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# Uncertainty and Liver Transplantation: Women with Primary Biliary Cirrhosis Before and After Transplant

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*Uncertainty is a frequent feature of chronic illness and can have a particularly important impact in the case of organ transplantation. This study of 100 women with primary biliary cirrhosis who were either waiting for or had already had a liver transplant focused on both changes in uncertainty with transplant and the correlates of uncertainty both pre- and post-transplant. While those who were post-transplant had significantly lower uncertainty scores (measured by the Mishel Uncertainty in Illness Scale-Adult*

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*Version-MUIS-A) than those on the waiting list, uncertainty was still persistent and associated with a reduced quality of life. The most significant factors in relation to uncertainty were fatigue, depression, anxiety, and dissatisfaction with medical information received. It is important for both patients and transplant team members to recognize the impact of uncertainty on a patient's well-being, both before and after a transplant, and to address the underlying factors that continue to compromise quality of life even after a life-saving procedure.*

*KEYWORDS* *uncertainty, transplantation, primary biliary cirrhosis*

## INTRODUCTION

Researchers describe uncertainty as a major source of stress with chronic illnesses (Mishel, 1999; Royer, 2000). This study examined the occurrence of uncertainty in a sample of women with a progressive, chronic illness—primary biliary cirrhosis (PBC)—who were either on the waiting list (WL) for or who were already post-transplant (PT). Since appropriate organs are always in short supply relative to need, uncertainty about whether one will receive an organ and recover or die waiting is a major issue for people on waiting lists. Even PT, uncertainty can continue, related to possible organ rejection and disease symptoms. We sought to understand the role of uncertainty both before and after liver transplant, its role in quality of life (QOL), and the factors that made it more problematic for some than for others.

This examination was undertaken within the context of a larger study analyzing the effects of medical, psychological, and social factors on quality of life in women with PBC pre- and post-transplant (Lasker et al., 2010). PBC is an autoimmune disease associated with genetic, infectious, and/or environmental factors that involves inflammation of the liver's small bile ducts, which may lead to cirrhosis in its final stages and then require transplantation for survival (Gershwin & Mackay, 2008). Affected individuals are usually in their fifth to seventh decades of life at the time of diagnosis, and 90% are women (Parikh-Patel et al., 1999). PBC is the second leading reason for liver transplant in women in the U.S. (OPTN online database, 2009). PBC has a more favorable transplant outcome than all other disease categories. Yet it is estimated that about 20 to 25% of patients undergoing liver transplant for PBC will develop recurrent disease over the ensuing 10 years (Sylvestre et al., 2003).

Research on uncertainty before and after transplantation is still limited. Small qualitative studies have revealed uncertainty as a predominant theme (Bjork & Naden, 2008; Brown et al., 2006; Dudley et al., 2007; Gordon, 2001; Russell & Brown, 2002; Yorke & Cameron-Traub, 2008). A number of larger quantitative studies post-transplant have shown uncertainty to be related to difficulties in adapting to the new situation (Maikranz et al., 2006; Neipp et al., 2006; Rybarczyk et al., 2007). None have compared those on WL to those who were PT and considered the factors related to uncertainty in each.

A biopsychosocial model for understanding factors related to QOL with PBC was developed based on the literature and guided survey construction and data analysis. All factors were posited to be related to QOL, the latter including health-related quality of life (HRQOL). Of note, no attempt was made to test the model as a whole; it was used for heuristic purposes to help elucidate factors associated with QOL for those living with PBC.

## BACKGROUND

### Uncertainty and Chronic Illness

Uncertainty in relation to illness occurs when one cannot assign definite values to objects and events and cannot predict outcomes accurately (Bailey et al., 2009). Mishel's (1981) work was pioneering in this area; early on, she characterized uncertainty as a psychological state resulting from an individual's inability to form a cognitive schema, which is normally created when stimuli are recognized and classified, a process that gives meaning to an event. Mishel's theory (1988) emphasized the importance of "stimuli frame"; when components of this frame, such as the severity of the illness and the unpredictability and ambiguity of symptoms, make it difficult to form a cognitive schema, they contribute to uncertainty. Researchers have shown that uncertainty can be a stressor associated with decreased QOL (Mishel, 1983, 1999; Royer, 2000) and poorer coping with symptoms (Johnson, Zautra, & Davis, 2006).

