

# **Effects of Nocturnal Home Hemodialysis on Quality of Life**

## **A Literature Review**

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Abstract  <p>Approximately, 2 million people suffer from end-stage renal disease worldwide. People suffering from this disease are subjected to compromised physical health and poorer quality of life. Certainly, the death rate is higher when compared with general population. Many types of dialysis regimen are available globally in order to improve the everyday life of these patients. One such treatment modality is nocturnal home hemodialysis. It is carried out during the night when patients are sleeping in their homes. Currently, only a small portion of patients undergoing hemodialysis are using this modality internationally.</p> <p>The authors aim is to obtain answers on how nocturnal home hemodialysis effects end-stage renal disease patient's quality of life through existing literature. The purpose is to understand the impact of nocturnal home hemodialysis on end-stage renal disease patients' quality of life by reviewing the existing literature.</p> <p>The research was implemented using literature review. Data was retrieved from three databases (CINAHL, Academic Elite Search and Pubmed) and through manual search via references from related literature reviews. The time frame was set from 2005 to September 2016. In total 13 articles were chosen. Data was analyzed using inductive content analysis.</p> <p>Results were inconclusive. While some studies observed some improvements other studies did not. Previous researches did not support the idea that quality of life improves with nocturnal home hemodialysis, however, some secondary and kidney specific domains such as physical health might have been improved with this method.</p> <p>To date, only two larger randomized controlled trials have approached this topic. Difficulties in getting big samples in order to provide reliable data has been a major challenge. In order to have more solid data on this topic future research is needed.</p>		
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## 1 Introduction

Worldwide, over two million people suffer from end stage renal disease (ESRD) and associated functional disabilities (Hall, Larive, Painter, Kaysen, Lindsay, Nissenson, Unruh, Rocco, Chertow & FHN 2012, 782). Specially, people on hemodialysis are subjected to suffer more deteriorated physical health and poorer quality of life (Cook & Jassal 2008, 1289). The length and quality of life reduces to greater extent in persons who suffer with end stage renal disease (McFarlane, Pierratos, Bayoumi & Redelmeier 2007, 477). The death rate of the individuals is almost 20 times more when it is compared with general population (Gudex 1995, 359). Similarly, the quality of life of patients who are on dialysis is said to be alike with those individuals who suffer from hepatocellular carcinoma (Schneider & Varghese 1995, 719). Particularly, patients who are on hemodialysis report lower physical functioning which is associated with high mortality rate and hospitalization (DeOreo 1997, 204). Improvement of physical health of the individuals undergoing hemodialysis have positive influence on quality of life and lifestyle (Hall et al. 2012, 792).

Hemodialysis regimen and end stage renal disease have been associated with poor quality of life (Van Eps, Jeffries, Johnson, Campbell, Isbel, Mudge & Hawley 2010, 29). Various experiments are underway to find an optimal dialysis program which aims to enhance the health status and well-being of the patients with end stage renal disease (Twardowski 2003, 5). Previous literature have reported contradictory relationship between dialysis dose and quality of life and outcomes. Peculiarly, the HEMO study (Unruh, Benz & Greene 2004, 362) found that dialysis dose or high flux membrane did not have any impact on quality of life, however, small enhancement in physical functioning was noticed.

According to Culleton and Asola (2011) most end stage renal stage patients, often, receive conventional hemodialysis (CHD) globally which means that they undergo hemodialysis for three times per week. However, the quality of life remain compromised and mortality rate is enhancing. Short daily hemodialysis (SDHD) or nocturnal hemodialysis (NHD), five to six time per week, is said to augment quality of life, improve functional abilities, reduce cardiovascular risk and lengthen survival rate. Practically, nocturnal home hemodialysis is performed at home, nevertheless, certain

barriers to adopt home hemodialysis are important to consider. For example, absence of health care professional, family and social support, incapability of cannulation, and unable to understand the hemodialysis procedures are important aspects to think before converting in-center conventional hemodialysis to home nocturnal hemodialysis. (405.)

The authors aim is to obtain answers on how nocturnal home hemodialysis effects end-stage renal disease patient's quality of life through existing literature. The purpose is to understand the impact of nocturnal home hemodialysis on end-stage renal disease patients' quality of life by reviewing the existing literature. By identifying the impact of nocturnal home hemodialysis on quality of life, the authors believe that this information can be used by the nurses to empathize with the patient and determine if this method will be most beneficial. On the other hand patients can use this information to know the existence of nocturnal home hemodialysis and comprehend the impact of this method on their quality of life and possibly their lifestyle. The main research question is: How does nocturnal home hemodialysis affect end-stage renal disease patients' quality of life?

