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**Psychosocial Factors, Intentions to Pursue Arteriovenous Dialysis Access, and Access Outcomes: A Cohort Study**

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## Abstract

**Rationale & Objective:** Suboptimal dialysis preparation of patients with chronic kidney disease (CKD) is common but little is known about its relationship to psychosocial factors. This study aimed to assess patients' attitudes about access creation and to identify factors associated with patients' intentions regarding dialysis access creation and outcomes.

**Study Design:** Prospective cohort study.

**Setting & Participants:** 190 patients with CKD stage 4 or stage 5 not receiving dialysis treated at two hospitals in Singapore and 128 of their family members.

**Predictors:** Self-reported measures of illness perception, health-related quality of life, and attitudes toward access creation. Socio-demographic and clinical measures were also obtained.

**Outcome:** Intention to create an arteriovenous fistula (AVF) (*proceed with access vs. wait and see*) and time to creation of a functional AVF.

**Analytical Approach:** Exploratory factor analysis (EFA) was undertaken to construct internally consistent subscales for a newly developed questionnaire about attitudes toward access creation. Logistic regression and cause-specific hazards models were conducted to identify psychosocial factors associated with patients' access creation intentions and access outcomes, respectively.

**Results:** EFA (explained 50.1% variance) revealed 4 domains: access and dialysis concerns, need for dialysis, worry about cost, and value of access. A high risk of intention to delay access creation (51.1%) was found among patients despite early referral and education. Multivariable analysis ( $R^2=.45$ ) showed that the intention to proceed with access creation was associated with greater perceived value from access (OR=2.61, 95% CI=1.46–4.65,  $p<0.001$ ).

**Limitations:** Limited generalization as only those already in pre-dialysis care were studied

**Conclusions:** Approximately half of the patients studied planned to delay access creation.

The questionnaire developed to evaluate attitudes about access creation may help identify individuals for whom decision support programs would be useful. These findings highlight the need to understand and address patients' concerns about access creation.

**Index words:** vascular access; pre-dialysis; psychosocial factors; attitudes; renal replacement therapy; chronic kidney disease (CKD); arteriovenous fistula (AVF)

## **Quantifying Perceptions Towards Hemodialysis Preparation Among Pre-Dialysis**

### **Patients**

Many patients start hemodialysis with temporary vascular access despite regular kidney care and pre-dialysis education. Delay is often related to patient choice but research on patients' perspectives is limited and no measure of attitudes towards hemodialysis preparation presently exists. In this study, we surveyed pre-dialysis patients and their family members about their perceptions of CKD and their intentions to undergo access creation. We also report on a new survey instrument to measure attitudes towards hemodialysis preparation. Domains covered in the instrument included perceptions about the value of vascular access as well as concerns including about the need for dialysis and costs. Beliefs about value of vascular access predicted patients' intentions to prepare for hemodialysis as well as their access outcomes.

## Introduction

A growing concern in chronic kidney disease (CKD) care is patient delay in decision-making about renal replacement therapies (RRT) and urgent initiation on hemodialysis without a permanent access (1, 2). Clinical CKD practice guidelines recommend that patients engage in early preparation of an arteriovenous fistula (AVF) as permanent vascular access for hemodialysis (3). AVF use as opposed to central venous catheter (CVC) use is particularly important given its associations with better clinical outcomes and reduced health costs (4). However, despite the evidence in support of timely access creation and ensuing improvements in early referral and accessibility of pre-dialysis care, rates of suboptimal hemodialysis initiation (i.e., unplanned initiation with CVC) remain alarmingly high worldwide such as 57% in the United Kingdom and 80% in the United States (5, 6).

Individual- and system-level factors determine when and how patients make renal care decisions. System-level factors such as late referral to renal care or scheduling delay for surgical review and access creation are important barriers. Yet these alone cannot fully explain the high rates of suboptimal initiation for those already in renal care and exposed to pre-dialysis education (7, 8). Individual beliefs and attitudes as outlined in theoretical frameworks [i.e., health belief model (9) and the common sense model of illness representations (10)] appear to play a key role in treatment decision-making.

Decisions around dialysis (i.e., opting for dialysis, choosing between modalities, and access preparation) are inherently difficult and characterized by decisional conflict (11). Qualitative studies have identified attitudes towards CKD and treatment potentially implicated in decision-making. These include perceived effectiveness of dialysis, fear of dialysis, concerns with fistula, and attribution of symptoms to non-CKD causes (12-14). The importance of these cognitive and affective factors warrants greater attention to elucidate their potential contributions to CKD decision-making.

