Epistemology and Uncertainty:

A Follow-up Study With Third-year Medical Students

Lance Evans, PhD; David R.M. Trotter, MA; Betsy Goebel Jones, EdD; R. Michael Ragain, MD, MSEd; Ronald L. Cook, DO, MS, MBA; Fiona R. Prabhu, MD; Kitten S. Linton, MD

BACKGROUND AND OBJECTIVES: Prior research results indicate a relationship between medical epistemology (ie, how a physician organizes and prioritizes the biological and psychosocial data of a patient presentation) and stress reactions to uncertainty among primary care physicians. However, little is known about when this relationship forms. The purpose of this study was to begin answering this question by exploring the relationship between medical epistemology and stress reactions to uncertainty among a group of 89 third-year medical students from the class of 2010 of a three-campus state medical school located in the southwestern US.

METHODS: Data from Likert-type measures of medical epistemology and stress reactions to uncertainty were extracted from course evaluation information that was collected at the start (T1) and end (T2) of a continuity clinic experience that spanned most of the students' third year. Using these data, the authors conducted a simple bivariate regression analysis to identify the relationship between medical epistemology and stress reactions to uncertainty (Model 1), and a multivariate regression analysis to test for the independent effect of medical epistemology on stress reactions to uncertainty while controlling for gender and specialty interest (Model 2). These two regression models were calculated for both the T1 and T2 data sets.

RESULTS: The two regression models at T1 indicated no significant relationships between medical epistemology and stress reactions to uncertainty; however, the two regression models at T2 indicated that a biopsychosocial epistemology is associated with less stress reactions to uncertainty, and a biomedical epistemology is associated with more stress reactions to uncertainty.

CONCLUSIONS: The third year is an opportune time for medical educators to help shape and develop students' medical epistemology and stress reactions to uncertainty.

(Fam Med 2012;44(1):14-21.)

In a previous issue of *Family Medicine*, we have reported on the relationship between medical epistemology (ie, how a physician organizes and prioritizes the biological and psychosocial data of a patient presentation) and stress reactions to uncertainty among primary care physicians.[1] Specifically, the results of our study suggested that a biopsychosocial epistemology is associated with less stress reactions to uncertainty, and a biomedical epistemology is associated with more stress reactions to uncertainty. While these findings described a relationship relevant to primary care physicians and their practice behavior, little is known about when this relationship forms. For example, it is not known if this relationship forms during medical school or residency, immediately after residency, or after several years of independent practice. The purpose of this study was to begin answering this question by exploring the relationship between medical epistemology and stress reactions to uncertainty among a group of medical students at the start and end of their third year (ie, the principle clinical experience) in medical school.

Background

Medical Epistemology

Epistemology, as a discipline, is the branch of philosophy concerned with how knowledge is acquired and validated;[2] however, at an individual or personal level, an epistemology is a belief system about knowledge that determines how one organizes, interprets, and abstracts meaning from information or stimuli. In a medical context, an epistemology determines how a physician organizes and prioritizes the biological and psychosocial

From the Department of Family and Community Medicine (all) and Department of Psychology (Mr Trotter), Texas Tech University, Lubbock, TX.

data of a patient presentation,[3] and is the conceptual basis of a physician's diagnostic and treatment decisions. The key feature of a medical epistemology is found in its *a priori* assumptions about knowledge that determine which types of clinical data are relevant and which types are not. In the West, the practice of medicine has been primarily influenced by two epistemologies, namely, the biomedical model and the biopsychosocial model. A thorough explanation of these models is available elsewhere;[4] however, a defining feature of both models is the way in which each model deals with psychosocial content.[5] Based on the Cartesian division between mind and body, the biomedical model assumes that psychosocial data are peripheral or irrelevant to medical care. In contrast, the biopsychosocial model is based on general systems theory, which assumes a complex, reciprocal relationship between the mind and body whereby health problems are at once a biological, psychological, and social experience.

Research on the clinical implications for medical epistemology suggest that a physician's epistemology is associated with stress reactions to uncertainty,[1] diagnosis and treatment decisions,[6] communication style with patients,[7] burnout and patient depersonalization,[8] and likelihood of experiencing a patient as "difficult."[9] Other than descriptive data suggesting a relationship with gender, specialty choice, personality, and training environment,[10,11] little is known about medical students' epistemology.

