputed values for participants' missing data revealed similar findings as findings using complete data.

Relation of Perceived Susceptibility to High Blood Pressure Therapy Adherence

In multivariable models, participants with greater perceived likelihood of CKD development or progression had statistically significantly poorer adherence scores when compared to persons with less perceived susceptibility. There was no statistically significant difference in adherence scores when comparing persons considering themselves "very likely" and persons considering themselves "not likely." We observed similar, but not statistically significant, findings when assessing the relation between perceived concern regarding CKD development or progression and adherence (Table 3).

Table 2. Patient Characteristics Independently Associated with Low Perceived Susceptibility to Chronic Kidney Disease

Characteristic	Not likely			Not concerned		
	Unadjusted percent (N=195)	Adjusted*		Unadjusted percent (N=195)	Adjusted*	
		Percent (95% CI)	p†		Percent (95% CI)	p†
Age						
30–44 years	36	31 (6–76)	0.6	23	15 (3–48)	0.4
45–59 years	27	31 (13–56)	0.3	20	18 (5–49)	0.6
60 plus years	21	21 (reference)		23	23 (reference)	
Gender						
Female	27	19 (8–38)	0.6	25	38 (17–66)	0.03
Male	22	22 (reference)		15	15 (reference)	
Education						
College	28	12 (3–34)	0.2	32	38 (14–70)	0.1
Less than college	24	24 (reference)		18	18 (reference)	
Annual household income						
Greater than \$35,000	29	27 (11–53)	0.7	25	21 (5–54)	0.9
Less than \$35,000	23	23 (reference)		20	20 (reference)	
Race and diabetes						
Non-African American, no diabetes	22	19 (5–50)	0.7	22	20 (6–50)	0.6
Non-African American, with diabetes	24	36 (8–79)	0.2	22	44 (12–82)	0.07
African American, no diabetes	39	72 (36–92)	<0.01	25	32 (9–69)	0.2
African American, with diabetes	14	14 (reference)		14	14 (reference)	
Blood pressure control						
Controlled	30	44 (20–71)	0.3	24	19 (6–47)	0.9
Uncontrolled	19	31 (reference)		17	17 (reference)	
Clinical evidence of chronic kidney disease						
Absent	30	41 (11–79)	0.3	24	39 (15–69)	0.1
Present	20	20 (reference)		19	19 (reference)	
Body mass index						
≥30 kg/m ²	25	42 (20–67)	0.2	22	28 (10–57)	0.7
<30 kg/m ²	27	27 (reference)		23	23 (reference)	
Current smoking						
Smoker	19	17 (6–38)	0.3	16	14 (4–41)	0.1
Non-smoker	27	27 (reference)		23	23 (reference)	
Health literacy						
3rd grade or less	29	77 (49–92)	<0.01	29	85 (15–99)	0.08
4th to 6th grade	40	25 (1–97)	0.9	18	46 (3–96)	0.5
7th to 8th grade	24	41 (15–73)	0.3	26	54 (22–82)	0.04
29th grade or greater	25	25 (reference)		21	21 (reference)	

*Each individual characteristic is adjusted for the presence of all other characteristics listed in the table

†Represents p-value for comparison of subgroup to the reference subgroup

Table 3. Association of Low Perceived Susceptibility to Chronic Kidney Disease (CKD) with Hill-Bone High Blood Pressure Therapy Score

Attitude		Adjusted* mean score (SE)	p- difference
Likelihood	Not likely	18.1 (0.4)	0.1
	Slightly likely	17.2 (0.4)	0.03
	Moderately likely	17.5 (0.3)	0.03
	Very likely	18.9 (0.4)	(reference)
Concern	Not concerned	18.1 (0.5)	0.7
	Slightly concerned	17.3 (0.4)	0.5
	Moderately concerned	17.4 (0.3)	0.2
	Very concerned	18.2 (0.3)	(reference)

*Adjusted for demographics and presence of CKD according to lab data

DISCUSSION

In this study of hypertensive patients seen in primary care practices, few patients considered themselves “very likely” to develop kidney damage or failure in the next 10 years and few were “very concerned” about developing kidney damage or failure. Participants’ perceived susceptibility to CKD development or progression was low compared to their perceived susceptibility to other chronic illnesses. Participant gender, race and diabetes presence, and health literacy were independent predictors of low perceived susceptibility to CKD. Participants considering themselves “very likely” to develop kidney damage or failure in the next 10 years had statistically significantly poorer high blood pressure therapy adherence scores when compared to their counterparts considering themselves “slightly” or “moderately” likely to develop kidney damage or failure.