Although qualitative retrospective work has identified important constructs related to patients' personal understanding of disease and treatment, limitations remain (13-15).

Qualitative findings do not examine the strength of associations between variables and health behaviors; retrospective data is open to recall bias and may not generalize to CKD patients at the point that decisions about dialysis/access are made. Additionally, no validated tool is presently available to assess attitudes towards dialysis and access despite evidence in other patient populations supporting the role of treatment-specific attitudes in patient behavior (16).

Understanding the key psychosocial factors associated with dialysis access creation behaviors and constructing a measure to quantify them is important as these are modifiable targets for intervention. To address these gaps, this study aims to (a) develop a tool to measure attitudes towards dialysis access creation, and (b) identify factors that explain patients' access creation intentions and outcomes among a set of theory- and evidence-informed parameters.

## **Methods**

### **Participants**

Eligible patients and their family members were recruited between 2016 to 2019 from outpatient renal clinics at two hospitals in Singapore based on several criteria: (a) patients or family members of patients with Stage 4 or 5 CKD not on RRT, (b) in renal care and attended at least one renal counselling session for dialysis preparation in the preceding 3 months (patients only), (c) aged 21 years and above and (d) literate in English, Mandarin or Malay. Exclusion criteria included patients, and family members of patients already on RRT, opted for conservative management, and an inability to provide consent and complete assessments due to cognitive or language impairment. Renal healthcare providers identified potential participants for recruitment. Study was approved by the respective Institutional Review



Boards (NHG DSRB (Ref.: 2015/01225) and SingHealth CIRB (Ref.: 2016/2979)). All participants provided written informed consent.

### **Study Data**

**Dialysis Access Attitudes Questionnaire (DAAQ).** Drawing upon the PROMIS framework (17), we developed and evaluated the DAAQ in a 6-part iterative process. Steps 1 to 4 were undertaken prior to this study (2016 to 2018) and informed the development of initial DAAQ item pool: (1) literature review, (2) qualitative interviews, (3) instrument review and item screening by experts, (4) cognitive pre-test with patients and family members. The literature review (including validated survey tools and published works) was conducted to identify existing questionnaires and scope out key issues related to access creation, dialysis initiation, and decision-making for RRT using the following keywords: *access, creation, vascular, fistula, barriers, facilitators, beliefs, perceptions, patient(s), treatment delay, hemodialysis, renal replacement therapies, decision making, survey, and questionnaire.* Vascular access instruments identified focused on the impact of access already in place (i.e., symptoms, quality of life) or access self-care and were intended for use with patients already on hemodialysis with AVF or CVC (18-21). No instrument measuring dialysis access attitudes, relevant to access-related decision-making behaviors prior to RRT initiation was found. Items were compiled based on this review and dialysis access surveys used in prior studies. Qualitative data from interviews with  $n=96$  CKD patients, family members and renal healthcare providers was used to expand the item pool to  $k=35$  for testing (22). Screening for relevance, clarity, and redundancy by three renal experts, one researcher and one patient representative eliminated eleven items. Step 4 comprised a cognitive pre-test with five patients and two family members to assess item comprehension (i.e., ease of understanding, wording ambiguity and face validity). Three additional items were dropped, resulting in a

preliminary 21-item version of the DAAQ. Content was modified to achieve a target Grade 6 reading level.

DAAQ items assessed symptom attribution, perceived necessity of dialysis and access creation, and perceived benefits and barriers related to access. Example items include “*I worry about the effects of having the fistula/ PD [peritoneal dialysis] catheter on my everyday life*” and “*I see several advantages/benefits of preparing the fistula early*”. Items presented to family members were suitably modified with *I* or *my* substituted for *the patient* (e.g. *I worry about the effects of having the fistula/ PD catheter on the patient’s everyday life*) to elicit their views on access. The items assessed family members’ own perspectives rather than as a proxy for patients. All items were rated on a 5-point Likert scale (1=*strongly agree*, 2=*agree*, 3=*neutral*, 4=*disagree*, 5=*strongly disagree*). Step 5 involved survey administration of the preliminary 21-item DAAQ, followed by factor analysis for the final DAAQ refinement and dimensionality. Step 6 involved evaluation of criterion validity of this final DAAQ itemset against study outcomes.

