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Official Protocol Title: Social Network Analysis and Renal Education to Promote Transplantation (SNARE Transplant)

Research Strategy and Analysis Plan

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Research Strategy and Statistical Analysis Plan

1)SIGNIFICANCE: Despite the clear recognition that kidney transplantation is the optimal treatment choice for end-stage renal disease (ESRD), significant barriers lead to transplant disparities leaving disadvantaged groups, including women and blacks, with missed opportunities to receive optimal care when compared to white men^{11,18-21}. Women and blacks are less likely to be informed of the option of transplantation, referred to a transplant center, and complete the medical evaluation needed to be placed on the kidney transplant waiting list²². Modifiable barriers to these disparities include: lack of knowledge, lack of social support, and difficulty discussing transplantation and living donation^{4,9,10,19,23-26}. Interventions aimed at social networks may be critical in minimizing these barriers. An emerging body of literature has shown the importance of social networks in chronic diseases²⁷⁻²⁹, yet little is known about social networks in hemodialysis (HD) clinics. HD clinics are unique as patients are receiving a lifesaving treatment in a group setting, spending several hours next to each other in assigned seating, three times a week, for several years. This makes HD clinics potentially ideal for social network interventions to optimize chronic disease management.

Social network analysis measures the social structures people form and their relationships within those structures. Social network theory proposes that a person (ego) is affected by the relationships (links) with other people (alters) within a network³⁰ (Figure 1, a hypothetical friendship network). These relationships can influence whether people quit smoking^{29,31}, gain weight²⁸, and even participate in health interventions¹⁶. A person's position as well as the structure of the network can influence these relationships. One measurement of network position is betweenness centrality³²⁻³⁴. This is the number of times a person is in between two other people. For example in Figure 1, E and F are the most central in the network because if information were to spread from D to I, it would have to pass through E and F. One measurement of network structure is the clustering coefficient. This measures how connected a person's friends are with each other^{32,35}. It is the number of measured connections between a person's friends divided by the total possible connections between a person's friends. These smaller networks within a network are called sub-networks. Sub-networks with high clustering coefficient are often referred to as dense networks. Dense networks tend to reinforce attitudes and behaviors as well as provide instrumental support^{35,36}. The sub-network of A,B,C,D would be described as dense because the members are all connected (i.e., the sub-network members have high clustering coefficient), in contrast sub-network E,F,G,H,I would be defined as diffuse, because E,G,H and I share a mutual friend F, yet are not directly friends with each other (i.e., the sub-network has a low clustering coefficient).

Differences in HD social network centrality and density may offer insight into gender and racial disparities in transplantation^{9,10,26,37}. It has been hypothesized that since blacks and women tend to form dense social networks, they are less likely to receive correct information regarding kidney transplantation when compared to white men, who have diffuse networks^{9,26,38}. Diffuse networks have been shown to provide greater access to novel information including positive information about kidney transplantation⁹. In a recent study of support networks among black HD patients, Browne¹⁰ found that dense networks were associated with misinformation and failure to complete the steps towards transplantation. Clark *et al.* examined race, gender, and pre-transplant evaluations and found that white men and women, and black women benefited from higher levels of instrumental support, a character of dense network, but black men did not²⁶. These studies focused primarily on patients' support networks (e.g. spouse, family, friends, and HD clinic staff). Our recent study showed that patients, who formed dense networks with other HD patients, completed more of their transplant work-up and were transplanted¹. Taken together these results suggest small dense networks reinforce information, attitudes, and behaviors towards kidney transplantation and are a potential target for intervention.

Interventions that leverage the structure of HD social networks may improve access to transplantation in disadvantaged populations. Racial and ethnic minorities, who are overburdened by ESRD, often rely on their HD clinic for health information^{23,39,40}. Social network behavioral interventions in other fields^{16,17,32,35} have found that it may be better to target dense networks than diffuse networks. As diffuse networks function as discussion networks and can be more effective in changing behavior than diffuse networks which function as advice networks and are better at spreading novel information through a central person³²⁻³⁴. We propose a prospective pilot study that addresses the current gap in our knowledge about how transplant information and behaviors spread through HD patients' social networks. We will test the spread of