Low perceived risk and concern regarding CKD development or progression among most hypertensive study participants (many of whom also had diabetes or clinical evidence of CKD) may reflect lack of knowledge of the potential health impact of CKD on the part of both patients and their primary care physicians. While we are aware of no studies identifying rates or predictors of perceived susceptibility to CKD among high-risk populations under medical care, previous national studies have demonstrated awareness of CKD among the general public is low and that many persons, particularly ethnic minorities, do not view CKD as an important health problem.^{21,22} Results from the National Kidney Foundations’ Kidney Early Evaluation Program, a national community-based initiative to identify persons at high-risk for the progression of CKD, also reveal awareness of CKD is extremely low among high-risk individuals in the general public.²³ Recent studies demonstrate primary care physicians’ recognition of CKD and common CKD risk factors are suboptimal.^{24,25} Since primary care physicians play an important role in communicating health risks to patients,^{26–28} it is possible their lack of awareness and knowledge regarding CKD may contribute to patients’ inaccurate perceptions. Our findings support calls within the medical community for enhanced efforts to improve awareness of CKD among high-risk patients and their primary care physicians.²⁹ Improved awareness of CKD might be achieved by pairing education about CKD with education about common CKD risk factors (i.e. hypertension and diabetes) also cared for in primary care.³⁰ Complex interactions between demographic and clinical factors (e.g.

persons from different ethnic/racial backgrounds with or without diabetes) with perceptions of CKD highlight the need for further research to ascertain mechanisms through which high-risk persons from different backgrounds may perceive their risks of CKD differently.

Our findings linking perceived susceptibility to high blood pressure therapy adherence should be interpreted with caution, as the parent study was not designed to study the relation between risk perceptions and adherence. It is notable, however, that persons stating they were either “not at all likely” or “very likely” to develop CKD had poorest adherence scores. While those who perceived themselves “not at all likely” to develop CKD may have been less likely to adhere to prescribed therapies due to a lack of perceived need, persons who perceived themselves as “very likely” to develop CKD may have had fatalistic attitudes about the benefit of adherence on adverse outcomes. Studies in other areas have demonstrated fatalistic attitudes regarding the inevitability of disease may contribute to poor adherence rates^{31–34} and that persons who perceive their ability to control their health are better able to adhere to medical regimens for chronic illnesses.^{35–37} Greater perceptions of risk might also be associated with other attitudes we did not measure (e.g. perceptions of treatment effectiveness or harm, self-efficacy, readiness to change behavior) which may influence adherence.^{38–40}

Limitations of this study deserve mention. First, we ascertained associations between participant characteristics and attitudes as well as attitudes and adherence behaviors in a cross-sectional manner, limiting our ability to draw causal inferences. Second, since the incidence of CKD is lower than the incidence of cardiovascular disease and stroke, participants’ belief that CKD is the lesser threat is often accurate.^{4,41–44} For example, the 25% of participants who were 60 years old or older and had no evidence of CKD at baseline may have little risk of developing clinically important CKD. Third, the parent study was designed to identify the effectiveness of patient and provider interventions on blood pressure adherence. While we controlled for treatment group assignment, it is possible our findings could be confounded by effectiveness of the interventions. Similarly, the parent study was not designed to study population subgroups, and our results regarding subgroups should be interpreted with caution. Fourth, we did not ascertain participants’ primary care physicians’ understanding and perceptions of CKD or whether participants had previously seen nephrologists. Patients’ perceptions of their susceptibility to CKD may be influenced by their exposure to specialists as well as by the extent and quality of their discussions with physicians about kidney disease risk. Finally, the sample size was small, potentially limiting the generalizability and precision of some findings. Notwithstanding these limitations, our findings provide valuable insight regarding perceptions of CKD among high-risk patients seen in primary care and the potential association of perceptions with adherence behaviors.

In summary, many patients at high-risk for the development or progression of CKD had low perceived susceptibility to CKD, and perceptions regarding susceptibility to CKD were lower than perceptions regarding susceptibility to other chronic illnesses. Greater perceived susceptibility to CKD was inversely associated with adherence to high blood pressure therapy. Efforts to improve awareness of CKD among patients and their primary care providers could enhance adherence to therapies

and improve clinical outcomes. Further research to enhance our understanding of the mechanisms through which attitudes regarding susceptibility of disease may influence health behaviors, such as adherence, is needed.