**Clinical and socio-demographic variables.** Data on socio-demographic and clinical characteristics were obtained. Participants reported on gender, age, ethnicity, relationship status, employment status, and household income levels. Family members’ relation to the patient and whether the family member was the primary caregiver were noted. Patients’ medical records were reviewed to collate information on laboratory values and estimated glomerular filtration rate (eGFR) using the IDMS-traceable 4-variable MDRD Study equation (23), and details of nephrology care (i.e., referral date, number of RRT counselling sessions with renal coordinator). Comorbid burden was measured with the age-adjusted Charlson Comorbidity Index (24), in which higher scores indicate greater burden.

**Illness perception.** The Brief Illness Perception Questionnaire [BIPQ (25)] was used to measure CKD illness perceptions: Consequences, Timeline, Personal Control, Treatment

Control, Identity, Concern, Coherence, and Emotional Representation. Each item was scored on a scale with a range 1-10. BIPQ has been shown to have good psychometric properties and used with renal patients (25, 26). As recommended by authors and widely implemented in prior applications, items were made disease-specific by replacing the term *illness* with *kidney disease* (25, 26).

**Health-related quality of life (QOL).** Health-related QOL was measured using the Kidney Disease Quality of Life Short Form (KDQOL-SF) comprising five kidney disease-specific domains (i.e., Symptom burden, Effects of Kidney Disease, Burden of Kidney Disease, Patient Satisfaction, and Staff Encouragement), and the SF-12 (i.e., General Health, Physical Functioning, Physical Role Limitation, Emotional Role Limitation, Emotional Well-Being, Bodily Pain, Vitality, and Social Functioning). Standard scoring methods (27, 28) were used to compute subscale scores and the derived composite scores (i.e., Physical Component Summary and Mental Component Summary) ranging from 0 to 100. Higher scores indicated better QOL.

**Study outcomes.** Primary outcomes were intention and timely creation of functional AVF. Intention was measured with a single dichotomous item where respondents self-reported their intention regarding access creation (*proceed with access* vs. *wait and see*). Access creation events (i.e., AVF creation; type of access and modality on RRT initiation), censoring events (i.e., loss to follow up and end of follow up), and competing events (i.e., hemodialysis initiation with CVC, modality change and death) were extracted from medical records during the study observation window (i.e., study entry to March 2020). Hemodialysis initiation with CVC was considered a censoring event as it signaled suboptimal initiation onto hemodialysis. Patients with low eGFR levels ( $<10$  mL/min/1.73 m<sup>2</sup>) at point of AVF surgery and whose AVF creation shortly preceded hemodialysis initiation with a CVC were

considered to not have created a functional AVF in time. Access outcomes for patients of the family member participants were not recorded unless patients too had enrolled and consented.

### **Statistical Analyses**

A quantitative evaluation of the newly developed DAAQ was conducted to establish reliability and factorial integrity. Exploratory factor analysis (EFA) using Promax rotation was performed to derive factor structure of the DAAQ based on an eigenvalue >1 cutoff and scree plot. EFA was based on complete data cases with no missing data imputation. Data were screened for factorability based on the Kaiser-Meyer-Olkin (KMO) measure, Bartlett's test of sphericity, and anti-image correlational matrix. Mean subscale scores were computed based on final factor loadings. Internal consistency was assessed using Cronbach's alpha. Items with unclear factor loading patterns (i.e., primary loading <0.4 with cross-loading >0.3) and low communalities were eliminated. Item-total correlations were computed within each subscale and items were dropped if they had low values and their elimination led to a moderate increase in Cronbach's alpha. EFA were run on combined patient and family member dataset to ensure that it can be administered to both groups. This was guided by the qualitative work for DAAQ on the role of family input on access-related decisions. Confirmatory factor analyses (CFA) were run on patient data alone to confirm factorial structure of DAAQ.

Unadjusted and adjusted logistic regressions were conducted to identify predictors of patients' intentions towards access creation. Unadjusted and adjusted odds ratios (OR), 95% confidence intervals (CI) and Nagelkerke pseudo  $R^2$  were reported. Nagelkerke  $R^2$  indicates the goodness-of-fit of the model to the data, with higher values indicating better fit (29). ORs of 1.5, 2.5, and 4 indicated small, medium, and large effect sizes respectively (30). Tolerance was computed, whereby a value <0.2 suggests no issue with multicollinearity (31). Time-to-event was measured from baseline assessment to one of the following: outcome of interest (i.e., functional AVF creation/hemodialysis with AVF), death, initiation on PD, initiation on

hemodialysis with CVC, loss to follow-up or end of follow-up (March 2020). Cause-specific hazards models, where the competing events were treated as censoring, were used to estimate hazard ratios (HR) and their 95% CI. Multivariable models were constructed as follows: socio-demographic and clinical variables in block 1 to control for known and potential confounds (7, 8) followed by selected psychosocial variables in block 2 (using likelihood ratio tests with significance level of  $p < 0.05$  in each unadjusted model). DAAQ domains were included in block 2 to assess their contribution to prognostication of AVF creation outcomes.