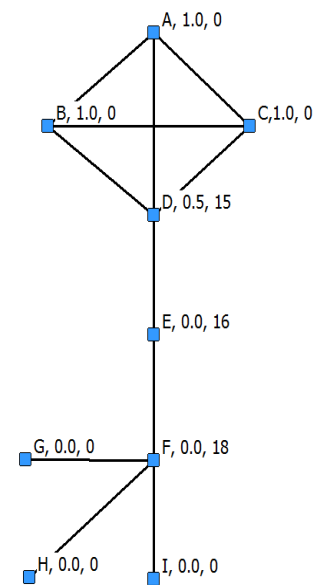


Figure 1. is a friendship social network. Each blue node represents a person, and is lettered A-I. The lines represent friendships. The first value after the letter is the clustering coefficient. The second value after letter represents the betweenness centrality.

information through targeting either the most clustered patients or the most central patients of the network to disseminate information learned through a transplant education intervention. What we learn from this study will provide the foundation for developing a clinical intervention tailored to spread health information, attitudes, and behaviors in order to increase transplantation among disadvantaged HD patients.

2) INNOVATION: Social contagion is a theory that ideas, attitudes, and behaviors spread within networks^{26-28, 41}. Emerging evidence suggests that the theory of social contagion can be applied to health interventions^{16,17,42}; however, different people in the social network need to be targeted depending on the type of intervention^{16,33,35}. Little is known about the structure and influence of social networks within the unique setting of HD clinics, and whether these networks can be utilized to improve patient outcomes³⁷. The proposed research challenges the current ecological approach to barriers to transplantation which attributes only a small role to the HD clinic and often neglects the role of patient interactions⁴⁰. Our previous research has shown the importance of clustered HD patient social networks in access to kidney transplantation¹. Utilizing the COACH (Communicating about Choices in Transplantation) intervention, which has been shown to improve transplant knowledge and LDKT communication skills³, we will explore the spread of transplant information and behaviors through HD social networks. The information gained from this research will not only prove useful in increasing access to kidney transplant but potentially many other educational and behavioral interventions in kidney disease.

3) APPROACH

A) *Preliminary Results:* The proposed research plan is based on our data providing insight into HD patients' attitudes and knowledge about kidney transplantation. Our previous research has found that the primary barrier to the transplant wait-list is neither interest nor primary referral but the completion of tests required to become active on the transplant list. We developed, tested, and utilized the *Dialysis Patient Transplant Questionnaire* (DPTQ, Appendix) to examine barriers to live donor kidney transplantation (LDKT) and completion of the steps toward deceased donor kidney transplantation (DDKT) among 116 patients treated at two urban HD clinics. The results revealed that 52.9% of the 34 patients undergoing pre-transplantation evaluation were unaware of their true listing status, 88.9% of these patients mistakenly believed that they were waitlisted⁴. Further analysis of the 101 self-identified black patients found that black women wanted a LDKT less often than men (odds ratio 0.13, $p=0.001$), despite being nearly twice as likely as men to receive unsolicited offers of kidney donation (73.2% v. 43.2%, $p=0.02$)¹¹. Furthermore, only 34.2% of the patients interested in LDKT had ever asked another person to donate regardless of gender^{11,12}. The patient's major concerns about asking for a LDKT were for the health and burden of the donor (33.3%), not knowing how to ask for a kidney (28.1%), and their own health (24.6%)¹². The limitation of these studies is that participation was largely limited to an underserved black population, and further research is necessary to see if findings are generalizable to other populations. These findings also show the potential for an intervention like the COACH.

