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Physician Cognitive Processing as a Source of Diagnostic and Treatment Disparities in Coronary Heart Disease: Results of a Factorial Priming Experiment*

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Abstract

Literature on health disparities documents variations in clinical decision making by patient characteristics, physician attributes, and between healthcare systems. Using data from a vignette-based factorial experiment of 256 primary care providers, we examine the cognitive basis of disparities in the diagnosis and treatment of coronary heart disease (CHD). To determine whether previously observed disparities are due to physicians: (1) not fully considering CHD for certain patients or (2) considering CHD but then discounting it, half of physicians were explicitly directed to consider a CHD diagnosis. Relative to their unprimed counterparts, primed physicians were more likely to order CHD-related tests and prescriptions. However, main effects for patient gender and age remained, suggesting that physicians treated these demographic variables as diagnostic features amounting to lower risk of CHD for these patients. This finding suggests potential for physician appeals to perceived base rates to contribute to the further reification of socially constructed health statistics.

Extensive research has documented persistent variations in medical practice across a range of countries and conditions (Gurjeva et al. 2005; Kramer et al. 2003; Pilote et al. 2003; Weisz, Gusmano, and Rodwin 2004) despite a questionable physiological basis for such differences. Even when presenting with comparable symptoms, diagnostic and treatment variation occurs as a function of patient characteristics such as race (Holmes, Arispe, and Moy 2005; Popescu, Vaughan-Sarrazin, and Rosenthal 2007), age (Holmes et al. 2005; Martin, Gordon, and Lounsbury 1998), socioeconomic status (Armstrong, Strogatz, and Wang 2004; Fincher et al. 2004), gender (Arber et al. 2004; Arber et al. 2006), and comorbidity status (Wexler et al. 2005). They are also a function of provider and system attributes such as physician gender (Popescu et al. 2007), perceptions of pressure from patients (Armstrong, Fry, and Armstrong 1991), and practice culture (Curoe, Kralewski, and Kaissi 2003). Differences in the diagnosis and treatment of coronary heart disease (CHD)

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are especially common. Patient characteristics have been consistently linked to variations in the treatment and care of CHD (Arber et al. 2004; Barnhart et al. 2006; Harries et al. 2007); women in particular are treated less aggressively than men in risk assessments and treatment for coronary conditions (Bird et al. 2007; Crilly et al. 2007). In cases with comparable symptom presentation, studies have shown differential use of coronary revascularization services (Popescu et al. 2007), hospitalization for hypertension (Holmes et al. 2005), history taking (James, Feldman, and Mehta 2006), and differences in attributions of cardiac-related symptoms (Martin et al. 1998).

From a Bayesian decision making perspective (Gelman et al. 2004), this observed congruence between epidemiologic base rates and newly diagnosed cases is to be expected precisely because the (posterior) probability of a condition in any given patient should be determined relative to the prevalence of the condition in the relevant population (prior probability). Therefore, for example, if CHD is diagnosed less frequently in women, it is because women have lower prevalence of CHD in epidemiologic base rates, and this is assumed to be a straightforward reflection of true biophysiologic differences (Ashby 2006; Harbison 2006). However, a large body of social science research challenges the physiological basis of these differences. For example, twice as many women as men aged 45–64 have undetected or “silent” myocardial infarction, suggesting diagnosis in this population is delayed (Arber et al. 2006; Cohn 1988). In addition, women have poorer outcomes after acute myocardial infarction after adjusting for clinical covariates (Marrugat, Gil, and Sala 1999), suggesting differences exist in medical care as opposed to underlying biology. McKinlay (1996) elaborates in detail a range of issues that implicate clinical decision making rather than biological differences alone as an explanation for rate differences in CHD.

Based on this body of work, researchers in several disciplines are examining how cognitive and social psychological aspects of clinical decision making may contribute to these variations. Despite the above documentation of differential treatment by gender, age, and SES, much of this theoretical literature has focused on race-based differences. For example, van Ryn suggests that racial differences may stem from providers evaluating black patients more negatively than whites (van Ryn and Burke 2000), Balsa and McGuire suggest that the problem is one of white physicians having difficulty making sense of minority patients’ symptom presentation and relying on statistical averages of their previous experience with people from that group (a process they term “statistical discrimination”) (Balsa and McGuire 2001). Additional work has considered the relative contributions of social distance and race concordance on the outcomes of patient-physician encounters (Cooper et al. 2003; LaVeist and Nuru-Jeter 2002) and the role of implicit bias in decision making (Green et al. 2007; Neighbors et al. 2003). Recent debates in sociological social psychology over the existence of unconscious racism (Quillian 2008) underscore the need to determine how such cognitive bias may influence actions (Duster 2008). We theorize that similar processes related to social distance may be relevant to explaining the observed differences in treatment by patient gender, age, and SES. For example, physicians may have stereotypes about women or low SES patients that interfere with their interpretation of symptoms, thereby increasing their reliance on preconceived ideas about those types of patients or aggregate base rates of disease.

A specific theme in this body of work that provides a theoretical backdrop to the present analysis is the question of how providers process and integrate patient-specific information and more general information about *types* of patients—including whether they can accurately interpret information from patients who are different from themselves; whether certain types of patient background characteristics (such as race and gender) tend to override presenting information (such as signs of disease); and the extent to which physicians are

able to develop mental prototypes that are independent of their specific experiences with patients. Taken together, imbalances among these factors can lead to biases and differential assessments of patients, either purposeful or unintended, and without supporting physiological evidence.

Cognitive psychologists have also generated significant work in this area, and while we situate our work within the larger multidisciplinary literature describe above, we draw most immediately from the work of psychologists on knowledge representation. In the psychological literature, traditional models of knowledge representation within the realm of clinical reasoning can be described as “analytic” (Eva 2005). The hallmark of analytic reasoning is a careful analysis of the relation between signs and symptoms of disease and diagnoses. Diagnostic reasoning is believed to predominantly involve understanding the relationship between the features detected and the underlying disorders. These models (including Bayes’ theorem) assume that physicians are aware of the a priori probability with which a particular diagnosis may present and the conditional probability associating each piece of evidence (e.g., signs, symptoms, and diagnostic tests) with the diagnosis.