Stress Reactions to Uncertainty

Although medical students tend to develop a tolerance for uncertainty as they progress through medical school,[12] experiences of uncertainty are nevertheless common for medical students[13] as well as practicing physicians.[14] As uncertainty has been linked to a variety of troublesome economic and clinical indicators (eg, increased morbidity and mortality, variability in diagnosis and practice behavior),[15-17] it is no surprise that researchers have attempted to understand its source. For practicing physicians, Beresford[18] reports the source of uncertainty as inadequate resources in three types of knowledge: technical (inadequate technical or procedural knowledge), personal (not knowing patients' wishes), or conceptual (difficulty applying abstract criteria to concrete situations). However, as Nevalainen et al[19] have demonstrated, the source of third-year medical students' uncertainty is associated with a variety of factors such as insecurity about professional skills, a growing realization that medicine is often inexact, and a heightened awareness of the responsibility associated with patient care.

Regardless of its source, uncertainty in a clinical setting has consequences. More often than not, as Katz[20] has noted, physicians tend to "resolve uncertainty and ambiguity by action rather than inaction." However, this propensity for action is predicated on beliefs and attitudes about uncertainty. As Gerrity et al[21-23] have observed, physicians' beliefs about uncertainty can be categorized as stress reactions to uncertainty (ie, anxiety due to uncertainty and concern about bad outcomes). Although there are several studies exploring these types of reactions for practicing physicians,[6,21-24] little is known about medical students' stress reactions to uncertainty.

Objectives and Hypothesis

The purpose of this study was to explore the relationship between medical epistemology and stress reactions to uncertainty among medical students at the start and end of their third year. Similar to our original study, we hypothesized that a biomedical epistemology would be associated with more stress reactions to uncertainty, and a biopsychosocial epistemology would be associated with less stress reactions to uncertainty. Our rationale for this—as well as our original—hypothesis was based on the assumptions that each epistemology makes about the importance of psychosocial content. For example, because a biopsychosocial epistemology provides a comprehensive conceptual resource for integrating patients' biological and psychosocial presentation into a coherent clinical whole, we theorized that students who adopt this epistemology would be less susceptible to being overwhelmed by the breadth and complexity inherent to the third-year clinical experience and would thus experience less stress reactions to uncertainty. Likewise, because a biomedical epistemology is a dualistic and reductionist conceptual resource that makes no attempt to integrate patients' biological and psychosocial presentation into a coherent clinical whole, we theorized that students who adopt this epistemology would experience psychosocial data as burdensome distractions that overwhelm the student and increase stress reactions to uncertainty.

While the rationale for a relationship between the two variables in the present study was essentially the same as that of our original study, we further hypothesized that this relationship would not be present at the beginning of the academic year, but rather, would materialize sometime over the course of the academic year. Our rationale for this second hypothesis was based on the theory that medical epistemology and stress reactions to uncertainty would be abstract or academic concepts at the beginning of the third-year clinical experience and that time, reflection, intensive clinical experience, and mentoring would provide a more meaningful context in which the students could form or solidify their beliefs in these areas. Support for our two-part hypothesis could have important educational implications.

Methods

Participants and Procedures

Eligible participants for this study included 134 third-year medical students from the class of 2010 of a

three-campus state medical school located in the southwestern United States. These students' training in medical school included typical first- and second-year basic sciences courses, as well as six 8-week third-year clerkships in family medicine, internal medicine, pediatrics, psychiatry, surgery, and obstetrics-gynecology. However, these students were also required to participate in two additional training experiences. First, this cohort completed an early clinical experience course (ECE) in each of their first 2 years of medical school (ie, ECE-1 and ECE-2). Both the ECE-1 and ECE-2 courses were designed to ease the transition from the preclinical years to the principle clinical year (ie, the third year) by introducing the ethical, cultural, psychological, and economic dimensions of clinical care through monthly group activities and personal reflections. In addition, the ECE-1 and ECE-2 courses required limited participation in ambulatory clinics, where students were assigned to master clinical teachers to learn basic skills in communication, history-taking and physical examination, and oral presentation.

