Key elements in selection of pre-dialysis patients for home dialysis

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Abstract

Background: Most pre-dialysis patients are medically eligible for home dialysis, and home dialysis has several advantages over incentre dialysis. However, accurately selecting patients for home dialysis appears to be difficult, since uptake of home dialysis remains low. The aim of this study was to investigate which medical or psychosocial elements contribute most to the selection of patients eligible for home dialysis.

Methods: All patients from a Dutch teaching hospital, who received treatment modality education and subsequently started dialysis treatment, were included. The pre-dialysis programme consisted of questionnaires for the patient, nephrologist and social worker, followed by an assessment of eligibility for home dialysis by a multidisciplinary team. Clinimetric assessment and logistic regression were used to identify domains and questions associated with home dialysis treatment.

Results: A total of 135 patients were included, of whom 40 were treated with home dialysis and 95 with incentre haemodialysis. The key elements associated with long-term home dialysis treatment were part of the domains 'suitability of the housing', 'self-care', 'social support' and 'patient capacity', with adjusted odds ratios ranging from 0.13 for negative to 18.3 for positive associations.

Conclusion: The assessment of contraindications by a nephrologist followed by the assessment of possibilities by a social worker or dialysis nurse who investigates four key elements, ideally during a home visit, and subsequent detailed education offered by specialized nurses is an optimal way to select patients for home dialysis.

Introduction

Home dialysis, that is, peritoneal dialysis (PD) or home haemodialysis (HD), offers more flexibility and independence than conventional incentre haemodialysis (CHD), whereas patient survival is comparable or better.[1–3] Therefore, it is not surprising that extensive pre-dialysis programmes lead to a preference for home dialysis in 70% of pre-dialysis patients.[4] Nevertheless, the percentage of patients treated with home dialysis is only about 9–11% throughout the world.[5,6] An important barrier to uptake of home dialysis is limited pre-dialysis care.[7–11]

However, it remains uncertain which elements of pre-dialysis programmes influence a patient's treatment decision. Identifying key elements linked to long-term home dialysis treatment could help various centres to assess eligibility for home dialysis in more patients and to present home dialysis as a viable option among other kidney

replacement therapies (KRTs). Elements with a negative correlation for home dialysis can be addressed during treatment modality education. Therefore, the aim of this study was to assess which elements of a multidisciplinary structured pre-dialysis programme[12] contribute most to

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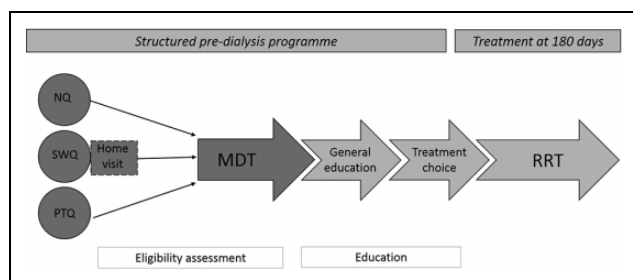Email: b.jaarsveld@amsterdamumc.nl

Figure 1. Overview of the structured pre-dialysis programme. NQ: nephrologist's questionnaire; SWQ: social worker's questionnaire; PTQ: patient's questionnaire; MDT: multidisciplinary team meeting; KRT, kidney replacement therapy (including conservative care).

adequate selection of patients eligible for treatment with home dialysis.

Methods

Study population and design

All patients, who had completed the pre-dialysis programme, were assessed for eligibility for home dialysis by both the nephrologist and the social worker and started dialysis between June 2013 and August 2018 in a large, non-academic teaching hospital in the Netherlands (Meander Medical Centre, Amersfoort, the Netherlands) and were eligible for inclusion into this retrospective study. From 2013, this teaching hospital adopted a 'home first' policy that resulted in adjusting the pre-dialysis programme. Prior to the implementation of this programme, the home dialysis rate was 18% as was noted in the article about the implementation.[12] All eligible patients had an estimated glomerular filtration rate (eGFR) of ≤ 15 ml/min/1.73 m^2 or chronic kidney disease stage 4 with rapid deterioration of kidney function prior to referral to the pre-dialysis programme. The programme, that is, eligibility assessment for home dialysis and treatment modality education, was also offered to patients who had an unplanned start of dialysis, that is, acutely started patients or so-called crash landers. The study was approved by the Medical Research Ethics Committee of the VU University Medical Centre, Amsterdam.