In sensitivity analyses, the univariate associations between family members' DAAQ with their own intentions, as well as patient study outcomes (intentions and access creation) were examined. For patient outcomes, sensitivity analyses were possible only for consenting dyads. Multivariable analysis was not conducted due to small numbers of consenting dyads. All analyses were conducted using IBM SPSS V.25 with an alpha level of 0.05.

## **Results**

### **Study Sample**

Of the 335 patients and 165 family members ( $n=500$ ) approached, 190 patients (56.7%) and 128 family members (77.6%) consented to participate ( $n=318$ , 63.8%). Those who declined participation most often cited lack of interest or willingness to discuss dialysis. A small proportion ( $n=45$ ) were deemed ineligible due to inability to consent due to confusion, limited comprehension or language, frail health, and planning for conservative management or renal transplant. Fifty-eight patients (30.5%) had another family member in the study (see Table 1). Mean age of patients was 62.8 years (standard deviation ( $SD$ )=10.8), higher than family members' mean age of 48.1 years ( $SD$ =14.2). Most family members were the patient's children or spouse and identified themselves as the primary caregiver.

### **Psychometric Evaluation and DAAQ Dimensionality**

The preliminary  $k=21$  items were administered to patients and family members in this study. Three patient-specific items, one PD-related item and one item that was phrased differently in patient and family member questionnaires were excluded from the EFA. The remaining  $k=16$  items that assessed perceptions of hemodialysis and were presented to both patients and family members were identified for the EFA. Sixty-three patients and 29 family members with missing data on DAAQ items were not included in the EFA. This mainly comprised those who only considered PD.

Complete DAAQ datasets of 127 patients and 99 family members were used in the EFA to derive the final DAAQ factor structure. Diagnostic criteria for factorability were met. EFA identified four factors accounting for 50.1% of the total variance (see Table 2 for final factor loadings and other statistics). Four extraneous items with low item-total correlations  $\leq 0.28$  were eliminated to obtain a final set of  $k=12$  items. Factor 1, *Access and Dialysis Concerns* comprised five items that measured concerns regarding the procedure, side-effects and outcome of access creation. Two items that loaded onto Factor 2, *Worry about Cost*, assessed financial concerns surrounding access creation and dialysis. Three items that loaded onto Factor 3, *Need for Dialysis*, probed respondents' perceived necessity of dialysis treatment. Factor 4, *Value of Access*, comprised two items that assessed perceived benefits of early access creation. All factors had acceptable internal consistency. Mean scores ranged from 1 to 5; higher scores denoting greater concerns about access and financial costs, stronger beliefs in need of dialysis, and higher perceived value of access creation. A four-factor CFA conducted on patient dataset alone yielded similar loading patterns.

### **Factors Associated with Patients' Access Intentions**

We focused on patients' access intentions as access creation procedures cannot be initiated without patient consent. Therefore, only patients' data ( $n=190$ ) are included in all

subsequent analyses. Ninety-three (48.9%) patients indicated an intention to proceed (“access intention”) while  $n=97$  (51.1%) indicated an intention to delay.

Table 3 presents results from the unadjusted and adjusted models with access intention as the outcome. Univariate analyses indicated significant associations between access intentions with Need for Dialysis (OR=2.05, 95% CI=1.54–2.72), Value of Access (OR=2.14, 95% CI=1.55–2.97), Timeline (OR=1.17, 95% CI=1.06–1.30), Consequences (OR=1.14, 95% CI=1.04–1.25), Emotional Representation (OR=1.10, 95% CI=1.01–1.20), and several QOL domains. No socio-demographic or clinical variables emerged statistically significant.

Multivariable analyses revealed that eGFR, Value of Access, Emotional Representation, General Health and Patient Satisfaction were independent predictors of access intention. The final model was significant comparing with the null model,  $\chi^2(11)=54.06$ ,  $p<0.001$ . No issues with multicollinearity were observed. Higher odds of access intentions were reported in patients with lower eGFR (OR=0.84, 95% CI=0.75–0.95), higher Value of Access (OR=2.61, 95% CI=1.46–4.65), lower General Health (OR=0.96, 95% CI=0.96–0.99), greater Emotional Representation (OR=1.18, 95% CI=1.02–1.36), and higher Patient Satisfaction (OR=1.03, 95% CI=1.01–1.05).