Interestingly, 39% of the patients surveyed with the DPTQ reported linking the social aspect of HD. Based on these results, we performed a three-year longitudinal, prospective observational study on the formation of social networks in a new HD clinic and examined the networks' effects on kidney transplantation¹. Forty six racially and ethnically diverse patients (24% White, 33 % Black, 30% Hispanic, and 13% Multiethnic) were enrolled and studied with repeated survey measures and clinical observations. Thirty one patients (67%) were observed interacting with each other and participating in the HD social network (Appendix, Figure2). Gender, not race, was associated with participation in the social network. Almost all (91%) transplant eligible males were linked to other patients compared to 56.3% of the eligible women ($p=0.02$). Patients participating in the social network completed a median of 50% (Interquartile Range (IQR) 33 – 96%) of steps towards transplant compared to a median of 0% (IQR 0 – 23%) of those who did not ($p<0.001$). On sub-network analysis, patients who participated in health discussions with other patients, as well as those who received a kidney transplant had dense, sub-networks with higher clustering coefficients with the a mean of 50% of the patients in their network being interconnected with each other (0.52 ± 0.35 vs. 0.14 ± 0.30 , $p=0.0002$). Women, who participated in the social network, discussed their health more than men (90% vs 45% $p=0.02$) and tended to have a higher clustering coefficient (0.623 vs 0.356 , $p=0.07$). On further sub-network analysis, the percent of the work-up completed by a patient correlated with the steps completed by members of their sub-network ($R^2 = 0.42$, $p = 0.02$) and for patients who were interested but had not started the transplant process (step 2, Table 4), the clustering coefficients predicted the percentage of transplant steps completed ($\beta=2.23$; [95% CI], 0.16-4.29, $p = 0.003$, $r^2=0.19$). Lastly patients, who received a kidney transplant during the study had denser networks (0.71 ± 0.36 vs. 0.23 ± 0.32 , $p= 0.002$). These dense, highly connected networks as measured by the

clustering coefficients were associated with completing steps and even successfully receiving a kidney transplant. This study was the first to perform a social network analysis on patient-patient interactions in an HD clinic and use it to model progression through the steps of transplantation. We hypothesize these dense networks function like echo chambers reinforcing both information and behaviors within the network. Although this study found that women were less likely to be in the network, women were unexpectedly underrepresented in this study. The proposed research will advance our understanding of sex differences in HD social networks.

B) Overview of Research Strategy

The proposed research expands on previous knowledge by combining both a longitudinal observational cohort study design (**AIMS 1 and 2**) and a clinical intervention trial (**AIM 3**) to evaluate the structure, function, and potential utilization of social networks in a racially diverse suburban clinic and compare that to a predominantly black urban clinic. The clinical trial will use a network targeted transplant education intervention (COACH) as to test the role of the network in the dissemination of knowledge, attitude, and behaviors with the overall goal of improving access to kidney transplantation (**AIM 3**).

C) Approach by AIM

Approach to AIM 1: Compare HD patient social networks by gender and race. **H1:** Female HD patients of all race and ethnicities have dense social networks when compared to white male HD patients.

Rationale: Previous social network research has shown that women and minorities tend to have dense social networks. This may contribute to gender and racial inequities in transplantation and greater insight may inform future interventions to minimize this disparity

Setting AIM 1,2,3: This study will include ESRD patients from two independently-functioning non-profit HD clinics in North Brunswick, New Jersey and Philadelphia, Pennsylvania owned by Dialysis Clinics Incorporated (DCI) (see Medical Directors' letters). These clinics were chosen for their similar size and diverse populations existing within a centralized electronic medical record system (DARWIN) supported by DCI. The Philadelphia clinic is serves a urban, minority population, (94% African American; 1% Caucasian; 5% Hispanic patients); and a median income⁴³ of \$28,363. In contrast, DCI North Brunswick is a suburban clinic with an ethnically diverse patient population (43% White, 37% African American, 12% Asian, 8% Hispanic); a median income⁴³ of \$82,406. Each clinic has an average census of 140 patients (280 total) with 3 shifts on Monday, Wednesday, Friday (MWF) and Tuesday, Tuesday, Saturday (TTS), with approximately 25 patients per shift.

Research Staff Training and Quality Control: At the end of **Year 1**, the research coordinator (RC) and assistant (RA) will be provided reading materials on LDKT, RCTs, and receive a 6 week training in administration of the survey and conducting semi-structured interviews. They will be trained in survey administration (**Year 1**) and COACH intervention facilitation (**Year 2**). The PI will demonstrate semi-structured interview administration and then observe them complete 2 interviews and 2 interventions before they will be allowed to do so alone. The PI will oversee data coding and will provide ongoing supervision of their performance and skill development.

Data Management and Analysis Software: Data management will be the primary responsibility of the Research Coordinator. Data will be saved in password protected files that will only be accessed by research staff. All personally identifying information will be kept in a password-protected file in a secure, HIPAA-compliant server and each subject will be assigned a unique code number that will be kept in a separate password-protected file. The PI will assure the integrity of the data security procedures. Each interview and survey will be digitally recorded for accuracy. The recordings will be transcribed verbatim using Microsoft Word by RA within one week. The PI will check the transcripts against the audiofiles for accuracy, after which the audiofiles will be deleted. The PI will assure the integrity of data security procedures. Quantitative data stemming from the DPTQ will be entered into Microsoft Access by the RA for data management. The Access data file will be stored on the Nephrology Division's HIPAA-compliant server. MAXQDA⁴⁴, SPSS⁴⁵, MATLAB⁴⁶, and Galileo¹⁴ will be used for qualitative, descriptive, regression, network analyses, and graphs.