Structured pre-dialysis programme

The structured pre-dialysis programme started with three questionnaires (provided as Online Supplemental Appendix A): for the patient (containing 31 questions), the social worker (20 questions) and the nephrologist (30 questions) of this patient (Figure 1).[12] The questionnaires were developed by the Medworq project 'Gezonde Nieren (Healthy Kidneys)', aiming to collect as much relevant information as possible regarding patients and their possibilities for home dialysis. The patient's questionnaire consisted of

questions about physical performance, daily activities and the patient's social support system. The social worker's questionnaire consisted of questions about hygiene, availability of space in the patient's housing and the capability of the patient and his family to perform dialysis at home. This questionnaire was ideally completed after the social worker performed a home visit. The nephrologist's questionnaire consisted of relative and absolute contraindications to home dialysis and CHD, for example, questions about non-compliance, multiple abdominal surgeries and morbid obesity for PD and impossibility for vascular access and severe heart failure for (home) HD. Both the social worker and the nephrologist assessed the eligibility of all patients for home dialysis, based on the questionnaires. These eligibility assessments were not binding but a mere recommendation, that is, a patient who was judged by the nephrologist as not eligible for home dialysis might initiate home dialysis. The time necessary to fill in a questionnaire was expected to be about 25, 35 and 10 min for a patient, social worker and nephrologist respectively.

Results of the three questionnaires and home visit were discussed during a multidisciplinary team meeting (Figure 1), in which nephrologists, (pre-)dialysis nurses and social workers were present. After this meeting, the patient received education on all medically feasible treatment modalities by pre-dialysis nurses, including kidney transplantation and conservative care. Depending on the preferences of the patient and the healthcare professionals, additional education was provided by transplant nurses and nurses specialized in home dialysis. After completing the education, the definitive choice for KRT was made by the patient, in consultation with his nephrologist. All healthcare professionals involved in the pre-dialysis programme were thoroughly informed about the potential benefits of home dialysis at the start of the pre-dialysis programme.

Data collection

Baseline demographic data, eGFR according to chronic kidney disease epidemiology collaboration (CKD-EPI; ml/min/1.73 m^2) and comorbidities were collected from patients' charts. Comorbidities were scored according to the Charlson comorbidity index.[13,14] Social situation and education level were retrieved from the questionnaires. Higher level of education was classified as university or college attendance. Treatment modality was assessed from patients' charts.

Definition of outcome

Treatment modality was defined as the modality, that is, CHD or home dialysis, used at 180 days after dialysis initiation to reflect long-term use. Both (assisted) PD and home HD were considered as home dialysis. The time point of 180 days was chosen to ensure that patients who were eligible and willing to perform PD or home HD, but started

for any reason with CHD, were identified as home dialysis patients. For example, patients presenting with acute kidney injury often start with CHD before switching to PD, and treatment with home HD is always preceded by CHD.

Statistical analysis

Continuous variables were reported as means with standard deviation or as medians with interquartile range (IQR), where appropriate. Categorical variables were presented as proportions. In general, a *p*-value of <0.05 was considered statistically significant.

Clinimetric properties of all questionnaires were evaluated by three independent researchers: two nephrologist–epidemiologists (FJvI and BCvJ) and an investigator (AAB). The questions were analysed according to having a formative or reflective nature and subsequently grouped within separate domains. Logistic regression analysis was performed to investigate the association between long-term home dialysis treatment and the questions within each domain. All questions within a domain with *p*-value <0.20 in univariable analysis were added to a multivariable model, to correct for correlation. The multivariable model was additionally adjusted for age and Charlson comorbidity index, where appropriate. All analyses were performed using SPSS Statistics 25 (Armonk New York: IBM Corp) or STATA® 14 (Texas: StataCorp LP).