Sensitivity analyses on family members’ DAAQ data showed similar associations: Need for Dialysis and Value of Access had significant associations with own (self-reported) access intentions in unadjusted models. Family members’ perceived need for dialysis was also associated with patient-reported access intentions (see Table S1).

### **Factors Associated with Patients’ AVF Creation**

Within the study observation window (Median=19, Interquartile range (IQR)=5, Mean=18.3, SD=3.1 months),  $n=45$  had placed AVF access (of which  $n=33$  had subsequently started hemodialysis with functioning AVF), and remaining competing events were censored as follows: initiated on hemodialysis with CVC ( $n=66$ ; including  $n=12$  who had placed fistula

at low eGFR with subsequent hemodialysis initiation at Mean=1.25, Median=1, *SD*=1.42 months), started on PD (*n*=35); died before RRT initiation (*n*=10); loss to follow-up (*n*=11), or pending outcome that included patients who opted for PD (*n*=9), those who opted for conservative non-dialytic management (*n*=2), undecided or with stable renal markers with hence no care-directive for access creation (*n*=12).

In univariate cause-specific hazards models, lower eGFR (HR=0.90, 95% CI=0.84–0.97), higher Value of Access (HR=1.77, 95% CI=1.21–2.58), higher scores in four BIPQ domains (all HR ranged from 1.13–1.21) and lower QOL in three domains (all HR ranged from 0.95–0.98) were associated with increased risk of timely and functional AVF creation. Table 4 shows the unadjusted and adjusted HR. In the multivariable model adjusting for sociodemographic and clinical parameters (final model  $\chi^2(11)=45.10$ ,  $p<.001$ ), Value of Access (HR=1.60, 95% CI=1.06–2.42), and Consequences (HR=1.25, 95% CI=1.08–1.45) remained significant predictors of AVF creation together with eGFR (HR=0.87, 95% CI=0.79–0.96). QOL parameters were not reliably associated with AVF outcomes as shown by 95% CIs (see Table 4). No issues with multicollinearity were observed.

### **Discussion**

Significant efforts have been invested to address late referral to renal care and improve access to pre-dialysis education. Nonetheless the rates of suboptimal initiation onto RRT are insistently slow to decline. Delay intentions were found to be dominant even among those already in renal care. Although patients in our study had attended one or more renal counselling sessions on RRT, majority preferred to delay access creation (51.1%) and initiated onto hemodialysis with CVC, replicating trends from other reports (1).

While the role of patient beliefs in health-related decision-making has received strong theoretical and empirical support in other patient populations (32), these have not been systematically examined in CKD and no instrument specifically assesses beliefs about



dialysis access. To bridge this gap, the DAAQ was developed through a systematic process of literature review, content-expert review, qualitative research, pilot testing, and psychometric testing. Factor analysis identified four domains: Access and Dialysis Concerns, Need for Dialysis, Worry about Cost, and Value of Access. The domains align to constructs in health behavior theories (9, 33).

Importantly, DAAQ domains were shown to have predictive value for access intention and creation outcomes in the ensuing 19 months. Univariate analyses indicate that both Need for Dialysis and Value of Access were significantly associated with access intentions. Treatment-related decisions typically involve balancing risks against perceived necessity and anticipated gains (34). In the multivariable model, Value of Access remained a significant predictor. Furthermore, high threat (indexed by low kidney function, worse general health perceptions and more negative emotional response) coupled with higher patient satisfaction fosters intention to prepare access. Given that dialysis initiation is seen as a threatening prospect (15, 35), emphasizing the positive outcomes afforded by timely access creation may help mitigate emotional threat and concerns. Without this emphasis, education efforts may become counterproductive as patients may adopt unhelpful coping strategies that interfere with treatment activation such as denial or defensive avoidance (36).

For AVF creation, significant prognostic associations for perceived benefits of access and consequences suggest that patients may feel more compelled to proceed with AVF creation when they recognize both the negative impact of their CKD on their lives and the benefits of early access preparation. Balancing negatively- and positively-framed information (i.e., consequences of delay vs. benefits of timely preparation) has been shown to influence and instill confidence in decision-making in other health contexts (37). Value of Access was observed to associate with both access intentions and timely AVF creation in multivariable analyses. Perceptions of benefit have been highlighted in several behavioral change models

(i.e., the transtheoretical model) as a key driver for developing and sustaining readiness to progress from ambivalence to activation (38).