### Reducing Uncertainty

Mishel (1988) indicated that uncertainty can be lowered as a result of "structural resources," including education, health care providers who act as credible sources of confidence and authority, and social support. Some studies (Clayton, Mishel, & Belyea, 2006; Donovan-Kicken & Bute, 2008) have found that individuals with higher levels of education have less uncertainty. The availability of sufficient and reliable information reduces uncertainty (Babrow & Kline, 2000; Brashers, Goldsmith, & Hsieh, 2002; Mishel & Braden, 1988). Yet, a study of breast cancer survivors found that measures of positive communication with providers may enhance thoughts of disease recurrence while not reducing uncertainty (Clayton, Mishel, & Belyea, 2006).

Social support may reduce uncertainty by providing reassurance as well as information (Brashers, Goldsmith, & Hsieh, 2002; Donovan-Kicken & Bute, 2008; Mishel, 1988, 1999; Royer, 2000).

Increased age also has been associated with reduced uncertainty (Basevitz et al., 2008). Clayton, Mishel, and Belyea (2006) suggested that older women may have a more developed cognitive schema that allows them to understand symptoms better and, thus, reduce uncertainty associated with ambiguous stimuli.

## Uncertainty with PBC and Transplant

One of the characteristics of PBC that may contribute to uncertainty is the fact that laboratory measures of its severity are unrelated to the experience of fatigue, one of the most challenging symptoms of PBC (Cauch-Dudek et al., 1998; Sogolow, Lasker, & Short, 2008). This may make it especially difficult to predict the course or severity of the illness. At advanced stages of PBC, additional uncertainty is associated with waiting for liver transplantation, with the possibility of not having a liver in time or of rejecting it after surgery (Bjork & Naden, 2008). Adding further stress to the uncertainty of waiting for a transplant is the Model for End-Stage Liver Disease (MELD) score priority system that requires patients to become more severely ill before being competitive for transplant, while at the same time avoiding complications that would disqualify them (Brown et al., 2006; Freeman et al., 2004).

For those who have received new organs, uncertainty may be reduced, but it is not eliminated; concerns persist related to the possibility of infection, organ rejection, and recurrence of disease as well as the side effects of medications (Dudley et al., 2007; Gautam, Cheruvattath, & Balon, 2006; Rothenhausler et al., 2002; Schreibman & Regev, 2006).

## Research Questions

The current report was derived from a study of factors related to QOL in women with PBC, both WL and PT (Figure 1). We sought in the current analyses to explore the relationship of uncertainty to the other variables in that model, to identify which ones were related to greater or lesser degrees of uncertainty both before and after transplant. We were particularly interested to see if uncertainty in this sample of women with PBC was negatively correlated with age, level of education, social support, and satisfaction with information from health care providers, as suggested in prior studies with other populations. Finally, we asked whether the relationship between uncertainty and QOL varied among the different dimensions of uncertainty, represented by the four subscales of the Mishel Uncertainty in Illness Scale-Adult version (MUIS-A).