Results

Patient characteristics

A total of 362 patients started the pre-dialysis programme (Figure 2). During the study period, 43 patients died or showed recovery of kidney function. A total of 66 of 319 patients (21%) opted for conservative treatment. For 72 patients, the questionnaires were incomplete. Furthermore, 41 patients had not commenced KRT by the end of the study period and 71 patients obtained a pre-emptive kidney transplant (*n* = 28, with a kidney transplant rate of 8%) or preferred conservative care (*n* = 43, Figure 2). The remaining 135 patients were included in the analysis, 85% of whom received a home visit. In 15% of patients, the social worker did not succeed in performing a home visit due to time constraints or because the patient did not consent to a home visit. Table 1 presents the characteristics of all included patients. More CHD patients lived alone and had congestive heart failure compared to home dialysis patients.

Preference of patients, healthcare professionals and treatment decision

Of the 135 included patients, initial preferences at the start of the programme were: 58 patients preferred CHD (43%), 47 PD (35%), 11 home HD (8%), 5 pre-emptive kidney transplantation (4%), 3 conservative care (2%) and 11 did
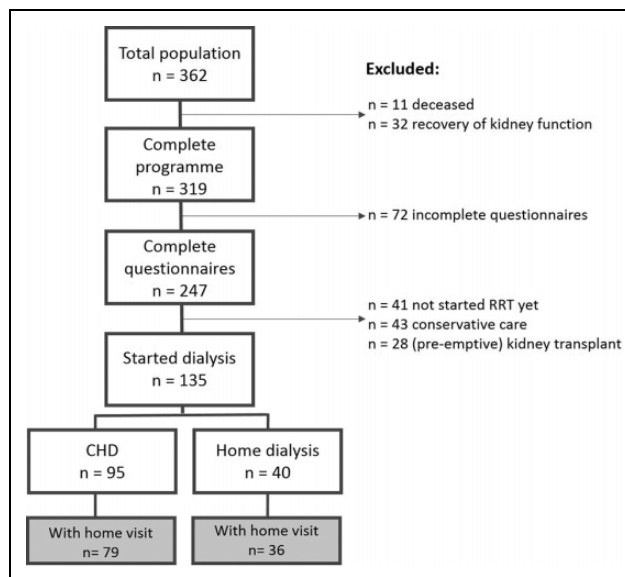

Figure 2. Flow chart of pre-dialysis programme and subsequent KRT. KRT: kidney replacement therapy; CHD: incentre haemodialysis.

Table 1. Characteristics of the included patients.[a]

	All patients *n* = 135	Home dialysis *n* = 40	CHD *n* = 95
Demographics			
Male sex	85 (63)	22 (55)	63 (62)
Age (years)	66.8 ± 13.8	65.4 ± 14.6	67.5 ± 13.5
Living alone	61 (45)	14 (35)	47 (49)
Higher education	23 (24)	12 (30)	21 (22)
Employment	26 (19)	9 (23)	17 (18)
eGFR at start education[b]	12.4 ± 5.9	12.2 ± 3.6	12.5 ± 6.7
eGFR at start KRT[b]	8.2 ± 2.8	8.7 ± 3.0	8.0 ± 2.7
Comorbidities			
Charlson CI	4 [2–5]	4 [3–5]	4 [2–5]
Age-adjusted Charlson CI	6 [4–8]	6 [5–7]	6 [4–8]
Diabetes mellitus	54 (40)	16 (40)	38 (40)
Ischaemic heart disease	33 (24)	11 (28)	22 (23)
Congestive heart failure	12 (9)	1 (3)	11 (12)