Study limitations should be noted. Although observed associations provide support for the criterion validity of DAAQ, study design precludes causal inferences. Findings are limited to those attending pre-dialysis care and may not be generalizable to those who defaulted on appointments or declined study participation. It is possible that these groups have weaker inclinations towards dialysis preparation. Selection biases were likely to be minimal given a fairly good response rate and that ethnic and gender proportions of the patient sample closely resembled the national renal population (39). The specific healthcare system in which study findings are embedded in may influence patient decisions, limiting its generalizability to other healthcare contexts.

The development of the DAAQ to quantify attitudes towards dialysis access offers clinicians a tool to elicit key perceptions towards access creation and guide conversations about dialysis access. The concerns identified could serve as individualized targets for pre-dialysis education and decision-support interventions, while clinicians may leverage on identified benefits to bolster confidence in decision-making. Still, we note that is the first validation study on DAAQ. While findings support its relevance for patients and clinicians in our study, more research is needed to cross-validate the DAAQ in other renal settings. More work is also needed to establish test-retest reliability, minimally important clinical differences or responsiveness of DAAQ domains to disease progression, or aspects of pre-dialysis education (i.e., exposure, content, or providers). Patients' attitudes about access may be influenced by variation in effectiveness of providers in delivering the standard content of pre-dialysis education but this was not assessed or controlled for in this study.

Much research on dialysis-related decision-making has focused on the retrospective assessment of patients already on dialysis. Less is known about pre-dialysis patients currently

faced with the impending decision regarding dialysis. The present study built on existing research through the development and preliminary validation of a measure of attitudes towards dialysis access and assessed psychosocial factors predictive of dialysis access intentions and outcomes in pre-dialysis patients. Several psychosocial risk and protective factors were identified. Study findings have important implications for the design of interventions to address concerns about access creation and for structuring patient centered RRT counseling sessions.

### **Article Information**

Authors' contributions: Research conceptualization and study design: KG, TY-YS; data acquisition: PSS, ZSG, JMXC; data analyses/interpretation: KG, JMXC, ZSG; supervision or mentorship: KG, TY-YS, JCJC, MF, SN. Each author contributed important intellectual content during manuscript drafting or revision and agrees to be personally accountable for the individual's own contributions and to ensure that questions pertaining to the accuracy or integrity of any portion of the work, even one in which the author was not directly involved, are appropriately investigated and resolved, including with documentation in the literature if appropriate.

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Table 1  
*Participant Socio-demographics and Clinical Profile*

<b>Characteristics</b>	<b>Patients (n = 190)</b>	<b>Family members (n = 128)</b>
<b>Age in years, Mean <math>\pm</math> SD</b>	62.8 $\pm$ 10.8	48.1 $\pm$ 14.2
<b>Gender—female (%)</b>	41.1	65.6
<b>Ethnicity (%)</b>		
Chinese	60.0	63.3
Malay	27.9	27.3
Indian	8.4	5.5
Others	3.7	3.9
<b>Employment status (%)</b>		
Employed	37.9	71.9
Retired	40.0	8.6
Unemployed but jobseeking	11.1	4.7
Others (including homemaker)	1.1	12.5
<b>Work Ability (%), missing data n=2</b>		
Able to work full time	34.7	78.9
Able to work part time	17.9	7.0
Unable to work	47.4	12.5
Missing data	-	1.6
<b>Monthly Household Income (%), missing data n=4</b>		
Below \$2,000	38.4	19.5
\$2,000 to \$4,999	21.6	31.3
\$5,000 to \$9,999	11.1	20.3
\$10,000 to \$17,999	6.8	7.8
\$18,000 and above	2.1	3.9
Do not know/do not wish to answer	15.3	17.2
Missing data	2.6	-
<b>Relationship Status (%)</b>		
Married or engaged	71.1	70.3
Divorced or widowed	20.8	5.5
Single	7.9	24.2
<b>Relation to patient (%)</b>		
Spouse		30.5
Child		61.7
Sibling/parent		3.9
Others		3.9
<b>Primary caregiver (%)</b>		69.5
<b>Patient-family member dyads, n (%)</b>	58 (30.5)	58 (45.3)
<b>Clinical Markers, Mean <math>\pm</math> SD</b>		
Estimated Glomerular Filtration Rate	10.79 $\pm$ 4.72	
Charlson Comorbidity Index	6.84 $\pm$ 1.86	
Number of RRT counselling sessions	2.12 $\pm$ 0.97	
<b>Access Creation Outcome at follow-up, n (%)</b>		
Functional AVF prepared for/used at hemodialysis initiation	45 (23.7)	
Started hemodialysis on temporary access (including those with nonfunctional AVF)	66 (34.7)	
No directive to prepare for AVF creation yet	12 (6.3)	
Initiated on PD/ Planning for PD	44 (23.2)	
Died/ Lost to follow-up/ Conservative	23 (12.1)	

*Note:* SD = Standard Deviation, RRT = Renal Replacement Therapy, AVF = Arteriovenous Fistula, PD = Peritoneal Dialysis.