Second, this cohort was required to participate in a longitudinal Continuity Clinic Experience (CCE) during their third year of medical school. The CCE took place on all three regional campuses. At each of the campuses, students met for a half-day continuity clinic and didactic session twice a month with an assigned faculty mentor from various departments or specialty practices (eg, family medicine, internal medicine, pediatrics). On two of the campuses, CCE took place in an academic medical center; on the third, a community-based clinic. Each of the CCE settings shared similar objectives and the overarching goal of providing students with an opportunity to develop patient-centered clinical skills by caring for patients over time; however, each campus was given latitude as to how this goal was to be achieved.

To help the CCE faculty assess the educational efficacy of CCE, various types of evaluation and demographic data were collected from the students via an online survey, including information on medical epistemology, stress reactions to uncertainty, gender, and specialty interest. The purpose of the data collection was explained to the students (ie, evaluation of an educational initiative), as well as the voluntary nature of providing it. These data were collected at two different times: August of 2008, shortly before starting CCE (T1), and May of 2009, shortly after completing CCE (T2). Following approval by the Institutional Review Board, these data were retrospectively de-identified and analyzed for the purposes of this study.

Measures

The students' medical epistemology and stress reactions to uncertainty were assessed using two well-validated,[5,21-23] self-report, Likert format questionnaires. Medical epistemology was measured using the Physicians' Belief Scale (PBS),[5] a 32-item measure of beliefs about the psychosocial aspect of patient care. Scores on the PBS range from 32 to 160, with lower scores indicating a biopsychosocial epistemology and higher scores indicating a biomedical epistemology.

Stress reactions to uncertainty were assessed using two sub-scales on the Physicians' Reactions to Uncertainty Scale: anxiety due to uncertainty (five items) and concern about bad outcomes (three items).[21-23] Combined, these two sub-scales measure affective, stress reactions to uncertainty. Scores on the Physicians' Reactions to Uncertainty "Stress" Scale (PRUSS) range from 8 to 48, with higher scores indicating a greater level of stress reactions to uncertainty.

Data Analysis

Analyses were conducted using SPSS (version 18, 2009, SPSS, Inc, Chicago). Demographic responses were analyzed by frequency, and descriptive statistics were calculated. To check the demographic consistency of our sample with that of the entire class of 2010, a chi-square goodness-of-fit analysis was conducted for both gender and specialty interest using de-identified demographic data from our student affairs office. These data included gender and residency Match statistics for the graduating class of 2010 and were used as the expected frequencies for the chi-square goodness-of-fit analyses. Prior research results[5,10,21-25] suggest that scores on the PBS and PRUSS may be associated with gender, specialty choice, or both. To test this finding in our sample, preliminary one-way ANOVAs were conducted at T1 and T2 to check for significant differences on these scores based on gender and specialty interest. Our primary hypotheses were tested via two regression models at both T1 and T2. The first model was a simple bivariate regression with PRUSS scores as the dependent variable and PBS scores as the independent variable, and the second model was a multivariate regression to test for the independent effect of PBS scores on PRUSS scores while controlling for gender and specialty interest.

Results

Of the 134 students, complete T1 and T2 data were available for 89 (66.4%). Demographic characteristics of the students are presented in Table 1. The chi-square goodness-of-fit analyses indicated no significant differences in distribution patterns for gender, χ^2 (1, n=89)=.08, P=.76, or specialty interest, χ^2 (2, n=89)=1.03, P=.60. The preliminary one-way ANOVAs at T1 and T2 indicated no significant differences on the PBS or the PRUSS based on gender or specialty interest (Table 2); however, given the influence of these variables in prior research, they were nevertheless included in the second T1 and T2 regression models.