Patient Recruitment, Eligibility, and Retention AIM 1 and Aim2: Patients will be approached to participate while in the HD clinic during their HD session by trained research staff (Year 2). Once consent has been completed, participants will be administered the DTPQ for baseline assessment.

Study Eligibility: All patients 18 years of age or older, able to consent to participation and respond to the validated survey in English, and who are present in the HD clinics during the initial survey periods, July 2018 to November 2018 are eligible to participate. All patients who participated in **AIM 1** will be analyzed in **AIM 2**.

Transplant Eligibility: Previous studies have shown that not all suitable candidates are referred by their nephrologist. All patients will be evaluated via chart review by a study transplant nephrologist for transplant candidacy and, if eligible, the primary nephrologist will be asked whether the patient is an appropriate candidate and reasons they have not been referred. We will defer the transplant referral to the attending nephrologist. Our criteria for transplant ineligibility are nursing home resident, >79 years of age⁴⁷, active or recent malignancy, inoperable coronary artery disease, or comorbid illness that will make it unlikely that the patient will survive >3 years after transplant.

Recruitment Goals and Expected Survey Response (AIM 1 and AIM 2): Our goal will be to conduct a census. Our previous response rates^{1,4} have been consistently over 90%, most likely due to the non-invasive nature of the study. We anticipate recruiting 252 patients; however, we are budgeted as if all 280 patients participate.

Retention/Attrition: Based on our previous study¹, patients are amenable to repeated surveys and do not leave the HD clinic unless they transfer, are transplanted, or die. The mortality of transplant candidates is lower than the average mortality, and we are powered for an overall 2 year mortality¹⁸ of 10% and 5% transfer rate.

Participant Remuneration: Patients will receive a \$10 gift card after completing each survey.

Data Collection AIM1 and AIM2:

Survey Instrument: The *Dialysis Patient Transplant Questionnaire* (DPTQ) includes a mix of 49 questions, single measures, and scales previously validated in HD and transplant populations and items developed to address the co-investigators' specific research interests (see appendix). The DPTQ has demonstrated construct validity in previous studies^{1,4,11,12}. It includes 17 items on communication confidence developed specifically to evaluate the COACH program and rated along a scale from 0 to 100 (Cronbach's alpha = .90); summed to create a composite confidence score. In addition, there are 12 true/false items on transplant knowledge items; correctly answered items are summed to create a composite knowledge score. The questionnaire will also include questions regarding medical conditions which may preclude the patient from transplantation. Clinic staff will also participate in a modified version of the survey to assess their attitudes towards HD^{48,49} and kidney transplantation, during Year 2.

Participant HD Seating and Observed Interaction Log: Patient seating assignments will be recorded, as well as, the staff observed social interaction log, which documents the frequency, duration, and nature of observed patient-patient interactions (appendix).

Clinical Data: Upon consent, routine HD laboratory and clinical data (including co-morbid conditions, e.g. diabetes, congestive heart failure, cardiovascular disease, chronic obstructive pulmonary disease, and malignancy, which will be reconciled with survey data) will be extracted from the DARWIN database by the DCI Information Technology Department. Data will be downloaded, cleaned, merged, and submitted for preliminary analysis. Patient's steps to transplantation (Table 2)^{1,2} will be recorded and listing status will be verified with the patient transplant center or centers (**AIM 2**).

Analytic Plan AIM1: To test **H1**, we will create nodal network graphs (Figure 1, for example) using data collected from the patient and staff surveys, and clinical observations. We will characterize and compare the structure of the patient HD clinic networks by gender and race. We will assign demographic, survey, and clinical data abstracted from the EMR to each node in the network.