However, it is also possible to solve many clinical problems through an unconscious application of prior experience. This form of “non-analytic” reasoning (sometimes referred to as “pattern recognition”) occurs when physicians unconsciously compare the current case to those that have been encountered in the past, and use these past experiences to make judgments regarding the probability that the current case belongs within a particular diagnostic category (Brooks 1987; Jacoby, Baker, and Brooks 1989; Norman and Brooks 1997). This form of ‘reasoning’ is hypothesized to take place with sufficient automaticity that it occurs without awareness. The fact that the causes of our behavior/decisions are often unknown to us [notwithstanding our tendency to provide explanations for said behavior/decisions (Bargh and Chartrand 1999)] make it necessary to infer the presence of non-analytic influences from experimentally induced changes in response patterns. Priming tasks in which diagnostic hypotheses are explicitly provided or withheld provide one such manipulation that has proven successful for delineating the presence of non-analytic biases in many clinical decision making (CDM) contexts (Brooks, LeBlanc, and Norman 2000; Eva and Brooks 2000).

We used a priming manipulation in a factorial experiment aimed at discerning the extent to which variations in CHD diagnosis and treatment result from physicians not considering CHD in certain demographic groups versus considering CHD, but discounting it as a diagnosis. We seek to understand whether CHD variations arise because (a) physicians have equal certainty of CHD for all types of patients, but treat some demographic factors as counter-indicative and, thereby, reduce the probability they assign to CHD accordingly, or whether (b) alternative diagnoses simply come to mind more readily for some patient groups, thus lowering the likelihood that the clinician will heavily weight the clinical features indicative of CHD in her decision-making. The unconfounded estimates made possible by our factorial experiment design allow us to simultaneously measure the influence of priming for a series of patient and physician attributes that have been shown, as discussed at the outset, to be significant in extant literature on clinical decision making and bias.

DATA AND METHODS

We conducted a factorial experiment to simultaneously measure the effects of: (a) patient attributes (age, gender, race and socioeconomic status); (b) physician characteristics (gender and years of clinical experience); and (c) cognitive priming status on medical decision making for an actor “patient” presenting with coronary heart disease in a videotaped

vignette. A full factorial of $2^4 = 16$ combinations of patient age (55 vs. 75), gender, race (black vs. white) and socioeconomic status (SES) (lower vs. higher, depicted by current or former employment as a janitor or school teacher) were used for the video scenarios. One of the 16 combinations was shown to each physician.

We employed an availability sample to equally fill four design cells (gender by level of experience). To be eligible for selection, physicians had to: (a) be internists or family/general practitioners with M.D. degrees (international medical graduates were included); (b) have graduated from medical school between 1996–2001 or 1960–87 (to obtain clear separation between higher and lower levels of experience); and (c) be currently working in primary care in North or South Carolina more than half-time. Due to constraints on study size and cost, physician race was not included as an experimental factor and physicians were recruited without regard for race/ethnicity. A letter of introduction was mailed to prospective participants and screening telephone calls were conducted to identify eligible physicians. An appointment was scheduled with each eligible participant at his/her office for a one-on-one, structured interview, lasting one hour. No deception was used in the study: the experiment was introduced to the physicians as a study of medical decision making (without reference to CHD) and the vignettes were referred to such and without suggestion that they were real patient cases.

Half of all physicians were primed (i.e., explicitly directed) to consider a CHD diagnosis. For those who were designated to be primed, the interviewer read the following cover story in addition to the regular introduction heard by all participants prior to viewing the vignette: “The patient in the video was recently on vacation and sought medical advice for her/his symptoms. The physician mentioned the possibility of coronary heart disease and suggested s/he see her/his primarycarephysicianuponreturninghome.”Primingstatuswasassignedatrandomwhenthe physician was enrolled in the study and the interview appointment scheduled (vignettes were randomly assigned to participants at the same time).

After viewing the videotaped vignette, physicians were asked to identify “the most likely condition” and to list additional candidate diagnoses they were considering. For each diagnostic possibility participants were asked to assign a number indicating their level of certainty on a scale of 0–100 with 0 indicating no certainty and 100 indicating complete certainty. They were also asked a series of structured interview questions regarding how they would treat the patient, with responses being recorded verbatim and coded in-house after the interview was completed (see Table 1).

The required 256 interviews (16 vignettes x 4 combinations of physician attributes x 2 priming conditions x 2 replications) were conducted over a period of ten months in 2006–7. IRB approval for the study was obtained and signed informed consents were collected from each participating physician. Each physician subject was provided a stipend ($200) to partially offset lost revenue and to acknowledge their participation.

The medical condition (CHD) was selected because: a) it is among the most common and costly problems presented by older patients to primary care providers (Cohen and Krauss 2003); b) it represents an example of a well-defined organic medical condition; c) it admits a range of diagnostic, therapeutic and lifestyle actions; and d) it is an extensively studied condition in which variations in diagnostic and treatment decisions have been repeatedly demonstrated. The script was developed from several tape-recorded role-playing sessions with experienced clinical advisors. Patients in the vignette presented with signs and symptoms suggestive of CHD, including chest pain worsening with exertion, pain in the back between the shoulder blades, stress, and elevated blood pressure. The vignette scripts,

including non-verbal gestures, were identical for each vignette condition. Because live patients do not typically present as clear-cut textbook cases of specific conditions, the vignette also built in several red herring symptoms potentially indicative of a gastrointestinal (GI) diagnosis. To this end, the patient also complained of indigestion, feeling worse after a large or spicy meal, having pain similar to heart burn but unresponsive to antacids, and feeling full and "gassy." This was done not specifically to make the physicians' diagnostic task more difficult, but to more accurately represent how actual patients present, based on advice from our clinical advisors. The vignette also incorporates references to the patient's mood, including the spouse's report that the patient has been difficult to be around and the patient's self -report of feeling irritated and having decreased energy.

Professional actors were trained under experienced physician supervision to realistically and consistently portray a patient presenting with these signs/symptoms to a primary care provider. An advantage of videotapes (over written scenarios) is that potentially relevant nonverbal indicators (e.g., the "Levine fist" as an indicator of cardiac pain) can be embedded in the presentation. In a direct comparison of vignettes, standardized patients, and chart abstraction, Peabody and colleagues (2000) found that vignettes were a valid and comprehensive method for measuring quality of outpatient care, and that vignettes consistently produced results that were closer to standardized patients than were chart abstraction results.