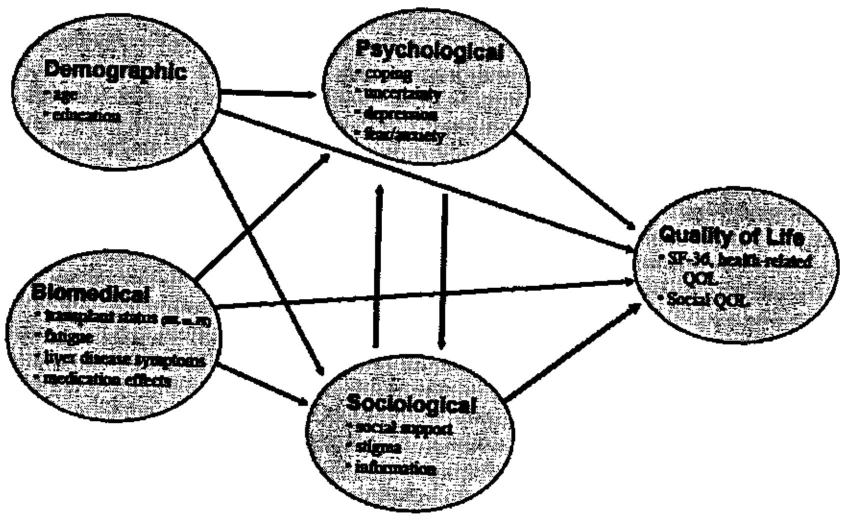

**FIGURE 1** Quality of life in primary biliary cirrhosis: A biopsychosocial model.

# METHODS

## Study Sample

Any woman who had been diagnosed with PBC and was either on a WL or PT was eligible for the study, regardless of age or date of diagnosis. Participants were recruited between 2005 and 2007 from: (1) the online PBCers Organization; (2) the University of Pittsburgh Medical Center; and (3) the University of Pennsylvania Health System. The project was approved by each of the medical school Institutional Review Boards as well as by Lehigh University's IRB (ORSP 05/86, 2/25/05) and by the Board of Directors of the PBCers Organization. Participants from the university medical centers were included to increase the number of participants and also to provide a comparison of results with online network participants, as the latter might bias results due to differences in the types of people who use the Internet or are likely to join support groups (Eysenbach & Wyatt, 2002).

The PBCers organization posted announcements about the survey on its website and on two listservs, one for all people with PBC and the other for people with PBC who were PT. Potential participants were directed to a link to the survey at www.surveymonkey.com. The organization had approximately 2,500 members at the time of the study, but not all members had PBC, and those who did were at all stages of the disease. Thus, we could not assess how many eligible participants saw these announcements and, therefore, could not determine eligibility or participation rates.

For the medical center sources, physicians identified eligible participants from their patient lists and contacted them by mail to ask them to participate. If interested, they returned a postcard to request that a copy of the survey be mailed to them or that they be called for a phone interview. They were also given the option of using a link to the surveymonkey.com site that was specific for their medical center, as it included the consent material approved by the specific center's IRB. Those participants who completed the online survey had to indicate their agreement on the consent form before being able to proceed to the survey; those who filled out a hard copy signed a consent form and mailed it with their surveys.

### Measures

The self-administered survey included standardized instruments for all of the variables in the model that were available and others developed for this study. These were the Fatigue Impact Scale (Fisk et al., 1994), the Center for Epidemiological Studies Depression Scale (Radloff, 1977), the Brief COPE (Carver, 1997), the Mishel Uncertainty in Illness Scale-Adult version (MUIS-A; Mishel, 1997), the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988), the stigma subscale from the Liver Disease Quality of Life measure (LDQOL; Gralnek et al., 2000), and the SF-36 for Health-Related Quality of Life (HRQOL; Ware, Kosinski, & Dewey, 2000). All of these measures have subscales, but for this article we used subscales only for the MUIS-A, as well as the Physical Component Summary (PCS), and the Mental Component Summary (MCS) of the SF-36. Descriptions of the measures and Cronbach's alphas for this sample are provided in Appendix A.

### Measure of Uncertainty

The MUIS-A, first published in 1981, has four subscales. Ambiguity (13 items) results when "cues about the state of illness are vague and indistinct and tend to blur and overlap." Complexity (7 items) results when "cues about treatment and the system of care are multiple, intricate, and varied." Inconsistency (7 items) results from "receiving information that either changes frequently or is not in accord with information previously received." Unpredictability (5 items) refers to a "lack of contingency between illness and treatment cues and illness outcome" (Mishel, 1997).

### Statistical Analysis

Data were analyzed using SPSS, version 16 (SPSS for Windows, 2007, SPSS Inc., Chicago, IL). Missing values were replaced using "linear trend at point" in SPSS. However, four participants did not respond to the Uncertainty measure at all, and these were excluded from the current analysis.

The MUIS-A and its subscales were compared between the two groups, WL and PT. Next, because of the expectation that the sources and nature of uncertainty would be quite different for the two groups, bivariate relationships (Pearson's $r$) between the variables in the model and uncertainty measures were analyzed for each of the two groups separately. Finally, the 12 independent variables in the model (besides Uncertainty) were entered in a stepwise multiple regression analysis to determine their relative importance in explaining Uncertainty in the entire sample. Variables were entered if their relation to Uncertainty was associated at $p < 0.05$ and removed at $p > 0.10$. To compensate for the multiple comparisons in this study, statistical significance was defined as $p = <0.01$ for all analyses. A "trend" was indicated by $p$ values of 0.01–0.05.