Primary outcome: Differences in clustering and centrality by gender and race (**H1**)

Independent Variables: Sex and Race

Covariates: Age, Marital Status, HD vintage, insurance, HD Clinic, and HD shift

Analysis: We will compare and contrast both network and nodal attributes based on sex and race/ethnicity. We will use a multivariable linear regression to test if gender and race can predict clustering coefficient while controlling for age, HD vintage and socioeconomic status. We will refine our network model by adding and removing links with each wave of the survey. For the nodal attributes that are continuous variables, standard tests of hypothesis such as t-test, ANOVA, and linear regression will be used. For categorical attributes, ANOVA density-models as well as logistic regression models will be used. For continuous variables, testing distances and similarities, Moran statistics will be calculated. Since the observations are not independent observations drawn at random from a large population, we will use a boot-strap approach for estimating the variation of estimates from a large number of random sub-samples of network members⁵⁰⁻⁵².

Limitations: Having patients self-report their own social links, while an established methodology, can still be subject to recall bias⁵¹. Thus, we will use observations of social interactions for verification using the aforementioned log. These observations will be used to weight the survey generated links.

Approach to AIM 2: Using network information from AIM 1, we will examine how structural differences in social networks affect knowledge, attitudes, and behaviors towards kidney transplantation. **H2:** Patients with dense HD social networks have similar attitudes (both positive and negative) about transplantation and completion of steps to kidney transplant as compared to patients diffuse networks.

Rationale: We have found the primary barrier to the transplant wait-list is the completion of the work-up^{1,4}. Previous research shows that patients in small dense networks share similar ideas⁴². This could either positively^{1,26} or negatively¹⁰ affect access and progress to kidney transplantation. We are using steps completed to measure progress to transplantation; a measure has been established for transplant disparity research to improve the granularity of the measurement and compare results across studies².

Step	Description
1	suitability for referral to transplant center
2	interest in transplantation
3	referral call to transplant center
4	first visit to transplant center
5	transplant center work-up
6	work-up complete
7	active on the list
8	successfully received a kidney transplant

Analytic Plan AIM 2: To test **H2**, we will use the network information from Aim 1 to analyze correlation of knowledge, attitudes, and behaviors between members of the network (transplant discussions, living donor recruitment, and step in kidney transplant process) from the surveys and the EMR.

Primary Outcome: Correlation of 1) attitudes about transplantation and 2) step in transplant process

Independent Variables: Clustering coefficient and attributes of alters

Covariates: Age, Marital Status, HD vintage, insurance, transplant eligibility, HD clinic, network attributes

Analysis: We will examine how knowledge, attitudes, and completion of steps differ by network attributes. These differences will then be validated by using logistic regression modeling to predict patient's attitudes towards transplantation and step in the transplant work-up using demographic and survey variables. We will then add network attributes and quantify the improvement in the prediction model using tests for goodness of fit. To further validate the model we will perform an Exponential Random Graph Model (ERGM) with temporal attributes⁵³ in which the patients current transplant step is a function of patients baseline data and network attribute as well as their alters' baseline step, current step, and network attributes.

Limitations: We have previously found that patients are often incorrect about their listing status⁴, thus we will confirm the transplant status by contacting the listing institution. Using the steps completed will allow for the analysis of patients that are highly motivated who complete all their work-up but are discovered to have an absolute contraindication to transplantation. Since AIM 1 and 2 are observational, we will be unable to determine whether patients form small networks with like-minded individuals or whether over time everyone in a small network will reach a common belief through spread of information and behaviors⁵⁴. To test the spread of information and behaviors, in **AIM 3**, we will use a network targeted intervention.

AIM3: Compare and contrast the diffusion of knowledge, attitudes, and behaviors regarding transplantation through HD social networks by targeting either the most central or the most clustered members of the network to disseminate a transplant education intervention. **H3:** Targeting patients with high clustering coefficients will be the most effective method for the spread of knowledge and favorable attitudes toward transplantation, and completing steps toward transplantation as compared to targeting by centrality.

Rationale: Previous studies have shown that barriers to transplantation tend to be less about information but rather behaviors related to completing the transplant steps^{1,2,4,13}, thus dense social networks are likely to be more effective in changing behavior and participating in a social network than diffuse networks, which are more effective at spreading novel information³²⁻³⁴.

Patient Recruitment, Eligibility, and Retention AIM 3: One year after the initial survey, we will use a targeted network intervention to measure the spread of information, attitudes, and behaviors. We will target transplant eligible patients based on their clustering coefficient or their betweenness centrality to participate in the COACH education using data collected in AIMS 1 and 2.