Table 2

*Factor Loadings for Exploratory Factor Analysis with Promax Rotation of the Dialysis Access Attitudes Questionnaire (N = 226)*

	<b>Factor</b>			
	Access/ Dialysis Concerns (Mean ± SD) (3.77 ± 0.92)	Worry about Cost (2.92 ± 0.89)	Need for Dialysis (4.30 ± 0.89)	Value of Access (3.60 ± 0.86)
Cronbach's alpha	0.81	0.76	0.61	0.64
Variance explained (%)	25.7	12.5	6.8	5.1
Having to undergo the operation for dialysis access (fistula/PD catheter) worries me	<b>.82</b>			
I worry about the effects of having the fistula/ PD catheter on my everyday life.	<b>.86</b>			
I am worried that the fistula will fail to work	<b>.68</b>			
I will worry about having to start dialysis earlier than usual once the fistula is in place	<b>.63</b>			
I am afraid of dialysis because of the bad things people say about dialysis	<b>.44</b>			
I am concerned about the cost of the fistula/ PD catheter surgery		<b>.58</b>		
I worry about the cost of dialysis		<b>.91</b>		
I do not see any value in early fistula creation as I may never need dialysis			<b>.62</b>	
I do not need dialysis as I feel that I am fine (no or minimum symptoms)			<b>.56</b>	
My symptoms are not due to my kidney condition			<b>.64</b>	
I see several advantages/benefits of preparing the fistula early				<b>.77</b>
Early fistula creation will make transition to dialysis more smooth in the future				<b>.64</b>

*Note:* Factor loadings > |.40| are in boldface. DM = Decision-Making, PD = Peritoneal Dialysis.



Table 3  
*Unadjusted and Adjusted Logistic Regression Explaining Patients' Access Intentions*

	<i>Access Intention (versus Delay Intention)</i>					
	<i>Unadjusted Model<sup>†</sup></i>		<i>Adjusted Model<sup>‡</sup></i>			
	<i>OR</i>	<i>95% CI</i>	<i>Block 1</i>		<i>Block 2</i>	
			<i>Adjusted OR</i>	<i>95% CI</i>	<i>Adjusted OR</i>	<i>95% CI</i>
<i>Socio-demographic/clinical variables</i>						
Age	1.01	0.98-1.04	1.01	0.97-1.06	1.04	0.99-1.10
Female <sup>a</sup>	0.69	0.39-1.24	0.41*	0.19-0.89	0.52	0.20-1.35
Chinese ethnicity <sup>b</sup>	0.78	0.44-1.40	1.09	0.51-2.32	1.22	0.48-3.09
Married or cohabitating <sup>c</sup>	0.80	0.43-1.51	0.90	0.41-1.97	0.87	0.34-2.25
Estimated Glomerular Filtration Rate	0.95	0.89-1.01	0.86**	0.78-0.95	0.84**	0.75-0.95
Charlson Comorbidity Index	1.00	0.86-1.16	1.05	0.83-1.32	1.04	0.78-1.39
Number of RRT counselling sessions	0.93	0.69-1.25	1.02	0.69-1.50	0.96	0.61-1.52
<i>Dialysis Access Attitudes Questionnaire</i>						
Value of Access	2.14***	1.55-2.97			2.61**	1.46-4.65
Need for Dialysis	2.05***	1.54-2.72				
Access and Dialysis Concerns	0.81	0.64-1.04				
Worry about Cost	0.99	0.77-1.27				
<i>Brief Illness Perception Questionnaire</i>						
Consequences	1.14**	1.04-1.25				
Timeline	1.17**	1.06-1.30				
Emotional Representation	1.10*	1.01-1.20			1.18*	1.02-1.36
<i>Kidney Disease Quality of Life-Short Form</i>						