## RESULTS

### Demographic and Clinical Variables

One hundred women completed the survey, 25 of whom were on WL and 75 of whom were PT. The women resided in 29 different U.S. states and in several other countries, and received care at over 50 transplant centers. Seventy-five responded online, 24 by mail, and 1 person was interviewed by phone.

Of the 100 women, 68% were recruited through the PBCers website or listservs, and 32 were recruited through the university medical centers and completed the survey either by mail or online. These 32 women represented almost one-third (31.7%) of those who were sent letters by their medical centers asking them to participate. Since the PBCers were recruited through announcements on the website and on 2 listservs, response rate could not be ascertained.

Of the PBCers participants, 27.9%, compared to 18.8% of the medical center participants, were on the WL (difference not statistically significant). When examining PT participants only, those recruited through the PBCers site were younger (mean age 57.2 years for PBCers vs. 61.8 years for those participating via medical centers; $t = -2.42$, $p = .018$), but not different on any other variables in the model. Therefore, participants recruited from different sources were combined for analysis. No significant differences were observed between WL and PT women on the demographic variables.

### Reliability of Measures Used

All of the existing measures had Cronbach's alphas for this sample between .878 (LDQOL Stigma subscale) and .954 (MSPSS—Social Support). For the measure of Uncertainty, the total MUIS-A had a Cronbach's alpha of .904, and the subscales were as follows: Ambiguity, .899; Inconsistency, .825;

**TABLE 1** Comparison of Means and Standard Deviations for Scales of MUIS-A, Present Sample and Other Samples in Mishel's Data Bank

| | Ambiguity (13 items, 13–65*) | Complexity (7 items, 7–35*) | Inconsistency (7 items, 7–35*) | Unpredictability (5 items, 5–25*) | Total (33 items, 33–165*) |
|---|---|---|---|---|---|
| PBC sample WL, $N = 24$ | 39.8 (7.8) | 16.4 (3.4) | 16.7 (5.7) | 18.4 (3.3) | 91.3 (13.3) |
| PBC sample PT, $N = 72$ | 31.4 (11.3) | 15.2 (4.3) | 14.3 (5.7) | 18.0 (3.8) | 78.9 (19.3) |
| Vossler, E. Heart and kidney transplants, $N = 162$ | 26.7 (8.6) | 14.0 (3.5) | 12.2 (3.9) | 16.4 (3.5) | 69.3 (14.1) |
| Nicholson, S. Heart transplants, $N = 23$ | 32.7 (7.9) | 17.3 (3.6) | 16.3 (4.2) | 15.2 (2.8) | 81.4 (15.0) |
| Mishel's combined data for chronic illnesses, $N = 659$ | 36.0 (9.1) | 16.6 (5.0) | 15.5 (5.0) | 16.0 (4.1) | 84.2 (15.6) |

*Maximum possible range for scale.
*Source:* Mishel, 1997.

Complexity, .598; and Unpredictability, .669. The measure of Social QOL—level of involvement in family, social, and work life combined, had poor internal consistency reliability and, thus, was not evaluated further. For the current analysis, we focus on HRQOL; Social QOL is addressed in a separate paper (Lasker, Sogolow, & Rich, in preparation)

Factor analysis of the Brief COPE with the current sample, as recommended by Carver (1997), resulted in two factors that we labeled Positive Coping (alpha = .851) and Negative Coping (alpha = .730). Positive Coping included 10 of the 14 subscales, e.g., Positive Reframing, Humor, Use of Instrumental Support, and Acceptance. Negative Coping was comprised of Self-Blame, Behavioral Disengagement, Denial, and Substance Abuse.

Comparisons were made for the total MUIS-A and its four subscales for the current sample to three other studies in the data bank of uncertainty studies compiled by Mishel (1997) (Table 1). These studies were selected as most closely related to our own because they were: (a) the only studies on transplant, or (b) combined multiple studies on chronic illness. Of note, the score for the PBC PT group was within the range of scores found in these other studies for total MUIS-A and three of the subscales (Ambiguity, Complexity, and Inconsistency), while the WL score was considerably higher, as one would expect. More recent studies have shown similar results for MUIS-A scores; for example, Bailey et al. (2009) obtained a total MUIS-A mean and standard deviation of 87.3 (17.6) in a sample of people with hepatitis C. These comparisons suggest that the reliability of MUIS-A scale for this study was high.