Key Variables

Independent variables—*Priming i*s the primary manipulation in our experiment and provides critical information about the extent to which differential decision making occurs because physicians do not consider a CHD diagnosis. If priming increases diagnostic certainty and treatment of CHD, it suggests that physicians more fully consider CHD when it is explicitly suggested to them. We are predominantly interested in whether or not differential rates of action on the part of the physician exist in both primed and non-primed cohorts, as this information is informative in determining whether or not physicians simply do not consider CHD in some patient groups or discount CHD as a plausible diagnosis. To study this question we varied select patient and physician characteristics as experimental factors.

Patient characteristics we selected for inclusion as experimental factors (gender, age, race, and SES) are consistently associated in extant literature with differential decision making for various medical conditions, as described above. Based on this evidence, we would expect physicians seeing vignette patients who are female, younger, black, or lower SES to have lower diagnostic certainty and be less likely to treat CHD than those seeing patients who are male, older, white, or higher SES. For CHD in particular, gender and age differences are highly persistent in extant literature, and often attributed to biological differences despite, as outlined above, research questioning the physiological basis of that approach.

Previous studies have also shown that *physician characteristics*, especially gender and level of experience, independently influence clinical decision making and are therefore also included as experimental factors in our study. Based on this literature, we expect that male physicians and/or those with more experience will have higher diagnostic certainty and increased likelihood of prescribing medications and ordering tests associated with CHD. However, we expect female physicians and those with less experience to ask more questions and provide more advice to patients, and have higher certainty for non-CHD diagnoses.

Dependent Variables—*Diagnostic certainty* is a focal dependent variable in this analysis, largely because it is known to be a robust predictor of decision making and treatment actions. Classic work in medical decision making that suggests physicians must

cross specific test- and treatment-certainty thresholds before taking clinical action for a patient (Pauker and Kassirer 1980), and recent empirical research on CHD corroborates the notion that certainty is more important than simply identifying a diagnosis (Lutfey et al. 2008; Lutfey et al. Forthcoming-a). Therefore, the presence of a CHD diagnosis within a full differential diagnosis is necessary but not sufficient to trigger clinical actions and needs to be understood in the context of these multiple factors.

Following from Duster's (2008) observation that we need to establish whether cognitive bias translates to differential treatment, we conceptualize our remaining outcome variables as types of *clinical actions* taken by physicians. Most previous work in this area has focused on differences in test-ordering or prescriptions, with results showing that the patient and provider differences described above hold for these outcomes. We therefore expect that fewer of these clinical actions will be taken on behalf of female, younger, black, lower SES patients, and by physicians who are female and have less experience. In terms of reducing observed gender and age disparities in the diagnosis and treatment of CHD, the ordering of tests and medications for CHD is critical.

We include additional measures of clinical actions that are less frequently addressed in other studies but provide more fine-grained information about clinical actions, including information-seeking, physical exams, advice-giving, time to follow-up, and referrals. In light of physicians' well-known time constraints and healthcare cost considerations, these measures are intended to capture a fuller range of actions physicians might take in response to different diagnostic certainty. For all outcomes, we assume the identical vignette presentation of essential signs and symptoms of CHD should be sufficient to trigger comparable diagnostic and treatment decisions for CHD regardless of the epidemiologic base rate of CHD for the type of patient depicted in any specific vignette. In Bayesian terms, significant differences across patient types would be evidence of physician priors overwhelming presenting patient-specific data (Lutfey et al. Forthcoming-b).

Analytic Strategy

Analysis of variance was used to test the main effects and two-way interactions of the design variables (patient gender, race, age, and SES; physician gender and level of experience; and priming) on a range of diagnostic and treatment decisions. The balanced factorial design allows the unconfounded estimation of all main effects and two-way interactions using analysis of variance. Because the experiment was replicated, a pure error term with 128 degrees of freedom was used to test all effects using analysis of variance. Due to the challenges of multiple testing, we emphasize consistency across results and focus on identifying general patterns of physicians paying differential amounts of attention to CHD. We analyzed 28 variables and would therefore expect, due to chance alone, 1.4 comparisons to be significant at the 0.05 level. To further facilitate interpretation of results, Tables 2–4 indicate the number of expected and observed significant results.

RESULTS

Mean scores and descriptive information for each variable are reported in Table 1. As expected, based on the presentation of key symptoms in the vignette, the vast majority of physicians correctly identified CHD (98.8%) somewhere in their differential diagnosis, with an average of 6.3 total diagnoses generated by each physician. However, diagnostic certainty for CHD was much more varied, with an average of 57.4 on a scale of 0–100 and a standard deviation of 23.0. Similarly, most physicians (98.0%) identified a gastrointestinal (GI) diagnosis, with an average diagnostic certainty of 54.7 out of 100 (standard deviation of 26.7); mental health diagnoses were also common, identified by 76.6% of physicians with an average diagnostic certainty of 43.1 (standard deviation of 33.0).

What is the effect of patient characteristics on CHD decision-making?

Of the four patient characteristics manipulated in the experiment, and as expected, patient gender and age had the greatest effect on clinical decision making (Table 2). On a scale of 0–100, physicians were an average of nine points more certain of their CHD diagnoses for men compared to women (61.7 vs. 53.0, p=.002) and also ordered.4 more medications for the male patients (p=.012). Physicians were also more likely to ask male patients questions about their smoking (p=.038) and to provide them with more lifestyle advice than they offered to women regarding smoking, alcohol, and exercise.

For 75-year-old patients, physicians considered more possible diagnoses (6.6 vs. 5.9, p=.030) but were also more certain of their CHD diagnoses (62.8 vs. 51.9 out of 100, p<.001) as compared with the younger 55-year-old patients. For younger patients, physicians were more likely to act on an alternative GI diagnosis by prescribing medications relevant for GI conditions (including H2 blocker, antacid, anti-emetic, constipation treatment, or proton pump inhibitor) in 84.4% of cases versus 71.9% of cases for the older patient. Physicians also provided smoking advice for fully half of the younger patients as opposed to only 31.3% of the older patients (p=.001). For patient race and SES, few significant differences were observed in main effects and no clear patterns in diagnostic disparities emerged.

What is the effect of physician characteristics on CHD decision making?

Consistent with previous studies reviewed above, we find that physicians' clinical decision making varies according to their gender and level of experience, independent of patient characteristics (Table 3). Compared with patient factors, we observed at least twice as many significant associations for the physician factors in the experiment.