eGFR: estimated glomerular filtration rate; CHD: incentre haemodialysis; KRT: kidney replacement therapy; Charlson CI: Charlson comorbidity index; IQR: interquartile range; CKD-EPI: chronic kidney disease epidemiology collaboration; SD: standard deviation.
[a]Data are shown as *n* (%), mean ± SD or median with IQR.
[b]eGFR according to CKD-EPI creatinine equation in ml/min/1.73 m^2

not have a preference (8%). The social workers considered the overall burden of home dialysis too high in 56 patients. The nephrologists considered previous abdominal surgery (8%), severe obesity (8%), large cystic kidneys (2%) and other reasons (3%), absolute contraindications for PD, and

no possibility for vascular access (1%), a contraindication for home HD. These other reasons were intellectual disability, manic-depressive illness or complete lack of self-sufficiency. For the final decision in the eligibility assessment, the nephrologist and social worker agreed on their eligibility assessment in 69% of patients. The nephrologist found that eight patients were possibly ineligible for home dialysis, whereas the social worker found that home dialysis was an eligible option. In 34 patients, the nephrologist found that home dialysis could be an eligible option, whereas the social worker found these patients ineligible for home dialysis (Online Supplementary Table S1).

Dialysis treatment was initiated at a median of 5 months [IQR 0–11] after starting the programme, at a mean eGFR of 8.2 ml/min/1.73 m^2. At 180 days after the start of dialysis, 95 patients were treated with CHD (70%), 34 with PD (25%) and 6 patients were treated with home HD (4%). The number of patients treated with home dialysis was comparable between acutely and non-acutely started patients (8 of 35 acutely (23%) vs. 32 of 100 non-acutely started patients (32%), $p = 0.31$). The rate of home dialysis in the total dialysis population, that is, including patients with incomplete questionnaires, was 29% (52/177), see Online Supplementary Figure S1.

Characteristics of questionnaires

Assessment of face validity of the questionnaires indicated that there was some overlap between the questionnaires regarding medical and housing parameters. Evaluation of the measurement model also indicated that the questions were predominantly formative (as opposed to reflective), meaning that the measured variables are considered to be the cause – and not a reflection – of the latent variable.[15] For example, the question about having enough space for the storage of supplies is a formative question, whereas a question on the consequences of home dialysis, for example, having more time for education or work, would be a reflective question. In this context, this implies that the questions for patient and social worker can be considered formative for, or having a causative relation to, final eligibility for home dialysis. By clinimetric assessment, the questions of the questionnaires for the patient and social worker were classified into the seven domains: work, mental health, patient capacity, physical health, social support, self-care and suitability of the housing (Figure 3). The questions from the nephrologists' questionnaire addressed assumed contraindications for home dialysis; these were not considered as a domain but as a professional practice pattern.

Questionnaires: Questions associated with home dialysis

The results of the associations between the different questions and long-term home dialysis treatment are depicted in Table 2. All questions that were associated with home
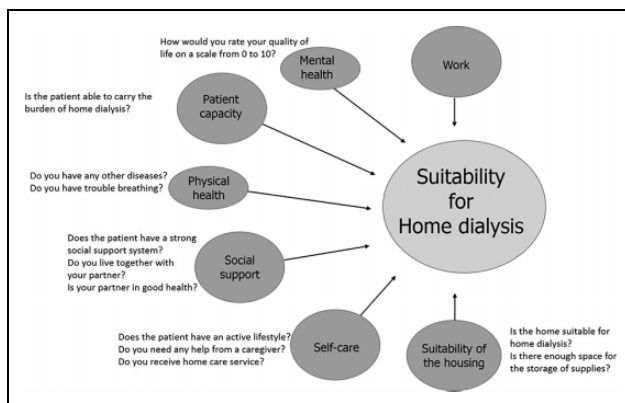

Figure 3. Domains within the patient's and social worker's questionnaires, with examples of the most discriminating questions.