	<i>Access Intention (versus Delay Intention)</i>					
	<i>Unadjusted Model<sup>†</sup></i>		<i>Adjusted Model<sup>‡</sup></i>			
	<i>OR</i>	<i>95% CI</i>	<i>Block 1</i>		<i>Block 2</i>	
			<i>Adjusted OR</i>	<i>95% CI</i>	<i>Adjusted OR</i>	<i>95% CI</i>
Mental Component Summary	0.97*	0.94-0.99				
Burden of Kidney Disease	0.99*	0.98-1.00				
Patient Satisfaction	1.02**	1.01-1.04			1.03**	1.01-1.05
Role-physical	0.99*	0.99-1.00				
Role-emotional	0.99*	0.99-1.00				
General Health	0.98**	0.96-0.99			0.96***	0.93-0.98

$R^2 = 0.45$  for multivariable model.

Note: \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ . <sup>†</sup> $n$  ranged from 152–190, <sup>‡</sup> $n = 136$ .

OR = Odds Ratio, CI = Confidence intervals. Criterion variable coded as 1 = Proceed with access, 0 = Wait and see.

- a. Male.
- b. Malay, Indian, or others.
- c. Not married or in a cohabiting relationship.

Table 4

*Association between AVF creation and socio-demographic, clinical and psychosocial variables using Cox proportional hazard model*

	<i>AVF Creation (versus No AVF Creation)</i>					
	<i>Unadjusted Model<sup>†</sup></i>		<i>Adjusted Model<sup>‡</sup></i>			
	<i>HR</i>	<i>95% CI</i>	<i>Block 1</i>		<i>Block 2</i>	
			<i>Adjusted HR</i>	<i>95% CI</i>	<i>Adjusted HR</i>	<i>95% CI</i>
<i>Socio-demographic/clinical variables</i>						
Age	0.99	0.96-1.02	1.00	0.97-1.04	1.04*	1.00-1.08
Female <sup>a</sup>	0.83	0.45-1.51	0.52	0.27-1.05	0.71	0.34-1.47
Chinese ethnicity <sup>b</sup>	0.68	0.38-1.23	0.77	0.42-1.43	1.01	0.52-1.97
Married or cohabitating <sup>c</sup>	0.68	0.38-1.24	0.75	0.39-1.42	0.74	0.36-1.52
Estimated Glomerular Filtration Rate	0.90**	0.84-0.97	0.91*	0.83-0.99	0.87**	0.79-0.96
Charlson Comorbidity Index	0.90	0.77-1.06	0.95	0.76-1.18	0.92	0.73-1.15
Number of RRT counselling sessions	1.13	0.86-1.49	1.11	0.83-1.48	0.90	0.64-1.27
<i>Dialysis Access Attitudes Questionnaire</i>						
Value of Access	1.77**	1.21-2.58			1.60*	1.06-2.42
Need for Dialysis	1.20	0.83-1.74				
Access and Dialysis Concerns	0.92	0.70-1.22				
Worry about Cost	1.00	0.75-1.35				
<i>Brief Illness Perception Questionnaire</i>						
Consequences	1.21***	1.09-1.34			1.25**	1.08-1.45
Timeline	1.14*	1.02-1.28				
Identity	1.16**	1.04-1.29				
Concern	1.13*	1.00-1.28				

	<i>AVF Creation (versus No AVF Creation)</i>					
	<i>Unadjusted Model<sup>†</sup></i>		<i>Adjusted Model<sup>‡</sup></i>			
	<i>HR</i>	<i>95% CI</i>	<i>Block 1</i>		<i>Block 2</i>	
<i>Adjusted HR</i>			<i>95% CI</i>	<i>Adjusted HR</i>	<i>95% CI</i>	
<i>Kidney Disease Quality of Life-Short Form</i>						
Physical Component Summary	0.95***	0.92-0.98			0.96*	0.92-0.99
Effects of Kidney Disease	0.98***	0.97-0.99			0.98*	0.97-1.00
Burden of Kidney Disease	0.98**	0.97-0.99				

Note: \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ . <sup>†</sup> $n$  ranged from 152–190, <sup>‡</sup> $n=135$ .

Secondary analyses only on patients with AVF/HD outcomes (i.e., excluding those with other events, loss to follow-up or no outcomes) replicated effects for value of access and consequences).

HR = hazard ratio, CI = confidence intervals, AVF = arteriovenous fistula, CVC = central venous catheter. 1 = AVF created, 0 = No AVF created (censored).

- a. Male.
- b. Malay, Indian, or others.
- c. Not married or in a cohabiting relationship.