Female physicians asked more questions on a range of topics, including cardiac symptoms, pain, smoking, alcohol, and medications, averaging 12.6 questions per patient compared to an average of 9.8 questions asked by male physicians (p<.001). While male and female physicians had comparable certainty for CHD, women identified mental health diagnoses in more cases than their male counterparts (in 82.8% vs. 70.3% of cases, p=0.013), were more certain of those diagnoses (50.1 vs. 36.1 out of 100, p=0.001), and reported higher maximum seriousness for their non-CHD diagnoses (91.7 vs. 86.4 out of 100, p=0.039). Despite these differences, there were no significant differences in test ordering or prescriptions, but women offered more advice and would wait longer until follow-up, requesting to see the patient again in 10.02 days, compared to the men's 7.84(p=.008).

Physicians with a higher level of experience were generally more focused on CHD in their differential diagnoses relative to their less experienced counterparts. More experienced physicians asked more frequently about cardiac risk factors and prior GI disease, while less experienced physicians asked more often about medications and prior cardiac disease. Physicians with more experience identified only 5.7 possible diagnoses compared with 6.8 listed by less experienced physicians (p=0.001), and listed a mental health diagnosis in only 67.2% of cases compared to 85.9% of cases for less experienced physicians (p<.001). Similarly, more experienced physicians had lower certainty for their GI diagnoses (49.4 vs. 60.0 out of 100, p=0.001) and the maximum seriousness of any of their alternative diagnoses was lower than for less experienced physicians (85.8 vs. 92.2 out of 100, p=0.014).

As with physician gender, these differences did not translate to significant differences in test ordering; however, less experienced physicians were more likely to prescribe a GI medication (in 83.6% of cases vs. 72.7%, p=0.033). Furthermore, while less experienced physicians provided more advice to patients, they also waited longer than their more experienced counterparts to follow-up (9.85 vs. 7.98 days, p=.046).

What is the effect of priming on CHD decision-making?

The priming manipulation in our experiment significantly affected several clinical actions related to CHD, independent of patient and physician characteristics (Table 4). Physicians who were primed asked questions about smoking and diet, and provided advice about exercise, more often than their unprimed counterparts. Primed physicians ordered cardiac tests in 100% of cases (vs. 95.3% of unprimed physicians, p=0.002), while only ordering GI tests in slightly more than half of the cases (52.3% vs. 70.3% of unprimed physicians). Primed physicians were also much more likely to prescribe some type of cardiac medication (75.8% vs. 57.8% of cases, p=0.001).

As discussed at the outset, a critical question is the extent to which patient variables such as gender and age interact with the priming manipulation. If the gender difference, for example, disappeared when physicians were primed, it would suggest that they were not fully considering CHD for some patients when not prompted to do so. Of the 112 possible interactions (28 questions * 4 patient variables), only 8 were statistically significant with no consistency in the pattern of the effects, thus suggesting that the interactions are attributable to chance. The lack of interactions leading to the elimination of age and gender disparities suggests that the disparities observed were generated even when the plausibility of CHD was deliberately considered.

DISCUSSION

Despite extensive research into patterns of health disparities and the specific contributions of physicians' clinical decision making to observed differences, much remains to be investigated about the cognitive processes that underlie such associations. Efforts to understand social psychological sources of bias in decision making have proliferated in recent years and made important contributions to our understanding of how stereotyping, prejudice, and uncertainty operate in a medical context. However, this type of work is often constrained by difficulty in making unconfounded causal estimates (particularly disentangling the effects of patient race and SES), as well as inability to determine the extent to which physicians purposely discount the risk faced by certain types of patients. As a result, it remains ambiguous whether variation arise because physicians tend not to consider CHD diagnoses for some types of patients (especially women and younger patients), or if they consider it and then discount it.

Our study addresses these questions by using an experimental priming manipulation to determine the extent to which physicians discount CHD risk in their clinical decision making for some types of patients even when prompted to deliberately consider CHD. The results illustrated in Table 4 suggest that priming had the desired effect of leading physicians to more fully consider CHD as a diagnostic possibility. The lack of interaction between this variable and patient characteristics suggests that the extent to which CHD is considered a diagnosis worth acting upon is directly influenced by the patient and physician characteristics rather than that CHD does not come to mind as readily with certain demographic groups. Despite the main effect of priming, the priming manipulation did not eliminate disparities in how patients from different groups were diagnosed and treated—that is, gender and age based differences remained. This result suggests that physicians treated the demographic variables of age and gender as diagnostic features that amounted to lower risk of CHD despite identical presentation of CHD symptoms. Despite extensive literature on race and SES differences, we did not observe significant results for these patient characteristics, either as main effects or in interactions with priming. This result suggests that physicians did not rely on these characteristics as diagnostic features, a pattern consistent with existing epidemiologic information about CHD prevalence. It may be that

those characteristics would be significant for a condition with larger race and SES differentials, such as diabetes.

Beyond the priming effects, our results corroborate previous work showing that physician gender and level of experience influence clinical decision making. Both women and less experienced physicians tend to ask more questions, and while their diagnostic certainty for CHD is comparable to their male and more experienced counterparts respectively, they are more likely to consider mental health diagnoses and allow more time to pass before seeing the patient for follow-up. By contrast, male and more experienced physicians appear more focused on CHD than alternative candidate diagnoses, and requested a shorter period to follow-up. These differences persisted regardless of patient characteristics and whether the physician was primed.

While patient and physician attributes predicted some expected differences in diagnostic certainty and some types of clinical actions, these factors were not associated with differences in CHD-related test or medication ordering. At the same time, priming led to differences for both of these outcomes, but not for diagnostic certainty (for CHD, GI, or mental health diagnoses). Previous work shows that diagnostic certainty is highly predictive of test and medication ordering, yet these results suggest that (net of the gender and age effects outlined above) a physician's consideration of a CHD diagnosis may be more important than having high certainty about it in terms of a patient receiving treatment.

We took four precautionary steps in an attempt to minimize possible threats to external validity. First, considerable effort was devoted to ensuring the clinical authenticity of the videotaped presentation. This was achieved by basing the scripts on clinical experience, filming with experienced clinicians present, and by using professional actors/actresses. Second, the subjects (doctors) were specifically asked how typical the patient viewed on the videotape was compared with patients they encounter in everyday practice (89.8% considered them either very typical or reasonably typical). Third, the doctors viewed the vignette in the context of their practice day (not at a professional meeting, a course update, or in their home) so that it was likely they encountered real patients before and after they viewed the patient in the videotape. Fourth, the doctors were specifically instructed at the outset to view the patient as one of their own patients and to respond as they would typically respond in their own practice.