dialysis in univariable analysis are shown. From the domain 'suitability of the housing', the general questions 'Is the housing suitable for home dialysis' and 'Is there enough space available for dialysis supplies' were associated with home dialysis treatment, with an adjusted odds ratio (OR) of 9.34 (95% confidence interval (CI) 3.01–28.96) and 3.27 (95% CI 0.80 – 13.38, $p = 0.10$) respectively. Not having an active lifestyle – domain 'self-care' – was associated with CHD treatment (adjusted OR 0.13, 95% CI 0.04–0.42). The question 'Does the patient have a strong social support system' from the corresponding domain was associated with home dialysis (adjusted OR 4.86, 95% CI 1.87–12.60). The question 'Is the patient able to bear the extra workload of home dialysis' was also strongly associated with home dialysis (adjusted OR 18.60, 95% CI 3.11–111.21). Other questions did not show relevant associations with home dialysis after adjustment. Thus, the questions indicative of suitable housing, self-care, social support and patient capacity were most strongly associated with long-term home dialysis treatment.

Eligibility assessment by nephrologists and social workers and long-term dialysis treatment

The nephrologists classified 83 patients (61% of all dialysis patients) eligible for home dialysis of whom 37 patients actually were on home dialysis at 180 days, resulting in a positive predictive value (PPV) of 45%. In comparison, the social worker classified 57 patients (42% of all dialysis patients) eligible for home dialysis of whom 35 patients performed home dialysis at 180 days, resulting in a PPV of 61%. Both the nephrologist and the social worker regarded few true home dialysis patients initially ineligible for home dialysis (Online Supplementary Tables S2 and S3).

Discussion

In this study on a pre-dialysis programme, we disentangled the value of different questions and characteristics that are

Table 2. Association of questions with home dialysis at 180 days.

Domains	OR (95% CI) crude	*p* Value	OR (95% CI) adjusted[a]	*p* Value
Suitability of the housing				
Owner occupied home	2.06 (0.97–4.38)	0.06	1.07 (0.44–2.64)	0.88
Does the property have stairs?	1.78 (0.83–3.78)	0.14	1.42 (0.59–3.42)	0.44
Enough space available for dialysis machine	2.98 (1.37–6.49)	0.01	0.34 (0.08–1.51)	0.16
Enough space available for dialysis supplies	4.74 (2.03–11.04)	<0.001	3.27 (0.80–13.38)	0.10
The housing is suitable for home dialysis	9.33 (4.02–21.68)	<0.001	9.34 (3.01–28.96)	<0.001
Self-care				
Each hour of care by home care agency or caregiver	0.77 (0.61–0.97)	0.03	0.88 (0.71–1.08)	0.22
Each point on Katz scale[b]	2.31 (0.79–6.78)	0.13	1.14 (0.37–3.54)	0.82
The patient does not have an active lifestyle	0.10 (0.03–0.30)	<0.001	0.13 (0.04–0.42)	0.001
Social support				
Is your partner, with whom you live together, in good health?	2.28 (1.06–4.89)	0.04	1.76 (0.71–4.38)	0.23
Do you have people in the household to help you?	2.62 (0.99–6.90)	0.05	2.54 (0.71–9.04)	0.15
Does the patient have a strong social support system?	4.62 (1.86–11.46)	0.001	4.86 (1.87–12.60)	0.001
Physical health				
Do you have trouble breathing?	0.32 (0.09–1.17)	0.09	0.31 (0.08–1.12)	0.07
Do you have any other diseases?	2.11 (0.74–6.04)	0.16	2.66 (0.89–7.98)	0.08
Patient capacity				
Is the patient's understanding of their illness good?	1.38 (1.00–1.91)	0.05	0.99 (0.67–1.48)	0.96
Is the patient's mental health eligible for home dialysis?	6.87 (1.97–23.97)	0.002	0.71 (0.11–4.81)	0.73
Are there sufficient financial resources for home dialysis?	2.50 (0.69–9.11)	0.17	1.98 (0.47–8.39)	0.35
Is the patient able to bear the extra workload of home dialysis?	15.56 (4.49–54.01)	<0.001	18.60 (3.11–111.21)	0.001
Mental health				
How would you rate your quality of life on a scale from 0 to 10?	1.31 (0.92–1.85)	0.12	1.31 (0.92–1.85)	0.12

OR: odds ratio; CI: confidence interval.