## Comparison of WL and PT

We expected a significantly lower level of Uncertainty for those who were PT compared to those who were on WL. T-tests revealed significant differences for Ambiguity ($t = 3.36, p = .001$) and for the total scale ($t = 2.91, p = .004$) but not for Complexity, Inconsistency, or Unpredictability (Table 1).

## Factors Associated with Uncertainty

Contrary to our expectation, education, age, and social support were not significantly correlated with MUIS-A scores for either WL or PT groups (Table 2). Social Support showed only a trend toward being related to reduced Inconsistency in the PT group. Satisfaction with helpfulness of Information received while on the waiting list showed a trend of significant relationships, with more satisfaction related to less total Uncertainty, Ambiguity, and Complexity for PT; for WL, less Inconsistency improved satisfaction with Information received.

In examining the relationship between the other factors in the model and Uncertainty, we found that for those who were on the WL, Uncertainty was related to Fatigue, Depression, and Fear/Anxiety, with a trend ($p = .012$) for Stigma. For the PT group, total Uncertainty was related to Fatigue, Medication Effects, Negative Coping, Depression, Fear/Anxiety, and Stigma.

All of the 12 independent variables in the biopsychosocial model were entered in a stepwise multiple regression, with MUIS-A-Total as the dependent variable (Table 3). Four variables—Depression, Fatigue, Fear/Anxiety, and satisfaction with Information while on waiting list—were associated with Uncertainty and accounted for 58.0% of the variance. Although WL vs. PT status was entered into the equation, it proved not to be significantly related to Uncertainty once the other variables were taken into account.

## Uncertainty and QOL

The Physical Component Summary of the SF-36 was correlated only with Ambiguity both WL and PT, with significance just above the $p < .01$ criterion (Table 2). The Mental Component Summary (MCS) was significantly related to the Total Uncertainty and all subscales except Unpredictability, but only for the PT group. Hence, higher Uncertainty was, as predicted, related to a poorer QOL in this sample of women with PBC, but much more so for the mental component of QOL than for the physical component, particularly in the PT group.

# DISCUSSION

## Limitations of Study

This study had a relatively small sample, limiting the statistical power to detect other possible relationships with uncertainty as statistically significant in multivariate analysis. Yet, PBC is a relatively rare disease, and obtaining

**TABLE 2** Pearson's Correlations Between MUIS-A Scores and Demographic, Biomedical, Psychological, Sociological, and Quality of Life Factors, $N = 96$

| | Ambiguity (13 items, 13–65*) | | Complexity (7 items, 7–35*) | | Inconsistency (7 items, 7–35*) | | Unpredictability (5 items, 5–25*) | | Total Uncertainty (33 items, 33–165*) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | WL | PT | WL | PT | WL | PT | WL | PT | WL | PT |
| *Demographic* | | | | | | | | | | |
| Age | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| Education | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| *Biomedical* | | | | | | | | | | |
| Fatigue | .604, $p = .001$ | .598, $p < 0.001$ | .475, $p = .016$ | .500, $p < 0.001$ | NS | .436, $p < 0.001$ | NS | NS | .602, $p = .001$ | .611, $p < 0.001$ |
| Symptoms due to liver disease | .448, $p = .025$ | NS | NS | NS | NS | NS | NS | NS | .426, $p = .034$ | NS |
| Medication effects | NS | .345, $p = .002$ | NS | .327, $p = .004$ | NS | NS | NS | NS | NS | .343, $p = .003$ |
| *Psychological* | | | | | | | | | | |
| Positive coping | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| Negative coping | NS | .398, $p < 0.001$ | NS | .383, $p = .001$ | NS | .334, $p = .003$ | NS | NS | NS | .425, $p < 0.001$ |
| Depression | .425, $p = .038$ | .541, $p < 0.001$ | .611, $p = .002$ | .515, $p < 0.001$ | NS | .444, $p < 0.001$ | NS | NS | .633, $p = .001$ | .578, $p < 0.001$ |
| Fear/anxiety | .660, $p < 0.001$ | .568, $p < 0.001$ | NS | .491, $p < 0.001$ | NS | .332, $p = .004$ | NS | NS | .413, $p = .040$ | .558, $p < 0.001$ |
| *Sociological* | | | | | | | | | | |
| Social support | NS | NS | NS | NS | NS | −.244, $p = .038$ | NS | NS | NS | NS |
| Stigma | .410, $p = .047$ | .284, $p = .016$ | NS | .347, $p = .003$ | .407, $p = .048$ | .298, $p = .012$ | NS | NS | .503, $p = .012$ | .315, $p = .008$ |
| Information | NS | −.291, $p = .012$ | NS | −.265, $p = .023$ | −.474, $p = .017$ | NS | NS | NS | NS | −.236, $p = .044$ |
| *Quality of Life* | | | | | | | | | | |
| SF-36 Physical Component Summary | −.497, $p = .011$ | −.286, $p = .013$ | NS | NS | NS | NS | NS | NS | NS | NS |
| SF-36 Mental Component Summary | NS | −.447, $p < 0.001$ | NS | −.436, $p < 0.001$ | NS | −.449, $p < 0.001$ | NS | NS | NS | −.506, $p < 0.001$ |