The clinical and policy implications of these results are significant and far-reaching, yet highlight the need for a nuanced approach. On one hand, encouraging physicians to more fully and routinely consider CHD diagnoses may result in greater CHD-relevant testing and prescriptions, while at the same time limiting the pursuit of unnecessary testing and treatment for alternative possibilities (such gastrointestinal conditions). On the other hand, this type of approach will not solve the problem for all types of patients. Specifically, the observed gender and age disparities will not be resolved by training doctors to more thoroughly consider CHD for these populations given physicians appear to discount CHD diagnoses in these types of patients even when prompted to consider a CHD diagnosis. If CHD is under-valued in certain patient populations (and by certain physician populations) as a result of explicit and analytically applied decision rules, the most effective policy strategy will need to address inaccuracies in those decision rules, which could include either clarifying the real distribution of the clinical phenomenon of interest (if, for example, the perceived CHD risk for women was lower than actual epidemiologic base rates) or discouraging over-reliance on prior probabilities to determine risk when the presenting symptoms suggest the risk is higher. If, in contrast, the biases in diagnostic rates are the result of implicit (i.e., non-analytic) discounting of particular diagnoses, the optimal public policy strategy is more likely to involve an emphasis on patient-specific feedback that will

allow physicians to be more aware of the discrepancies between their expectations about disease distribution and reality. These principles could be practically implemented through a range of media, including revised clinical practice guidelines for CHD, physician education and training, or increased use of some types of information technology.

While this study answers so me important questions regarding physicians' cognitive reasoning processes, it also points to additional opportunities for future research. For example, to what extent are physicians accurate in their perceptions of published CHD base rates? In the absence of this information, it is difficult to disentangle the extent to which physicians' analytic decisions result from inaccurate knowledge of existing base rates versus accurate knowledge of rates accompanied by inappropriate weighting of prior probabilities in determining the likelihood of a condition for a given type of patient. Similarly, to what extent are observed gender and age patterns a function of discounting based on demographic characteristics versus other types of assessments for which demographics act as proxy indicators? Policy interventions of the sort described above will have limited utility if, for example, the demographic characteristic of gender is interpreted by physicians less a marker of biologic difference and more as a proxy for gendered social behaviors that are seen as relevant for health behavior and medical treatment (Lutfey et al. 2008). Finally, we expect that these results may vary by condition, so that conditions that are less life-threatening than CHD, less "silent," or whose treatments are more reliant on lifestyle change may involve different cognitive processing (such as depression or diabetes). Considered in conjunction with policy reports calling for increased attention to the role of clinical decision making in health disparities (Institute of Medicine 2001; Institute of Medicine 2003), these results underscore the importance of examining the social and psychological processes embedded in clinical decision making and the ways those results are related to epidemiologic rates of disease. To the extent that prior assumptions about likelihood of risk override presenting symptoms, physicians remain at increased risk for not only missing potentially life-threatening diagnoses with individual patients, but also for contributing to the reification of bias in some types of health statistics. In a decision making environment largely dominated by Bayesian models (Ashby 2006), there is a continued and pressing need for sociological and social science perspectives to unravel these associations.

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References

Arber, Sara; McKinlay, John B.; Adams, Ann; Marceau, Lisa D.; Link, Carol L.; O'Donnell, Amy B. Influence of Patient Characteristics on Doctors' Questioning and Lifestyle Advice for Coronary Heart Disease: A UK/US Video Experiment. British Journal of General Practice. 2004; 54:673–678. [PubMed: 15353053]

Arber, Sara; McKinlay, John B.; Adams, Ann; Marceau, Lisa D.; Link, Carol L.; O'Donnell, Amy B. Patient Characteristics and Inequalities in Doctors' Diagnostic and Management Strategies relating to CHD: A Video-simulation Experiment. Social Science and Medicine. 2006; 62:103–15. [PubMed: 16002197]

Armstrong, David; Fry, John; Armstrong, Pauline. Doctors' Perceptions of Pressure from Patients for Referral. British Medical Journal. 1991; 302:1186–8. [PubMed: 2043816]

Armstrong, Donna L.; Strogatz, David; Wang, Ruby. United States Coronary Mortality Trends and Community Services Associated with Occupational Structure, Among Blacks and Whites, 1984–1998. Social Science and Medicine. 2004; 58:2349–61. [PubMed: 15047090]

Ashby, Deborah. Bayesian Statistics in Medicine: A 25 Year Review. Statistics in Medicine. 2006; 25:3589–631. [PubMed: 16947924]

Balsa, Ana I.; McGuire, Thomas G. Statistical Discrimination in Health Care. Journal of Health Economics. 2001; 20:881–907. [PubMed: 11758051]

Barnhart, Janice M.; Cohen, Oshra; Wright, Natania; Wylie-Rosett, Judith. Can Non-Medical Factors Contribute to Disparities in Coronary Heart Disease Treatments? Journal of Health Care for the Poor and Underserved. 2006; 17:559–74. [PubMed: 16960322]

Bird, Chloe E.; Fremont, Allen; Bierman, Arlene S.; Wickstrom, Steven L.; Shah, Mona; Rector, Thomas; Horstman, Thomas; Escarce, Jose J. Does Quality of Care for Cardiovascular Disease and Diabetes Differ by Gender for Enrollees in Managed Care Plans? Women's Health Issues. 2007; 17:131–8.

Brooks, Lee R. Decentralised Control in Categorisation: The Role of Prior Processing Episodes. In: Neisser, U., editor. Concepts and Conceptual Development: Ecological and Intellectual Factors in Categorisation. Cambridge: Cambridge University Press; 1987. p. 141-74.

Brooks, Lee R.; LeBlanc, Vicki R.; Norman, Geoffrey R. On the Difficulty of Noticing Obvious Features in Patient Appearance. Psychological Science. 2000; 11:112–7. [PubMed: 11273417]

Cohen, Joel W.; Krauss, Nancy A. Spending and Service Use Among People with the Fifteen Most Costly Medical Conditions. Health Affairs. 2003; 22:129–38. [PubMed: 12674416]

Cohn, Peter F. Silent Myocardial Ischemia. Annals of Internal Medicine. 1988; 109:312–7. [PubMed: 3293494]

Cooper, Lisa A.; Roter, Debra L.; Johnson, Rachel L.; Ford, Daniel E.; Steinwachs, Donald M.; Powe, Neil R. Patient-Centered Communication, Ratings of Care, and Concordance of Patient and Physician Race. Annals of Internal Medicine. 2003; 139:907–15. [PubMed: 14644893]

Crilly, Mike; Bundred, Peter; Hu, Xiyuan; Leckey, Lisa; Johnstone, Fiona. Gender Differences in the Clinical Management of Patients with Angina Pectoris: A Cross-Sectional Survey in Primary Care. BioMed Central Health Services Research. 2007; 7:142. [PubMed: 17784961]

Curoe, Ann; Kralewski, John; Kaissi, Amer. Assessing the Cultures of Medical Group Practices. Journal of the American Board of Family Medicine. 2003; 16:394–8.