Recruitment Goals: Based on previous research^{1,4}, we anticipate approximately half the patients would be eligible for a kidney transplant but not on the list. If 250 patients participate in **AIM 1 and 2**, then at least 125, or approximately 10 patients per shift will be eligible for the intervention. The intervention will target either the two most central transplant eligible patients or the two most clustered patients to participate in the COACH education. As this is a social network intervention, although we are targeting only two patients per shift, all the patients on that shift are considered exposed to the COACH education. To prevent selecting a patient that is both relatively central and clustered, the patients selected by centrality will have a centrality greater than 1 standard deviation (SD) from the mean and a clustering less than 1 SD from the mean. Conversely, the

patient selected by clustering, will have a clustering coefficient greater than 1 SD from the mean and centrality 1 SD less than a mean. In our previous study, there was no correlation between clustering and centrality ($r=0.024$, $p=0.875$). The research and clinical staff will be blinded to whether the patient was chosen to participate in COACH because of clustering or centrality. Patients will be excluded if they are ineligible for a kidney transplant, had a previous kidney transplant, or have an active living donor.

Assignment of Intervention groups: The intervention assignment will be alternated between MWF and TTS (Table 3) to avoid patient differences between those respective days (for example patients on MWF may have been on dialysis longer while patients on TTS may be more likely to work)⁵⁵.

Retention/Attrition: **AIM3** will be carried out over the course of a year with a possible drop-out rate of 5% (Death and Transfer). If a patient transfers, the patient will be contacted via phone to do a follow-up survey.

Participant Remuneration: All patients will receive \$10 for the initial survey (Wave 1), and Wave 2 survey, \$10 for the 3 month follow-up (Wave 3), and \$10 for Wave 4. Patients will not receive remuneration for participating in the COACH education but will be able to keep the handouts and reading materials.

Data Collection (AIM 3)

Education Intervention: COACH is a behavioral communication intervention designed specifically for ESRD patients pursuing kidney transplantation. The COACH program (appendix) consists of four modules: 1) Kidney transplant options, 2) Discussing your transplant options, 3) Requesting living donation, and 4) Maintaining positive relationships. The content and teaching strategies were guided by the concepts of social cognitive theory as well as principles of adult learning and communication skill acquisition^{31,56,57}. A study coordinator will conduct the intervention in four, face to face, one hour sessions in the HD clinic. Patients will receive the a handbook and video for the COACH intervention.

Shift	Clinic 1		Clinic 2	
	MWF1	TTS1	MWF2	TTS2
1st 5am-9am	Cluster	Central	Central	Cluster
2nd 9am-1pm	Cluster	Central	Central	Cluster
3rd 1pm-5pm	Cluster	Central	Central	Cluster

Staggered Surveys: We propose a pre-post design to assess the impact of the COACH education on patients' transplant-related knowledge and behaviors. Before administering the COACH education, we will survey targeted patients to assess changes in knowledge and behaviors towards transplant from the baseline survey. As another measure of the impact of the COACH intervention, patients not receiving the intervention will serve as controls and will be surveyed along with those receiving the intervention; we will then assess within and between group differences in transplant-related knowledge and behaviors. To assess the dissemination of information contained in the COACH intervention, all patients will be surveyed at 3-months post-intervention. The follow-up surveys will determine the sources of these changes (eg. self-reading after the survey, the COACH intervention, or discussing with other patients). Finally, during Year 4, one year post-intervention, a final survey will be administered to the all the patients in both clinics to assess retention of information and change in attitudes and behaviors of those who participated in COACH and the spread of information and behaviors to the patients who were not targeted.

Clinical Data: In addition to the survey data, we will collect patient transplant listing status, living donor evaluations from participants' respective transplant centers.

Analytic plan AIM3: To test **H3** we will assess the successful spread of the intervention by evaluating the difference in the primary outcome of completion of steps toward transplantation between patients being exposed via the most clustered (Cluster) members versus the most central (Central). We will use repeated surveys to measure our secondary outcomes include change in knowledge, attitudes, behaviors of the patients either directly exposed to the intervention or those who were exposed indirectly through the social network.