## **2 Chronic Kidney Disease (CKD) and End-Stage Renal Disease (ESRD)**

El Nahas and El Kossi (Kar Neng 2009, 157) defined Chronic Kidney Disease (CKD) as kidney damage or a glomerular filtration rate (GFR) of less than 60ml/min/1.73m<sup>2</sup> regardless of the cause for at least three months. According to Tang in Kar Neng (2009, 8), GFR is the standard measure of renal function (6). In order to calculate the GFR of a patient, creatinine clearance results from a 24-hour timed sample is used into the GFR equation which contains different variables such as age, gender and ethnicity. The Kidney Disease Outcomes Quality Initiative (K/DOQI) developed five different stages to classify CKD according to the patients glomerular filtration rate results (Refer to Table 1). When a patient is diagnosed with stage five or end-stage kidney disease, a kidney replacement therapy (dialysis or kidney transplant) is mandatory. (9).According to the data collected during the years 2005/2006 from the United States Renal Data Systems (USRDS), the Australia and New Zealand Dialysis and

Transplant Registry (ANZDATA) and the UK Renal Registry glomerulonephritis, diabetes, hypertension/renovascular, infective or obstructive nephropathies, cystic or congenital disease are, in no particular order, the most common causes of ESRD. (Levy, Brown & Daley 2009, 8). Clinical features of ESRD in approximate order of frequency are anorexia, nausea and vomiting, fatigue and weakness, pruritus, lethargy, peripheral edema, dyspnea, insomnia, bleeding tendency, pulmonary edema, apathy, muscle cramps, feeling cold, Raynaud's phenomenon, metabolic flap, nocturia, polyuria, headache, pericarditis, fever, cough, diarrhea, constipation, seizures, hiccough, restless legs, growth retardation, sexual dysfunction, neuropathy, cognitive impairment, confusion, coma and proximal myopathy (14).

Table 1: Stages of Chronic Kidney disease according to the glomerular filtration rate (Kar Neng 2009, 9)

Stages of Chronic Kidney Disease	Description	Glomerular Filtration rate (GFR)
Stage 1	Kidney damage with normal or high GFR	90 ml/min/1.73m <sup>2</sup>
Stage 2	Kidney damage with mild GFR	60-89ml/min/1.73m <sup>2</sup>
Stage 3	Moderate low GFR	30-59ml/min/1.73m <sup>2</sup>
Stage 4	Severe low GFR	15-29 ml/min/1.73m <sup>2</sup>
Stage 5	Kidney failure or End-Stage Renal Disease	Less than 15ml/min/1.73m <sup>2</sup>

### 3 Dialysis

Dialysis is a treatment which replaces several of the functions of the kidney. It removes excess water and nitrogenous waste from the blood and thus regulating the electrolyte, water and acid-base balances of the body. However, it does not replace the endocrine nor the cardiovascular functions of the kidneys. The removal of solutes is achieved by filtering the blood through a semipermeable membrane with the help of a dialysis solution. The two main types of dialysis are hemodialysis (HD) and peritoneal dialysis (PD). (Levy et al. 2009, 71; Stein & Wild 2002, 90.) Depending on the location, periodicity and timing of the treatment, the two main types of dialysis can be classified further. Subjective symptoms, assessment by a nephrologist of objective parameters, evaluation and management of comorbidity, timing of dialysis initiation, socioeconomic status, cultural influences and choice of modality are evaluated in a multidisciplinary approach in order to provide the patient the best therapy available

(Kar Neng 2009, 169). There are different available modalities of dialysis (Refer to Figure 1).