Duster, Troy. Introduction to Unconscious Racism Debate. Social Psychology Quarterly. 2008; 71:6.

Eva, Kevin W. What Every Teacher Needs to Know about Clinical Reasoning. Medical Education. 2005; 39:98–106. [PubMed: 15612906]

Eva, Kevin W.; Brooks, Lee R. The Underweighting of Implicitly Generated Diagnoses. Academic Medicine. 2000; 75:81–83. [PubMed: 10667882]

Fincher, Contessa; Williams, Joyce E.; MacLean, Vicky; Allison, Jeroan J.; Kiefe, Catarina I.; Canto, John. Racial Disparities in Coronary Heart Disease: A Sociological View of the Medical Literature on Physician Bias. Ethnicity and Disease. 2004; 14:360–71. [PubMed: 15328937]

Gelman, Andrew; Carlin, John B.; Stern, Hal S.; Rubin, Donald B. Bayesian Data Analysis. 2. Boca Raton, FL: Chapman & Hall; 2004.

Green, Alexander R.; Carney, Dana R.; Pallin, Daniel J.; Ngo, Long H.; Raymond, Kristal L.; Iezzoni, Lisa I.; Banaji, Mahrazin R. Implicit Bias Among Physicians and Its Prediction of Thrombolysis Decisions for Black and White Patients. Journal of General Internal Medicine. 2007; 22:1231–8. [PubMed: 17594129]

Gurjeva, Olga S.; Bukhman, Gene; Murphy, Sabina; Cannon, Christopher P. Treatment and Outcomes of Eastern Europeans with Coronary Syndromes in OPUS- TIMI 16. International Journal of Cardiology. 2005; 100:101–7. [PubMed: 15820292]

Harbison, Jean. Clinical Judgment in the Interpretation of Evidence: A Bayesian Approach. Journal of Clinical Nursing. 2006; 15:1489–97. [PubMed: 17118071]

Harries, Claire; Forrest, Damien; Harvey, Nigel; McClelland, Alastair; Bowling, Ann. Which Doctors are Influenced by a Patient's Age? A Multi-Method Study of Angina Treatment in General Practice, Cardiology and Gerontology. Quality and Safety in Health Care. 2007; 16:23–7. [PubMed: 17301199]

Holmes, Julia S.; Arispe, Irma E.; Moy, Ernest. Heart Disease and Prevention: Race and Age Differences in Heart Disease Prevention, Treatment, and Mortality. Medical Care. 2005; 43:I33–41. [PubMed: 15746589]

Institute of Medicine. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, D.C: The National Academies Press; 2001.

Institute of Medicine. Unequal Treatment: Confronting Racial and Ethnic Disparities in Healthcare. Washington, D.C: The National Academies Press; 2003.

Jacoby, Larry L.; Baker, John G.; Brooks, Lee R. The Priority of the Specific: Episodic Effects in Picture Identification. Journal of Experimental Psychology: Learning, Memory, and Cognition. 1989; 15:275–81.

James, Thea L.; Feldman, James; Mehta, Supriya D. Physician Variability in History Taking When Evaluating Patients Presenting with Chest Pain in the Emergency Department. Academic Emergency Medicine. 2006; 13:147–52. [PubMed: 16436792]

Kramer, Judith M.; Kristin Newby, L.; Wei-Ching Chang, R.; Simes, John; Van de Werf, Frans; Granger, Christopher B.; Lee, Kerry L.; White, Harvey D.; Piegas, Leopoldo S.; Topol, Eric J.; Califf, Robert M.; Armstrong, Paul W. for the SYMPHONY and 2nd SYMPHONY Investigators. . International Variation in the Use of Evidence-Based Medicine for Acute Coronary Syndromes. European Heart Journal. 2003; 24:2133–41. [PubMed: 14643274]

LaVeist, Thomas A.; Nuru-Jeter, Amani. Is Doctor-Patient Race Concordance Associated with Greater Satisfaction with Care? Journal of Health and Social Behavior. 2002; 43:296–306. [PubMed: 12467254]

Lutfey, Karen E.; Link, Carol L.; Grant, Richard W.; Marceau, Lisa D.; McKinlay, John B. Is Certainty More Important than Diagnosis for Understanding Race and Gender Disparities?: An Experiment Using Coronary Heart Disease and Depression Case Vignettes. Health Policy. 2009; 89(3):279–87. [PubMed: 18701185]

Lutfey, Karen E.; Link, Carol L.; Marceau, Lisa D.; Grant, Richard W.; Adams, Ann; Arber, Sara; Siegrist, Johannes; Bönte, Markus; von dem Knesebeck, Olaf; McKinlay, John B. Diagnostic Certainty as a Source of Medical Practice Variation in Coronary Heart Disease: Results from a Cross-National Experiment of Clinical Decision Making. Medical Decision Making. Forthcoming a.