Primary Outcomes: 1) Differences in patient knowledge, 2) Differences in transplant steps completed

Secondary Outcomes: 1) Completion of transplant work-up, 2) Asking for a living donor

Independent Variables: Intervention assignment to Cluster or Central

Covariates: Age, Marital Status, insurance, transplant eligibility, HD shift, HD Clinic, network attributes

Exposure: While only two patients per shift will receive the COACH intervention, all patients regardless of participation in the COACH education will be analyzed as exposed to the intervention via social spread. This will result in two groups for the primary analysis Cluster (MWF1 Cluster + TTS2 Cluster) and Central (MWF2 Central + TTS1 Central)

Analysis: To measure global changes, we will use a t-test to test changes in knowledge and changes in completion of steps between Cluster and Central. Individual level transfer of information will be analyzed with a

Markov chain Monte Carlo accept-reject procedure in the chain⁵⁸. We will examine the correlation in changes of a patient's(ego) knowledge with his or her first degree alter and measure the decay in correlation as the degree of the alter increases. We will also examine the ego's distance (how many links the patients are from each other) from the alter receiving the intervention. In addition, we will use Gaussian Conditional Random Fields (GCRF) methods to model a patient's stage in the transplant process by taking into account various factors such as personal demographics, social influence of alters, and global trends of HD shift and clinic⁵⁹. We will examine the characteristics of the patients disseminate and receive information. The data directly measuring the spread of information, influence, and behavior within the network from this experiment will be used to validate and strengthen the social network model developed in AIM1 and AIM2.

Limitations: If the targeted patient refuses to participate, we will select another two transplant eligible patients to participate in the intervention based on their clustering and centrality. The network attributes of the patients if they refuse to participate will be analyzed and can inform AIMS 1 and 2 as well as recruitment strategies for future studies. In the unlikely event no patients on the shift participate in the COACH education, they will be analyzed as intention to treat. Since we are measuring change in knowledge using repeated surveys we are at risk for a learning effect⁶⁰. For this reason on the repeated survey questionnaires, we will also assess where the new knowledge came from patient interactions or self-reading after the survey. Given the focus of the proposed research on urban and suburban locales, future research is indicated to see if this social network mapping and intervention can also be used in rural settings, especially since recent studies shown many patients in rural southeast are disadvantaged regarding transplantation⁶¹.

Sample size and power AIM3: Using the data from our previous HD clinic social network study, we expect the patients in the Clustering targeted intervention to complete at least 2 more steps in the transplant work-up than those in the Centrality intervention (7, SD 1.5 vs 5, SD 1.7, p=0.03). The observed effect size was 1.06 or a difference of 2 steps. We estimate at least 10 patients per shift will be exposed to the intervention either directly through participation in the intervention or indirectly through information/behavior spread through the social network. Both clinics have 6 shifts, and we would have 60 patients assigned to each intervention condition. Based on a two tailed t-test, a total sample of 30 (15 in each treatment arm) would yield 80% power at significance level $\alpha = 0.05$ to detect a difference of 2 steps. With 120 patients (60 patients in each treatment arm) we will be powered to detect a difference of 1 step. The COACH intervention produced a change in knowledge³ with an effect size of 1.2, thus if we expose 90 patients (45 in each arm) to the intervention, we will have the power to detect at least half that effect.

Future Directions: This research will provide Dr. Gillespie with novel data in a critically-important and poorly-understood area of nephrology and equip him with the experience and tools to successfully compete for external funding and transition to independence as a clinician scientist. In addition to improving access to transplant, many other aspects of ESRD are behavioral, such as adherence to dialysis prescription, interdialytic weight gain, diet, medication and even choice of modality. Beyond ESRD, these methods could be used to improve kidney disease awareness, education, as well as medication adherence, especially transplant medication. The next step after this pilot study is to perform a large national study to examine the regional differences in hemodialysis clinic social networks, how these differences explain transplant disparities, and how the social networks can be engineered to improve access to transplant.

Timeline: The completion of the research is feasible in a 5 year timeline

Year	1				2				3				4				5			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
IRB review and modifications	X				X				X				X				X			
Train Research Assistant				X																
Survey by Wave 1,2,3,4					1				2	3			4							
AIM 1					X	X	X	X												
Collection of Follow-up data for AIM2					X	X	X	X	X	X	X	X								
Network Experiment AIM3									X	X	X	X	X							
Final Analysis														X	X	X	X	X		
Report to NIDDK				X				X				X				X				X