*Maximum possible range for scale.

**TABLE 3** Multiple Regression of Uncertainty Total Score on Age, Education, WL/PT Status, Fatigue, Liver Disease Symptoms, Medication Side Effects, Positive and Negative Coping, Depression, Fear/Anxiety, Social Support, Stigma, and Helpfulness of Information While on Waiting List ($N = 94$)

| Uncertainty: dependent variable | Anova | Adjusted $R^2$ | Significant factors | Beta | $P$ |
|---|---|---|---|---|---|
| MUIS-A—Total | $F = 33.119$<br>$p < 0.001$ | 0.580 | Fatigue | .365 | <0.001 |
| | | | Helpfulness of Information while on waiting list | −.214 | .002 |
| | | | Fear/Anxiety total | .292 | <0.001 |
| | | | Depression | .246 | .012 |

100 participants during 2 years of intensive recruitment efforts allowed us to arrive at valuable results. Recruiting nationally for people on WL is particularly a challenge, as persons ill enough for WL may be less able to participate, which, along with the poor participation rate of those recruited from medical centers, compromised the representativeness of the sample and the generalizability of the results.

Additionally, as a cross-sectional study, we could not conclude that uncertainty would be reduced in the same people from before to after transplant, and the temporal relation of variables to uncertainty could not be assessed. A larger, more representative sample in a prospective longitudinal study would be desirable.

Finally, online recruitment, increasingly used in the study of rare diseases, has the potential for selection bias. The comparison in the current study of online recruits with participants recruited through medical centers was reassuring in that regard, although the small number of participants in each group may have not permitted detection of some differences as statistically significant. Online recruitment did yield a higher percentage of WL participants, an advantage in reaching a relatively small and very sick population. Yet no other study has used systematic validated measures to examine the role of uncertainty both before and after liver transplantation, making the findings from this study valuable in initial exploration of the importance of uncertainty in these situations.

## Key Findings

Uncertainty was significantly related to HRQOL (specifically the Mental Component Summary of the SF-36) in this study of women with PBC. This was particularly true of those who were PT. The correlational findings were less impressive for those on WL, but this was likely a result of both the small WL numbers and the higher mean and lower variability of Uncertainty scores for women on WL.

As expected, Uncertainty was significantly higher while waiting for a transplant than after, but it continued to be a concern PT, comparable to scores in studies of people with chronic illnesses (Mishel, 1997). Indeed, WL vs. PT status was not significantly related to Uncertainty in multiple regression.

Unrelated to Uncertainty, contrary to previous findings, were Age, Education, and Social Support. The latter showed a trend toward association in bivariate analyses. The lack of association of these variables may have been due to the small sample size, which inhibited our ability to detect significant differences when these variables were examined simultaneously in multivariate models. It may also be due to the low variability in this sample. The women were mostly in their 50s and 60s, and the requirements for qualifying for transplantation favor those who are more educated and have good systems of support. However, helpfulness of information while on WL was associated with reduced Uncertainty in multivariate analysis.