Lutfey, Karen E.; Link, Carol L.; Marceau, Lisa D.; McKinlay, John B. Sociological Contributions to the Study of Clinical Decision Making. In: Kattan, Michael; Cowan, Mark E., editors. Encyclopedia of Medical Decision Making. New York: Russell Sage; Forthcoming b

Marrugat, Jaume; Gil, Miguel; Sala, Joan. Sex Differences in Survival Rates after Acute Myocardial Infarction. Journal of Cardiovascular Risk. 1999; 6:89–97. [PubMed: 10353068]

Martin, René; Gordon, Ellen E.; Lounsbury, Patricia. Gender Disparities in the Attribution of Cardiac-Related Symptoms: Contribution of Common Sense Models of Illness. Health Psychology. 1998; 17:346–57. [PubMed: 9697944]

McKinlay, John B. Some Contributions from the Social System to Gender Inequalities in Heart Disease. Journal of Health and Social Behavior. 1996; 37:1–26. [PubMed: 8820308]

Neighbors, Harold W.; Trierweiler, Steven J.; Ford, Briggett C.; Muroff, Jordana R. Racial Differences in DSM Diagnosis Using a Semi-Structured Instrument: The Importance of Clinical Judgment in the Diagnosis of African Americans. Journal of Health and Social Behavior. 2003; 43:237–256. [PubMed: 14582306]

Norman, Geoffrey R.; Brooks, Lee R. The Non-Analytical Basis of Clinical Reasoning. Advances in Health Sciences Education. 1997; 2:173–84. [PubMed: 12386407]

Pauker, Stephen G.; Kassirer, Jerome P. The Threshold Approach to Clinical Decision Making. New England Journal of Medicine. 1980; 302:1109–17. [PubMed: 7366635]

Pilote, Louise; Saynina, Olga; Lavoie, Frederic; McClellan, Mark. Cardiac Procedure Use and Outcomes in Elderly Patients with Acute Myocardial Infarction in the United States and Quebec, Canada, 1988 to 1994. Medical Care. 2003; 41:813–22. [PubMed: 12835605]

Popescu, Ioana; Vaughan-Sarrazin, Mary S.; Rosenthal, Gary E. Differences in Mortality and Use of Revascularization in Black and White Patients with Acute MI Admitted to Hospitals With and Without Revascularization Services. Journal of the American Medical Association. 2007; 297:2489–95. [PubMed: 17565083]

Quillian, Lincoln. Does Unconscious Racism Exist? Social Psychology Quarterly. 2008; 71:6–11.

van Ryn, Michelle; Burke, Jane. The Effect of Patient Race and Socio-Economic Status on Physicians' Perceptions of Patients. Social Science and Medicine. 2000; 50:813–28. [PubMed: 10695979]

Weisz, Daniel; Gusmano, Michael K.; Rodwin, Victor G. Gender and the Treatment of Heart Disease in Older Persons in the United States, France, and England: A Comparative, Population-Based View of a Clinical Phenomenon. Gender Medicine. 2004; 1:29–40. [PubMed: 16115581]

Wexler, Deborah J.; Grant, Richard W.; Meigs, James B.; Nathan, David M.; Cagliero, Enrico. Sex Disparities in Treatment of Cardiac Risk Factors in Patients with Type 2 Diabetes. Diabetes Care. 2005; 28:514–20. [PubMed: 15735180]

Biographies

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John B. McKinlay is Founding Director, Senior Vice President, and Chief Scientist at New England Research Institutes. Dr. McKinlay maintains an extensive portfolio of research in community-based epidemiology, male endocrinology, clinical decision-making, health disparities and healthy public policy. He is the 2008 recipient of the ASA award for Distinguished Career for the Practice of Sociology.

Table 1

Descriptive information of study outcome variables. (All questions were asked in an open-ended format as written below and coded into closed categories after the interview.)

Questionnaire Items & Variable Names	Scoring	Mean
Questions: In addition to information elicited in the vignette, what other information would you like to obtain before deciding what's going on with the patient today?		
# of questions	0–34	11.191
Cardiac risk factors (including hypertension, hyperlipidemia; vascular disease; diabetes status)	proportion reporting yes	0.586
Cardiac symptoms (including shortness of breath; palpatations; edema)	proportion reporting yes	0.359
Pain (any questions on pain symptoms)	proportion reporting yes	0.289
Smoking (any questions on smoking status)	proportion reporting yes	0.676
Alcohol (any questions on alcohol usage)	proportion reporting yes	0.309
Diet (any questions on diet)	proportion reporting yes	0.102
Medications (any questions on meds)	proportion reporting yes	0.473
Prior cardiac disease (any questions on history of cardiac problems)	proportion reporting yes	0.352
Prior GI disease (any questions on history of GI problems)	proportion reporting yes	0.262
Diagnosis: We recognize that you might be considering several possible diagnoses for this patient. Which do you think is the most likely condition?		
# of diagnoses	2–19	6.289
CHD	proportion reporting yes	0.988
Gastrointestinal diagnosis	proportion reporting yes	0.980
Mental Health diagnosis	proportion reporting yes	0.766
Certainty: Using a scale of 0–100, with 0 indicating no certainty and 100 indicating complete certainty, how certain are you that this patient has [CONDITION]?		
CHD certainty	0–100	57.367
Mental Health certainty	0–100	43.113
GI certainty	0–100	54.734
Maximum seriousness of alternative diagnoses	0–100	89.012
Tests: Which tests or lab work would you order today?		
Cardiac test ordered (stress test, EKG)	proportion reporting yes	0.977
GI test ordered (abdominal/pelvic CT scan, endoscopy, colonoscopy, liver function & others)	proportion reporting yes	0.613
Medications: Which medications would you prescribe today?		
# of medications	0–7	2.238
Cardiac meds	proportion reporting yes	0.668
GI meds	proportion reporting yes	0.781
Advice: What specific advice would you offer this patient today?		
# of pieces	0–15	4.129
Smoking	proportion reporting yes	0.406

Questionnaire Items & Variable Names	Scoring	Mean
Alcohol	proportion reporting yes	0.215
Diet	proportion reporting yes	0.699
Exercise	proportion reporting yes	0.379
Reduce stress	proportion reporting yes	0.242
Follow-up: Would you want to see this patient again for follow-up? [If YES,] how soon would you like to see this patient again?		
Time to follow-up	0–42 days	8.908