Consistent with our hypotheses, the two regression models at T1 indicated no significant relationships

Table 1: Student Demographics

	CCE (Evaluation) Setting							
	AMC-1		AMC-2		CBC		Totals	
Demographic	n	%	n	%	n	%	n	%
Gender								
Male	21	63.6	15	65.2	15	45.5	51	57.3
Female	12	36.4	8	34.8	18	54.5	38	42.7
Specialty interest								
Primary care	12	36.3	9	39.2	18	54.5	39	43.8
Non-primary care, non-surgical	13	39.3	7	30.4	8	24.3	28	31.5
Surgical	8	24.2	7	30.4	7	21.2	22	24.7
Totals	33	37.1	23	25.8	33	37.1	89	100.0

CCE—continuity clinic experience
AMC—academic medical center
CBC—community-based clinic

n=89

Table 2: Mean Score Differences on the Physicians' Belief Scale and the Physicians' Reactions to Uncertainty Stress Scale

	PBS			PRUSS		
Independent Variables	M	SD	*P* Value	M	SD	*P* Value
Gender (T1)						
Male	73.49	18.20	.181	28.02	4.84	.144
Female	68.61	14.93		29.58	5.07	
Specialty interest (T1)						
Primary care	69.23	14.87	.429	29.10	3.97	.522
Non-primary care, non-surgical	74.71	19.56		28.93	6.32	
Surgical	71.05	17.05		27.64	4.69	
Gender (T2)						
Male	75.76	19.43	.118	27.59	5.48	.664
Female	69.53	16.98		27.13	3.94	
Specialty interest (T2)						
Primary care	70.00	16.48	.345	26.67	4.02	.298
Non-primary care, non-surgical	76.61	21.99		28.54	5.31	
Surgical	74.14	17.29		27.23	5.55	

PBS—Physicians' Belief Scale (Higher scores indicate a biomedical epistemology; lower scores indicate a biopsychosocial epistemology).
PRUSS—Physicians' Reactions to Uncertainty Stress Scale (Higher scores indicate more stress reactions to uncertainty; lower scores indicate less stress reactions to uncertainty).
T1—August of 2008, shortly before starting the Continuity Clinic Experience.
T2—May of 2009, shortly after completing the Continuity Clinic Experience.

n=89

Table 3: Regression Models and Coefficients for the Physicians' Belief Scale, the Physicians' Reactions to Uncertainty Stress Scale, and Demographic Variables

Regression Models	b	SE b	β	*P* Value
Model 1 (T1)				
Constant	26.88	2.26		
PBS	0.03	0.03	.09	.421
Model 2 (T1)				
Constant	26.24	2.59		
PBS	0.03	0.03	.11	.338
Female	1.62	1.19	.16	.175
Primary care	-0.33	1.33	-.03	.803
Surgical	-1.14	1.42	-.10	.424
Model 1 (T2)				
Constant	20.93	1.99		
PBS	0.09	0.03	.34	.001
Model 2 (T2)				
Constant	21.86	2.30		
PBS	0.09	0.03	.33	.002
Female	0.51	1.11	.05	.648
Primary care	-1.52	1.24	-.16	.226
Surgical	-1.09	1.32	-.09	.415

PBS—Physicians' Belief Scale
T1—August of 2008, shortly before starting the Continuity Clinic Experience
T2—May of 2009, shortly after completing the Continuity Clinic Experience

n=89

between PBS and PRUSS scores; however, the two regression models at T2 did. As indicated in Table 3, the first T2 regression model indicated a significant positive relationship between PBS and PRUSS scores (β=.34, *P*=.001), while the second T2 model, which controlled for gender and specialty interest, slightly reduced the independent effect of PBS scores on PRUSS scores (β=.33, *P*=.002). There were no other significant findings.

Discussion

This research study was an exploration of the relationship between medical epistemology and stress reactions to uncertainty among a group of medical students at the start and end of their third year. As hypothesized, our results did not indicate a relationship between these two variables at T1; however, at T2, our results indicated that a biomedical epistemology is associated with more stress reactions to uncertainty, and a biopsychosocial epistemology is associated with less stress reactions to uncertainty.

Studies from educational psychology suggest that epistemological variance may be associated with gender[26] or specific domains or fields of study.[27] Similar patterns of variation are also thought to be associated with stress.[28] Because these types of findings have generally, but not always, been replicated in studies with physician populations,[1,5,10,21-25] we were concerned that our hypothesized relationship between medical epistemology and stress reactions to uncertainty would be confounded by these variables. However, in our sample, mean comparisons for stress reactions to uncertainty and medical epistemology, at both T1 and T2, indicated no significant differences based on gender or specialty interest. Thus, the relationship between medical epistemology and stress reactions to uncertainty among third-year medical students appears to be largely unaffected by these variables.