[a]Multivariable models were adjusted for other questions within the same domain; questions from the domains social support and physical health were additionally adjusted for age and Charlson comorbidity index.

[b]This scale elaborates the independency in activities of daily life and ranges from 0 to 6, in which higher scores reflect a more independent patient (Ref. Katz S, *JAMA* 1963; 185:914–919).

commonly addressed during preparation for dialysis care. We identified and quantified the value of questions that best predicted uptake of home dialysis following an eligibility assessment. We present four key questions on suitable housing, self-care, social support and patient capacity for optimal selection of patients for home dialysis. These elements should also be addressed in subsequent education, especially if the lack of these elements prevents home dialysis to be seen as a treatment option.

This study arose from the observation of a significant increase in the proportion of home dialysis patients in a centre that adopted a structured pre-dialysis programme.[12] Within this programme, we sought those elements that had the highest association with long-term home dialysis treatment. We discovered that a selected set of questions, in combination with information gathered during a home visit, is very efficient for selecting patients for home dialysis during pre-dialysis education. A barrier in the uptake of home dialysis is the feeling of lack of family support.[16,17] In our analysis, the simple question 'Does the patient have a strong social support system?' appears to be a good selection question for home dialysis.

Offering adequate treatment modality education is an important process involving multidisciplinary input. It is of utmost importance that patients are provided information on all forms of KRT, including home dialysis, and choose the treatment that suits them best in a process of shared decision-making. In clinical practice, negative associations with home dialysis unintendedly expressed by nephrologists or dialysis nurses may guide the patient's decision and form barriers to home dialysis.[18] By identifying elements of a patient's social and physical condition that most clearly distinguish long-term home dialysis treatment, our approach has the potential to increase the efficiency of the pre-dialysis decision process while ensuring a shared decision.

In our study, 80% of patients were medically eligible for home dialysis, compared to 76–87% in other studies.[7,9] The nephrologists in the teaching hospital of this study considered some conditions, for example, large polycystic kidneys and previous abdominal surgery absolute contraindications for PD, yet many studies showed that in similar patients PD can be performed with necessary precautions.[19,20] In a previous study, it was mentioned that significant variation in eligibility assessments among centres existed.[7] This practice variation in medical eligibility for home dialysis urges the need for more guidelines on contraindications for home dialysis, especially in respect of

the increasing number of elderly patients with chronic kidney disease.[2] Elderly patients are often frail and more frequently have multiple comorbidities and thus might be considered ineligible for home dialysis treatment.[21] However, PD might be an excellent therapy option in elderly patients with for example haemodynamic instability.[20] Frail patients might need the assistance of caregivers or homecare workers, but with options for assisted PD home dialysis is also a feasible option for such patients.[22]

In the presented programme, three phases can be distinguished: the collection of information about the patient by nephrologist and the social worker and the general education session. Several studies suggest that a multistep pre-dialysis programme is associated with a higher percentage of home dialysis patients. Shukla et al.[4] found that a group education session followed by an individual session led to a steep increase in the number of patients starting home dialysis (38%). Manns et al. [23] randomized patients between standard education and an educational intervention including a group education session, combined with standard education. They reported that patients in the intervention group opted for home dialysis and self-care haemodialysis significantly more often. Velasco et al.[24] reported that the multicentre implementation of an education programme, consisting of an education session at home and multiple reflective sessions, resulted in a PD incidence of 48%, as opposed to the national PD incidence of 15% in Spain. Of interest, this was the only study of these three articles on multistep pre-dialysis programmes that reported the incidence rate of patients choosing conservative care. They reported a rate of 5%, while the incidence was 21% in our study. This underscores that our pre-dialysis programme provides optimal informed decision-making on all KRT programmes *and* conservative care.