The most important variables in differentiating levels of Uncertainty in bivariate and multivariate analyses were the Physical variables (especially Fatigue and Medication Effects), Psychological variables (Depression, Negative Coping, and Fear/Anxiety), and the helpfulness of Sociological variables of Stigma and Information.

## MUIS-A Subscales

Ambiguity was the only subscale that significantly differentiated between WL and PT participants; indeed, it correlated very highly with the total scale ($r = .927, p = .000$). It is possible that those who were feeling depressed and were anxious and fatigued found it more difficult to interpret information, and, thus, found it more ambiguous.

The Unpredictability scale, in contrast, did not correlate with any other variables in the model, and it also had the lowest internal reliability consistency (alpha = .670) and lowest correlation with the total scale ($r = .235$, $p = .021$). Yet, it was the set of statements with which participants were *most* likely to agree—an average per item score of 3.6 out of a maximum of 5.0, compared to 2.6, 2.2, and 2.1 for the Ambiguity, Complexity, and Inconsistency scales, respectively. The score for the Unpredictability subscale was also higher with the PBC sample, both WL and PT, than in all the comparison studies (Table 1). It is possible that Unpredictability was so frequently experienced in this population that a ceiling effect occurred, explaining the lack of results in bivariate analyses; in fact, results for Unpredictability had the least amount of variance of any of the subscales and the Total score. Much of the information needed to predict outcomes while on the WL is not available to patients, so it is not surprising that Unpredictability would be very high for this group; nevertheless, it is notable that it was just as high for the PT group.

## Reducing Uncertainty

The four factors significantly associated with Uncertainty in multivariate analysis—Fatigue, Depression, Fear/Anxiety, and helpfulness of Information while on waiting list—accounted for 58% of the variance of Uncertainty and demonstrated the relationship of a patient's physical and mental health as well as social interactions with health professionals to her level of uncertainty. Conversely, the uncertainty that is inherent in the condition of having a chronic and potentially fatal illness may lead to greater depression and fear and anxiety about the future. Further research should explore the extent to which physiological and emotional manifestations of illness affect uncertainty, and vice versa, as well as the extent to which specific types of information can reduce the harmful effects of uncertainty.

The role of information in relation to uncertainty is complex (Clayton, Mishel, & Belyea, 2006). Health care providers supplying patients with information on the cause, intensity, and duration of symptoms can enable them to develop a cognitive schema, yet too much information might increase uncertainty, because the information can be overwhelming and difficult to understand (Babrow & Kline, 2000). Additionally, uncertainty may be more desirable than certainty regarding a negative outcome; *maintaining* a level of uncertainty can help people with chronic illnesses preserve hope (Brashers, Goldsmith, & Hsieh, 2002; Cohen, 1993; Folkman, Schaefer, & Lazarus, 1979; Holmes & Houston, 1974; Mishel, 1988).

Indeed, Mishel (1999) proposes reconceptualizing the idea of uncertainty as something that patients can integrate into their daily lives, turning it from a deficit to a source of valuable personal growth. To realize such a feat, patients need health care professionals who will provide the level of information desired by their patients and also pay greater attention to the psychological and physical qualities that appear to contribute most to uncertainty. Efforts to diminish fatigue, depression, and anxiety are critical to alleviating uncertainty and improving overall quality of life (Lasker et al., 2010).

Uncertainty must be recognized as a persistent and complex problem, one that has the potential to act as a significant psychological stressor, particularly in a cultural environment that favors predictability and control (Mishel, 1990). This acknowledgment and the active efforts of health care providers are especially important in today's health care system, which remains ill-adapted to serve the chronically ill (Royer, 2000).

The persistence of uncertainty after transplant is an important finding because of the frequent expectation that a transplant will result in a return to a normal QOL, which we have found not to be the case (Lasker et al., 2010). Other recent studies also have indicated the persistence of uncertainty over long periods of time, even after life-saving procedures (Martin et al., 2010; Mauro, 2010).

Uncertainty management programs (Gil et al., 2006) can be effective in enhancing coping and improving well-being. Further research on such interventions may identify informational and symptom management strategies that are most effective in helping women cope with the challenges of transplantation.