Given a response rate of 66.4%, we were also concerned that our sample may not be representative of the entire class of 2010. However, the results of our chi-square analyses

indicated that our distribution patterns for gender and specialty interest were not significantly different from the gender or specialty match patterns of the entire class. As such, it appears that our sample is a valid representation of the entire class in terms of gender and specialty interest.

The exploratory nature of this study limits our ability to offer causal explanations about the relationship, or the development of the relationship, between epistemology and stress reactions to uncertainty among third-year medical students. However, as we originally theorized, it is possible that our results are the product of two underlying processes. First, with respect to the relationship itself, it is possible that the epistemologies are so foundationally different from one another, they lead students to experience the demands of the third-year clinical experience in fundamentally different ways. If this is true, it is not surprising that the more comprehensive and integrative epistemology (ie, the biopsychosocial model) would be associated with less stress reactions to uncertainty. Second, with respect to the development of the relationship, it is possible that students begin the third-year clinical experience with only an abstract or academic sense of medical epistemology and stress reactions to uncertainty and that time, reflection, intensive clinical experience, and mentoring provide a more meaningful context in which to form or solidify their beliefs in these areas.

Irrespective of how and why the relationship between these two variables develops, it is interesting to note the similarities between our findings in this study with those of our earlier study. In our original study with primary care physicians,[1] the relationship between medical epistemology and stress reactions to uncertainty was .30 (P=.007), while this same relationship in the present study with third-year medical students was .33 (P=.002) at T2. Although more research is needed to explore other processes or temporal factors that may influence the relationship between epistemology and stress reactions to uncertainty among third-year medical students, the small difference between these coefficients, coupled with the lack of a relationship between the two variables at the beginning of the third year of medical school (T1), suggests that the third year plays an important developmental role in the formation of students' medical epistemology and stress reactions to uncertainty.

Educational Implications

For medical educators, the results of our study suggest that the third year is an opportune time to help shape and develop students' medical epistemology and stress reactions to uncertainty. This is important for two reasons. First, as described in this paper, epistemology and stress reactions to uncertainty are attitudes or beliefs. Although the relationship between attitudes and beliefs and behavior is complex—and researchers have generally found attitudes and beliefs challenging to measure for predictive purposes[29]—prior research has demonstrated that attitudes and beliefs nevertheless have a measurable influence on behavior.[30-32] Given that the purpose of the third-year clinical experience is to help students develop a core set of clinical skills, medical epistemology and stress reactions to uncertainty represent two sets of foundational beliefs that have the potential to influence present and future clinical behavior. For example, consider the previously mentioned troublesome economic and clinical indicators (eg, increased morbidity and mortality, variability in diagnosis, and practice behavior)[15-17] associated with physician behavior in the face of uncertainty. To the degree that medical epistemology, stress reactions to uncertainty, or both drive this type of behavior, the third year represents an opportunity for medical educators to help students identify and adjust their epistemological understanding of patients and their medical problems, as well as an opportunity to help students manage their stress reactions to patients when confronted with uncertainty.

Second, there is evidence to suggest that that learners tend to uncritically adopt the prevailing epistemology of their training environment[11] and that many physicians and medical students are unaware of epistemology or how it influences clinical practice.[33,34] Collectively, these observations confirm what Engel[35] noted 3 decades ago about medical education: "How physicians approach patients and the problems they present is very much influenced by the conceptual models in relationship to which their knowledge and experience are organized. Commonly, however, physicians are largely unaware of the power such models exert on their thinking and behavior. This is because the dominant models are not necessarily made explicit. Rather, they become that part of the fabric of education which is taken for granted, the cultural background against which they learn to become physicians." Given the results of our study, the third year represents a timely opportunity for medical educators to help students critically evaluate the advantages, limitations, and *a priori* assumptions of a chosen medical epistemology, as well as provide an opportunity to think through the clinical implications that accompany an epistemological commitment.