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REFERENCES

- Coresh J, Selvin E, Stevens LA, et al. Prevalence of chronic kidney disease in the United States. *JAMA*. 2007;298(17):2038–47.
- Shlipak MG, Sarnak MJ, Katz R, et al. Cystatin C and the risk of death and cardiovascular events among elderly persons. *N Engl J Med*. 2005;352(20):2049–60.
- Sarnak MJ, Katz R, Stehman-Breen CO, et al. Cystatin C concentration as a risk factor for heart failure in older adults. *Ann Intern Med*. 2005;142(7):497–505.
- Haroun MK, Jaar BG, Hoffman SC, Comstock GW, Klag MJ, Coresh J. Risk factors for chronic kidney disease: a prospective study of 23,534 men and women in Washington County, Maryland. *J Am Soc Nephrol*. 2003;14(11):2934–41.
- Jee SH, Boulware LE, Guallar E, Suh I, Appel LJ, Miller ER 3rd. Direct, progressive association of cardiovascular risk factors with incident proteinuria: results from the Korea Medical Insurance Corporation (KMIC) study. *Arch Intern Med*. 2005;165(19):2299–304.
- Hostetter TH, Lising M. National kidney disease education program. *J Am Soc Nephrol*. 2003;14(7 Suppl 2):S114–116.
- NKDEP Urges Primary Care for People with CKD. NIH Publication No. 08-4531 [http://kidney.niddk.nih.gov/about/Research_Updates/KidneyDiseaseWin08/6.htm. Accessed August, 2009]
- Peralta CA, Hicks LS, Chertow GM, et al. Control of hypertension in adults with chronic kidney disease in the United States. *Hypertension*. 2005;45(6):1119–24.
- Pathman DE, Konrad TR, Freed GL, Freeman VA, Koch GG. The awareness-to-adherence model of the steps to clinical guideline compliance. The case of pediatric vaccine recommendations. *Med Care*. 1996;34(9):873–89.
- Kirkman MS, Williams SR, Caffrey HH, Marrero DG. Impact of a program to improve adherence to diabetes guidelines by primary care physicians. *Diabetes Care*. 2002;25(11):1946–51.
- Cooper LA, Roter DL, Bone LR, et al. A randomized controlled trial of interventions to enhance patient-physician partnership, patient adherence and high blood pressure control among ethnic minorities and poor persons: study protocol NCT00123045. *Implement Sci*. 2009;4:7.
- Davis TC, Crouch MA, Long SW, et al. Rapid assessment of literacy levels of adult primary care patients. *Fam Med*. 1991;23(6):433–5.
- Kim MT, Hill MN, Bone LR, Levine DM. Development and testing of the Hill-Bone Compliance to High Blood Pressure Therapy Scale. *Prog Cardiovasc Nurs*. 2000;15(3):90–6.
- Chobanian AV, Bakris GL, Black HR, et al. The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA*. 2003;289(19):2560–72.
- Expert Panel on the Identification E, Treatment of Overweight in A. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: executive summary. *Am J Clin Nutr*. 1998;68(4):899–917.
- Zhang J, Yu KF. What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. *JAMA*. 1998;280(19):1690–1.
- Huber PJ. The Behavior of Maximum Likelihood Estimates under Nonstandard Conditions. *Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability*. Berkeley, CA: University of California Press;1967:221–3.
- White H. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica*. 48:817–30.
- Williams RL. A note on robust variance estimation for cluster-correlated data. *Biometrics*. 2000;56:645–6.
- Rogers WH. Regressions standard errors in clustered samples. *Stata Tech Bull*. 1993;13:19–23.
- Coresh J, Byrd-Holt D, Astor BC, et al. Chronic kidney disease awareness, prevalence, and trends among U.S. adults, 1999 to 2000. *J Am Soc Nephrol*. 2005;16(1):180–8.
- Waterman AD, Browne T, Waterman BM, Gladstone EH, Hostetter T. Attitudes and behaviors of African Americans regarding early detection of kidney disease. *Am J Kidney Dis*. 2008;51(4):554–62.
- National Kidney F. Annual data report: Kidney Early Evaluation Program. *American Journal of Kidney Diseases*. 2003;42(5): Supplement 4.
- Lea JP, McClellan WM, Melcher C, Gladstone E, Hostetter T. CKD risk factors reported by primary care physicians: do guidelines make a difference? *Am J Kidney Dis*. 2006;47(1):72–7.
- Boulware LE, Troll MU, Jaar BG, Myers DI, Powe NR. Identification and referral of patients with progressive CKD: a national study. *Am J Kidney Dis*. 2006;48(2):192–204.
- Davis RE, Dolan G, Thomas S, et al. Exploring doctor and patient views about risk communication and shared decision-making in the consultation. *Health Expect*. 2003;6(3):198–207.
- Royak-Schaler R, Lemkau JP, Ahmed SM. Discussing breast cancer risk in primary care. *J Am Med Womens Assoc*. 2002;57(2):115–6.
- Buchanan AH, Skinner CS, Rawl SM, et al. Patients' interest in discussing cancer risk and risk management with primary care physicians. *Patient Educ Couns*. 2005;57(1):77–87.
- National Kidney Disease Education P. Health professionals. <http://nkdep.nih.gov/professionals/index.htm>. Accessed July 17, 2009.
- Boulware LE. Challenges for public campaigns to improve the health of persons at high risk of developing CKD. *Am J Kidney Dis*. 2008;51(4):535–8.
- Niederdeppe J, Levy AG. Fatalistic beliefs about cancer prevention and three prevention behaviors. *Cancer Epidemiol Biomarkers Prev*. 2007;16(5):998–1003.
- Farmer D, Reddick B, D'Agostino R, Jackson SA. Psychosocial correlates of mammography screening in older African American women. *Oncol Nurs Forum*. 2007;34(1):117–23.
- Russell KM, Perkins SM, Zollinger TW, Champion VL. Sociocultural context of mammography screening use. *Oncol Nurs Forum*. 2006;33(1):105–12.
- Greiner KA, James AS, Born W, et al. Predictors of fecal occult blood test (FOBT) completion among low-income adults. *Prev Med*. 2005;41(2):676–84.
- Burkhart PV, Rayens MK. Self-concept and health locus of control: factors related to children's adherence to recommended asthma regimen. *Pediatr Nurs*. 2005;31(5):404–9.
- Cvengros JA, Christensen AJ, Lawton WJ. The role of perceived control and preference for control in adherence to a chronic medical regimen. *Ann Behav Med*. 2004;27(3):155–61.
- O'Hea EL, Grothe KB, Bodenlos JS, Boudreaux ED, White MA, Brantley PJ. Predicting medical regimen adherence: the interactions of health locus of control beliefs. *J Health Psychol*. 2005;10(5):705–17.