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**APPENDIX A** The Model and Measurements Used*

| Category | Measure | Description and maximum potential range of scores | Source | α (Cronbach's alpha) |
|---|---|---|---|---|
| *Demographic* | | | | |
| Age | Self-report | Calculated from date of birth and date of survey | | |
| Education | Self-report | High school or less, some college, college graduate, post-college | | |
| *Biomedical* | | | | |
| Transplant status | Self-report | Waiting list or post-transplant | | |
| Fatigue | Fatigue Impact Scale | 40 items, 5-point scale from 'no problem' to 'extreme problem'; 0–160 | Fisk et al., 1994 | .989 |
| Total symptoms | Self-report | 8 items—ascites, bleeding problems, encephalopathy, fatigue, itching, leg swelling, osteoporosis, varices. Check those experienced in last 60 days; 0–8 | Derived from the NIDDK-QA instrument: Friedman, Keeffe, and Schiff, 2004; Kim et al., 2000 | .801 |
| Medication Effects | Self-report | 17 items—agitation, anemia, difficulty concentrating, depression, diabetes, diarrhea, fatigue, headaches, insomnia, kidney disease, short- and long-term memory loss, nausea, neuropathy, osteopenia/osteoporosis, pain, weight change. Check those experienced in last 60 days; 0–17 | *Physicians' desk reference (PDR)*, (2003) for side-effects of medications most commonly used pre- and post-transplant | .796 |
| *Psychological* | | | | |
| Coping | Brief COPE Scale | 14 scales, 2 items each, indicating frequency of using different coping styles, 4-point scale from 'I haven't been doing this at all' to 'I've been doing this a lot.' Factor analysis produced 2 scales:<br>Positive coping, 10 scales, 20–80<br>Negative coping, 4 scales, 8–32 | Carver, 1997 | .849<br>.726 |
| Uncertainty | Mishel Uncertainty in Illness Scale—Adult version | 33 items, 5-point scale, 'strongly disagree' to 'strongly agree' with 'undecided' mid-point; 33–165 | Mishel, 1997 | .836 |
| Depression | CES-D | 20 items, rated on 4-point scale from 'rarely or none of the time' to 'most or all of the time'; 0–60 | Radloff, 1977 | .739 |
| Fear/Anxiety | Measure created for current study | Total score for 5 items—rate level of anxiety/fear about not obtaining a liver when needed, infection, rejection, pain, and death. 3-point scale from 'very anxious/fearful', 'somewhat', or a 'little/not at all'; 5–15 | | .877 |
| *Sociological* | | | | |
| Social Support | Multidimensional scale of perceived social support | 12 items, 7-point scale from very strongly disagree to very strongly agree with neutral mid-point; 12–84 | Zimet et al., 1988 | .954 |
| Stigma | LDQOL stigma subscale | | | |
| | Berger HIV stigma scale, adapted | 6 items from liver disease quality of life measure, 5-point scale, strongly disagree to strongly agree with neutral mid-point; 6–36<br>40 items, 'HIV' changed to 'liver disease' and question on others' perception of substance abuse added, 4-point scale from strongly disagree to strongly agree; 40–160 | Gralnek et al., 2000<br>Berger, Estwing-Ferrans, and Lashley, 2001 | .878<br>.960 |
| Information | Measure created for current study | How helpful was information received from health care personnel while on waiting list? 4-point scale from very unhelpful to very helpful; 1–4 | | |
| *Quality of life* | | | | |
| Health-related QOL | SF-36 | 36 items, 8 subscales and 2 summary scales; 1–100 for each scale | Ware, Kosinski, and Dewey, 2000 | |
| Social QOL | Measure created for current study | 3 items, rating of activity levels in social, work, and family life, 5-point scale from very low to very high for each domain. Asked for before illness, while on waiting list, and after transplant; 1–5 for each domain at each time. | | .440<br>Without work:<br>.695 |

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*All scores are based on summing of all the individual items; the exception is the two coping measures, which was derived from the factor analysis of the items, then the summing of scores for all items in each factor. Higher total scores always refer to a greater presence of the construct, e.g., more fatigue, more anxiety, better quality of life.

**For the purposes of the present report, we include only the analyses for the two summary scores, the Physical Component Summary and the Mental Component Summary. More detailed results are available upon request to authors.