Limitations and Future Research

The results of this study are subject to several limitations. First, the study utilized a longitudinal design and a self-report, retrospective questionnaire format to measure medical epistemology and stress reactions to uncertainty. While appropriate for our exploratory purposes, the self-report, retrospective questionnaire format is susceptible to participant distortion, and the longitudinal design may have been subject to cohort

effects. Another limitation involves the use of a convenience sample of third-year medical students from a single, three-campus state medical school who participated in two unique curricular experiences (ie, ECE-1 and ECE-2, CCE). As such, our results may not be generalizable to other student populations or to students who have not participated in similar curricular experiences.

The results of our study, as well as the methods used to obtain them, present investigators with several opportunities for future research. For example, future researchers may want to expand the time frame for assessing medical epistemology and stress reactions to uncertainty (eg, beginning of medical school through graduation) or, alternatively, assess these variables in student populations that have not participated in activities such as ECE-1, ECE-2, or CCE. In addition, future researchers may want to explore how other factors (eg, time, maturation, culture, education) affect medical epistemology and stress reactions to uncertainty among medical school students.

Conclusions

Prior research indicates that among primary care physicians, a biopsychosocial epistemology is associated with less stress reactions to uncertainty and a biomedical epistemology is associated with more stress reactions to uncertainty. The results of the present study, however, suggest that this relationship between medical epistemology and stress reactions to uncertainty likely forms during the third year of medical school. More research is needed to confirm our findings, as well as to investigate other factors or processes that affect the relationship between medical epistemology and stress reactions to uncertainty among medical students. In the interim, however, our results suggest that the third year is an opportune time for medical educators to help shape and develop students' medical epistemology and stress reactions to uncertainty.

ACKNOWLEDGMENTS: Grant support for this project was provided by the Health Resources and Services Administration, Department of Health and Human Services, Grant # D56HP08342. A poster presentation based on the data analyzed in this manuscript was presented at the Society of Teachers of Family Medicine 2010 Predoctoral Education Conference in Jacksonville, FL.

CORRESPONDING AUTHOR: Address correspondence to Dr Evans, Texas Tech University Health Sciences Center, Department of Family and Community Medicine, 3601 4th Street, Lubbock, TX 79430-8143. 806-743-1100, ext. 262. Fax: 806-743-3955. lance.evans@ttuhsc.edu.