Table 2

Analysis of variance results for main effects of patient characteristics on CDM

		Patient Gender		Patient Age		Patient Race		Patient SES	
		Female	Male	55	75	Black	While	Lower	Upper
Questions	# of questions	10.906	11.477	11.070	11.313	11.047	11.336	11.141	11.242
	Cardiac risk factors	0.578	0.594	0.578	0.594	0.609	0.563	0.609	0.563
	Cardiac symptoms	0.344	0.375	0.359	0.359	0.352	0.367	0.336	0.383
	Pain	0.281	0.297	0.281	0.297	0.336	0.242	0.234	0.344
	Smoking	0.617	0.734*	0.703	0.648	0.641	0.711	0.711	0.641
	Alcohol	0.266	0.352	0.313	0.305	0.313	0.305	0.328	0.289
	Diet	0.094	0.109	0.078	0.125	0.078	0.125	0.109	0.094
	Medications	0.484	0.461	0.445	0.500	0.461	0.484	0.422	0.523
	Prior cardiac disease	0.352	0.352	0.297	0.406	0.328	0.375	0.367	0.336
	Prior GI disease	0.227	0.297	0.242	0.281	0.227	0.297	0.281	0.242
Diagnosis & Certainty	# of diagnoses	6.070	6.508	5.945	6.633*	6.234	6.344	6.352	6.227
	CHD certainty	53.031	61.703**	51.930	62.805***	58.289	56.445	55.914	58.820
	Mental Health Dx	0.805	0.727	0.813	0.719	0.742	0.789	0.773	0.758
	Mental Health certainty	46.273	39.953	45.680	40.547	41.797	44.430	45.180	41.047
	GI certainty	55.531	53.938	52.586	56.883	52.992	56.477	56.945	52.523
	Max seriousness of alternatives	88.430	89.594	89.102	88.922	87.922	90.102	90.094	87.930
Tests	Cardiac test ordered	0.961	0.992	0.969	0.984	0.969	0.984	0.984	0.969
	GI test ordered	0.641	0.586	0.656	0.570	0.641	0.586	0.672	0.555*
Medications	# of medications	2.039	2.438*	2.195	2.281	2.422	2.055*	2.266	2.211
	Cardiac meds	0.625	0.711	0.633	0.703	0.711	0.625	0.648	0.688
	GI meds	0.773	0.789	0.844	0.719*	0.836	0.727*	0.789	0.773
Advice	# of pieces	3.961	4.297	4.164	4.094	4.172	4.086	4.352	3.906
	Smoking	0.320	0.492**	0.500	0.313**	0.344	0.469*	0.461	0.352
	Alcohol	0.164	0.266*	0.250	0.180	0.195	0.234	0.234	0.195

		Patient Gender		Patient Age		Patient Race		Patient SES	
		Female	Male	55	75	Black	While	Lower	Upper
	Diet	0.672	0.727	0.688	0.711	0.703	0.695	0.664	0.734
	Exercise	0.281	0.477***	0.406	0.352	0.375	0.383	0.352	0.406
	Reduce stress	0.266	0.219	0.250	0.234	0.250	0.234	0.273	0.211
Next Appointment	Time to follow-up	8.944	8.872	9.595	8.216	8.968	8.849	8.616	9.198
Expected significant			1.4		1.4		1.4		1.4
Observed significant			6		4		3		1

Notes: P-values are from two-sided tests,

* denotes significance at the p<0.05 level,

** denotes significance at the p<0.01 level,

*** denotes significance at the p<0.001 level.

Table 3

Analysis of variance results for main effects of physician characteristics on CDM

		Physician Gender		Physician Experience	
		Female	**Male**	**Less**	**More**
Questions	# of questions	12.570	9.813***	10.953	11.430
	Cardiac risk factors	0.547	0.625	0.516	0.656*
	Cardiac symptoms	0.438	0.281**	0.391	0.328
	Pain	0.375	0.203**	0.258	0.320
	Smoking	0.758	0.594**	0.656	0.695
	Alcohol	0.391	0.227**	0.328	0.289
	Diet	0.109	0.094	0.117	0.086
	Medications	0.563	0.383**	0.539	0.406*
	Prior cardiac disease	0.344	0.359	0.422	0.281*
	Prior GI disease	0.258	0.266	0.203	0.320*
Diagnosis & Certainty	# of diagnoses	6.336	6.242	6.836	5.742**
	CHD certainty	58.055	56.680	54.703	60.031
	Mental Health Dx	0.828	0.703*	0.859	0.672***
	Mental Health certainty	50.094	36.133**	47.016	39.211
	GI certainty	57.664	51.805	60.047	49.422**
	Max seriousness of alternatives	91.664	86.359*	92.188	85.836*
Tests	Cardiac test ordered	0.992	0.961	0.977	0.977
	GI test ordered	0.594	0.633	0.625	0.602
Medications	# of medications	2.289	2.188	2.234	2.242
	Cardiac meds	0.656	0.680	0.688	0.648
	GI meds	0.781	0.781	0.836	0.727*
Advice	# of pieces	4.711	3.547**	4.516	3.742*

		Physician Gender		Physician Experience	
		Female	Male	Less	More
	Smoking	0.453	0.359	0.391	0.422
	Alcohol	0.266	0.164*	0.211	0.219
	Diet	0.742	0.656	0.758	0.641*
	Exercise	0.391	0.367	0.375	0.383
	Reduce stress	0.289	0.195	0.305	0.180*
Next Appointment	Time to follow-up	10.016	7.844**	9.848	7.976*
Expected significant			1.4		1.4
Observed significant			12		13

Notes: P-values are from two-sided tests,

* denotes significance at the $p<0.05$ level,

** denotes significance at the $p<0.01$ level,

*** denotes significance at the $p<0.001$ level.

Table 4

Analysis of variance results for main effects of priming status on CDM

Clinical Decisions & Actions		Physician Priming Status	
		No	Yes
Questions	# of questions	10.945	11.438
	Cardiac risk factors	0.523	0.648
	Cardiac symptoms	0.328	0.391
	Pain	0.313	0.266
	Smoking	0.609	0.742*
	Alcohol	0.313	0.305
	Diet	0.055	0.148*
	Medications	0.445	0.500
	Prior cardiac disease	0.391	0.313
	Prior GI disease	0.266	0.258
Diagnosis & Certainty	# of diagnoses	6.563	6.016
	CHD certainty	55.438	59.297
	Mental Health Dx	0.797	0.734
	Mental Health certainty	45.383	40.844
	GI certainty	54.289	55.180
	Max seriousness of alternatives	88.750	89.273
Tests	Cardiac test ordered	0.953	1.000*
	GI test ordered	0.703	0.523**
Medications	# of medications	2.180	2.297
	Cardiac meds	0.578	0.758**
	GI meds	0.820	0.742
Advice	# of pieces	4.016	4.242
	Smoking	0.422	0.391
	Alcohol	0.242	0.188
	Diet	0.672	0.727
	Exercise	0.320	0.438*
	Reduce stress	0.250	0.234
Next Appointment	Time to follow-up	9.081	8.740
Expected significant			1.4
Observed significant			6

Notes: P-values are from two-sided tests,

* denotes significance at the p<0.05 level,

** denotes significance at the p<0.01 level,

*** denotes significance at the p<0.001 level.