38. **Dunbar-Jacob JM, Schlenk EA, Burke LE, Matthews JT.** Predictors of patient adherence: patient characteristics. In: Schumamer SA, Schron EB, Ockene JK, McBee WL, eds. *The Handbook of Health Behavior Change*. 2nd ed. New York: Springer Publishing Company; 1998: 491–511.
39. **Glanz K, Lewis FM, Rimer BK.** Part Two: Models of Individual Health Behavior. *Health Behavior and Health Education. Theory, Research and Practice*. San Francisco: Jossey-Bass, Inc.; 1997.
40. **DiMatteo MR, Haskard KB, Williams SL.** Health beliefs, disease severity, and patient adherence: a meta-analysis. *Med Care*. 2007;45(6):521–8.
41. **Wilson PW, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB.** Prediction of coronary heart disease using risk factor categories. *Circulation*. 1998;97(18):1837–47.
42. **Wolf PA, D'Agostino RB, Belanger AJ, Kannel WB.** Probability of stroke: a risk profile from the Framingham Study. *Stroke*. 1991;22(3):312–8.
43. **Officers A, Coordinators for the ACRG.** Major outcomes in moderately hypercholesterolemic, hypertensive patients randomized to pravastatin vs usual care: the Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT-LLT). *JAMA*. 2002;288(23):2998–3007.
44. **Rahman M, Pressel S, Davis BR, et al.** Renal outcomes in high-risk hypertensive patients treated with an angiotensin-converting enzyme inhibitor or a calcium channel blocker vs a diuretic: a report from the Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT). *Arch Intern Med*. 2005;165(8):936–46.