References

1. Evans L, Trotter DRM. Epistemology and uncertainty in primary care: an exploratory study. Fam Med 2009;41(5):319-26.
2. Greco J, Sosa E, eds. The Blackwell guide to epistemology. Malden, MA: Blackwell, 1999.
3. Rosenzweig S. Paradigm reclaimed: restoring context to science in medical education. Acad Med 1994;69(9):732-3.
4. Frankel RM, Quill TE, McDaniel SH, eds. The biopsychosocial model: past, present, and future. Rochester, NY: University of Rochester Press, 2003.
5. Ashworth CD, Williamson P, Montano D. A scale to measure physician beliefs about psychosocial aspects of patient care. Soc Sci Med 1984;19(11):1235-8.
6. Main DS, Lutz LJ, Barrett JE, Matthew J, Miller RS. The role of primary care clinician attitudes, beliefs, and training in the diagnosis and treatment of depression: a report from the Ambulatory Sentinel Practice Network Inc. Arch Fam Med 1993;2(10):1061-6.
7. Levinson W, Roter D. Physicians' psychosocial beliefs correlate with their patient communication skills. J Gen Intern Med 1995;10:375-9.
8. Travado L, Grassi L, Gil F, Ventura C, Martins C, Southern European Psycho-Oncology Study Group. Physician-patient communication among southern European cancer physicians: the influence of psychosocial orientation and burnout. Psycho-Oncology 2005;14:661-70.
9. Jackson JL, Kroenke K. Difficult patient encounters in the ambulatory clinic: clinical predictors and outcomes. Arch Intern Med 1999;159:1069-75.
10. Coutts–van Dijk LC, Bray JH, Moore S, Rogers J. Prospective study of how students' humanism and psychosocial beliefs relate to specialty matching. Acad Med 1997;72(12):1106-8.
11. Williams GC, Deci EL. Internalization of biopsychosocial values by medical students: a test of self-determination theory. J Pers Soc Psychol 1996;70(4):767-79.
12. Simpson DE, Dalgaard KA, O'Brien DK. Student and faculty assumptions about the nature of uncertainty in medicine and medical education. J Fam Pract 1986;23(5):468-72.
13. Fox RC. Training for uncertainty. In: Merton RK, Reader GG, Kendall PL, eds. The student-physician. Cambridge, MA: Harvard University Press 1957:207-41.
14. Eddy DM. Variations in physician practice: the role of uncertainty. Health Aff 1984;3(2):74-89.
15. Green SM, Martinez-Rumayor A, Gregory SA, et al. Clinical uncertainty, diagnostic accuracy, and outcomes in emergency department patients presenting with dyspnea. Arch Intern Med 2008;168(7):741-8.
16. Huang IC. Self-esteem, reactions to uncertainty, and physician practice variation: a study of resident physicians. Soc Behav Personal 1998;26(2):181-94.
17. Kassirer JP. Our stubborn quest for diagnostic certainty: a cause of excessive testing. N Engl J Med 1989;320:1489-91.
18. Beresford EB. Uncertainty and the shaping of medical decisions. Hastings Cent Rep 1991;21(4):6-11.
19. Nevalainen MK, Mantyranta T, Pitkala KH. Facing uncertainty as a medical student—a qualitative study of their reflective learning diaries and writings on specific themes during the first clinical year. Patient Educ Couns 2010;78:218-23.
20. Katz J. The silent world of doctor and patient. New York: Free Press, 1984.
21. Gerrity MS, DeVellis RF, Earp JA. Physician's reactions to uncertainty in patient care: a new measure and new insights. Med Care 1990;28(8):724-36.
22. Gerrity MS, Earp JAL, DeVellis RF, Light DW. Uncertainty and professional work: perceptions of physicians in clinical practice. Am J Sociol 1992;97(4):1022-51.
23. Gerrity MS, White KP, DeVellis RF, Dittus RS. Physician's reactions to uncertainty: refining the constructs and scales. Motiv Emot 1995;19(3):175-91.
24. Bovier PA, Perneger TV. Stress from uncertainty from graduation to retirement—a population-based study of Swiss physicians. J Gen Intern Med 2007;22:632-8.
25. McLennan JD, Jansen-McWilliams L, Comer DM, Gardner WP, Kelleher KJ. The Physicians' Belief Scale and psychosocial problems in children: a report from the Ambulatory Sentinel Practice Network. J Dev Behav Pediatr 1999;20(1):24-30.
26. Clinchy BM. Revisiting women's ways of knowing. In: Hofer BK, Pintrich PR, eds. Personal epistemology: the psychology of beliefs about knowledge and knowing. New York: Lawrence Erlbaum, 2002:63-87.
27. Muis KR, Bendixen LD, Haerle F. Domain-generality and domain-specificity in personal epistemology research: philosophical and empirical reflections in the development of a theoretical framework. Educ Psychol Rev 2006;18(1):3-54.
28. Aldwin CM. Stress, coping, and development: an integrative perspective, second edition. New York: Guilford Press, 2007.
29. Eagly AH, Chaiken S. The psychology of attitudes. Fort Worth, TX: Harcourt Brace Jovanovich, 1993.
30. Glasman LR, Albarracin D. Forming attitudes that predict future behavior: a meta-analysis of the attitude-behavior relation. Psychol Bull 2006;132(5):778-822.

31. Wallace DS, Paulson RM, Lord CG, Bond CF Jr. Which behaviors do attitudes predict? Meta-analyzing the effects of social pressure and perceived difficulty. Rev Gen Psychol 2005;9(3):214-27.

32. Richard FD, Bond CF Jr, Stokes-Zoota JJ. One hundred years of social psychology quantitatively described. Rev Gen Psychol 2003;7(4):331-63.

33. Peña A, Paco O, Peralta C. Epistemological beliefs and knowledge among physicians: a questionnaire survey. Med Educ Online [serial online] 2002;7:4. Available from http://www.med-ed-online.net.

34. Peña A, Paco O. Attitudes and views of medical students toward science and pseudoscience. Med Educ Online [serial online] 2004;9:4. Available from http://www.med-ed-online.net.

35. Engel GL. The clinical application of the biopsychosocial model. Am J Psychiatry 1980;137(5):535-44.