To provide a practical workflow in pre-dialysis care, based on the experience collected in this study, one could adopt the following sequence of three-phase pre-dialysis programme (Figure 4). In this scenario, the professional knowledge of the nephrologist in assessing which patient *cannot* perform home dialysis for medical reasons is combined with the specific expertise of the social worker or dialysis nurse in determining which patient *can* perform home dialysis. We considered that a home visit was an important addition to this programme to satisfactorily assess the suitability of housing for home dialysis. But a home visit might also help to inform and reassure the social system surrounding the patient. In a study evaluating treatment modality education at home, family members that were present demonstrated improved understanding of dialysis and experienced fewer concerns and fears.[25]

A limitation of this study is that data were collected during the implementation of a new structured pre-dialysis programme in a single centre and that our study analysed the elements of this programme retrospectively. Therefore, we were unable to examine neither the influence of different professionals on treatment decision nor the
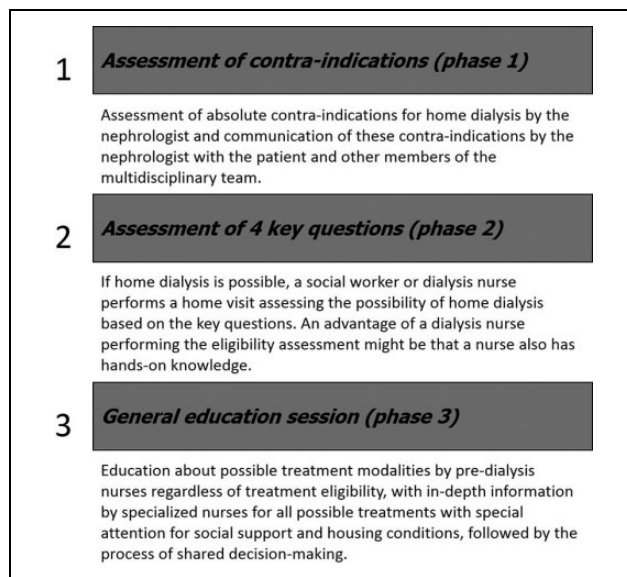

Figure 4. Proposed sequence in a structured pre-dialysis programme.

added value of a home visit instead of office consultations, whether verbal and non-verbal communication played a role in the treatment decision and whether other related factors correlating with home dialysis not measured in the questionnaire affected the assessment of eligibility (residual confounding). The questionnaires used were not validated for construct validity or reliability. Also, we did not investigate whether it makes a difference which healthcare professional assesses the four key questions. However, as some questions are best answered during a home visit, we think that the home visit rather than the social worker should play a central role in a pre-dialysis programme. A home visit could not be performed in every patient; but as the home visit was performed in 85% of patients, we believe that our conclusion about this part of pre-dialysis care is sufficiently well-founded.

Since certain questions involve a direct judgement by the social worker and are thus dependent on his expertise, a next step would be the validation of the key questions with assessments by other health professionals including dialysis nurses in external cohorts. Future studies might also specifically evaluate the effect of age and frailty on the treatment decision, as the number of elderly patients with chronic kidney disease increases.

The strength of this study includes the long follow-up period. Home dialysis was intentionally defined as a home modality 180 days after the start of dialysis, to enable the inclusion of late home dialysis starters. This definition is likely a reflection of the long-term dialysis modality. At 180 days after dialysis initiation as compared to 90 days after dialysis initiation, we were able to select two extra home HD patients. In addition, another strength of this study includes using clinimetrics to reduce a large number

of questions to four key elements that can be easily assessed during a pre-dialysis programme.

In conclusion, if there are no contraindications for home dialysis and a patient prefers this treatment, then a selection process including four key questions on suitable housing, self-care, social support and patient capacity, if possible addressed during a home visit, is an optimal way to assess a patient's eligibility for home dialysis. This strategy helps to do justice to the wish of many patients to be treated, or in fact treat themselves, with a dialysis modality at home.

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Supplemental material

Supplemental material for this article is available online.

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