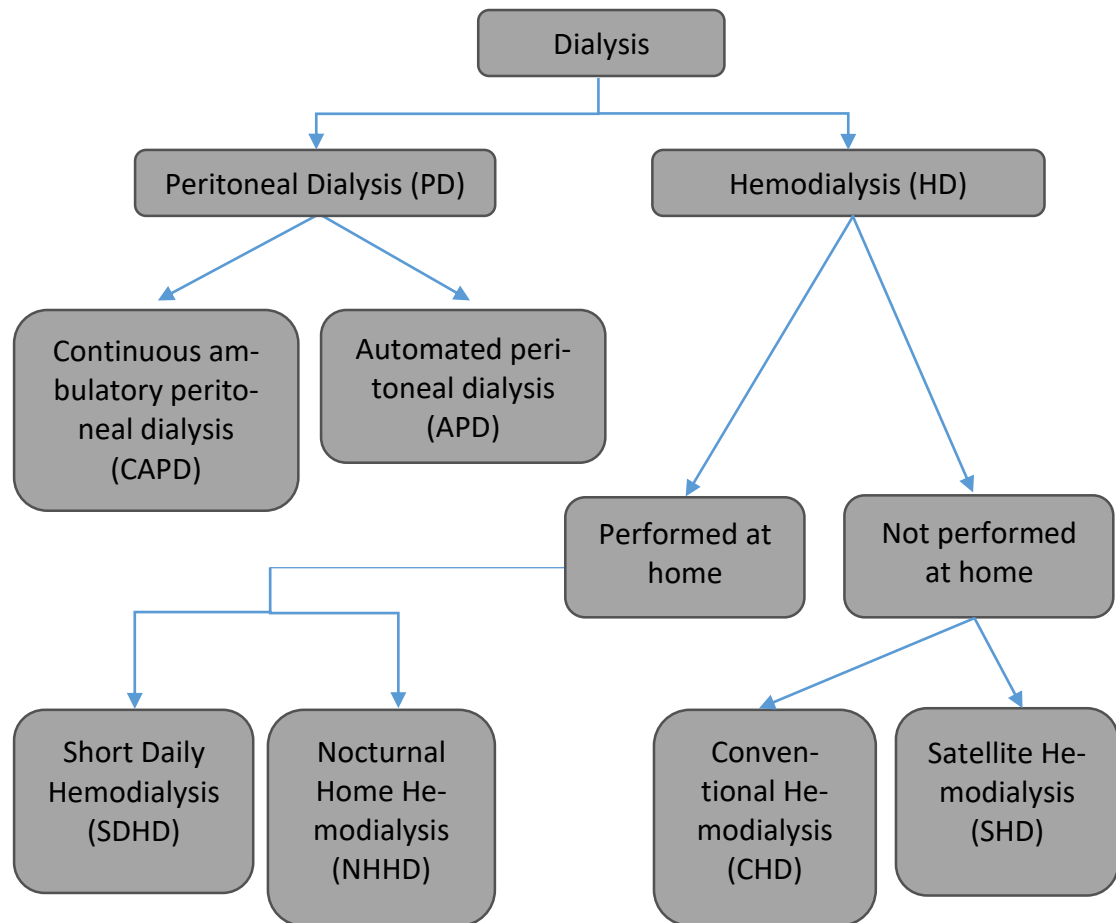


Figure 1: Modalities of dialysis (Kar Neng 2009, 169).

### 3.1 Peritoneal Dialysis (PD)

In peritoneal dialysis the peritoneum (natural membrane which lines the abdominal wall) is used as the filter. Dialysis solution is filled into the peritoneal cavity and solute and fluid exchange occurs between the solution and the peritoneum. Peritoneal dialysis is carried out at home. (Levy et al. 2009, 230; Stein & Wild 2002, 91-92.) The two main types of peritoneal dialysis are Continuous Ambulatory Peritoneal Dialysis (CAPD) and Automated Peritoneal Dialysis (APD). Both methods work according to the same principle. The main difference is that automated peritoneal dialysis is performed during the night with the help of a machine to speed up the process while in continuous ambulatory peritoneal dialysis, as the name suggests, the process is continually working during the whole day. (Stein & Wild 2002, 96.)



### 3.2 Hemodialysis (HD)

Unlike Peritoneal Dialysis, filtration in Hemodialysis is carried out by a machine outside the patient's body. (National Institute of Diabetes and Digestive and Kidney Diseases 2016, What is hemodialysis and how does it work?). In order for the machine to draw the blood, an access point is necessary. There are three main access points which are called dialysis catheter, Fistula and Graft. Each access is used according to the patient's state. For instance, dialysis catheter are mainly used as temporary hemodialysis access. The catheter is usually placed in the jugular, subclavian or femoral vein and the procedure can be done in a ward. On the other hand Fistula and Graft access require a surgical procedure and unless no complications occur, they last forever. Both have the same principle by joining an artery to a vein via surgical anastomosis. This allows repeated punctures to the vein and increase the pressure, facilitating returning of the filtered blood. The main difference of these two is that while a Fistula means joining an artery with a vein, the Graft connects an artery with a vein using a loop synthetic material, usually made of plastic. (Stein & Wild 2002, 112-115.)

There are two main circuits during the hemodialysis process. The first circuit is the blood circuit which pumps blood from the vascular access to the dialyzer and then back to the patient. In this circuit several sensors and mechanisms check for air bubbles and blood pressure for the patients' safety and triggers alarms if any complications occur. The second circuit is called dialysate circuit and delivers dialysate to the dialyzer. Dialysate is a mix of concentrate electrolytes and other solutes mix with purified water. The two circuits meet each other at the dialyzer separated by a membrane with the dialysate fluid flowing countercurrent of the blood flow. Filtration occurs in the dialyzer through a combination of diffusion, convection and absorption. (Kar Neng 2009, 208-212.) It is important to understand that the hemodialysis machine is a set of different equipment's (monitors, alarms, heating system, water purifying, and many more) with the main purpose of providing safety, independence and the most efficient dialysis to the patient as possible.

Hemodialysis can be performed in hospitals (in-center), at home by a trained patient or in free-standing facilities for easier access of patients in cities or rural areas (Akoh

& Hakim 2001, 24). There are several modalities of hemodialysis which are categorized depending on the periodicity, location and timing. The most used hemodialysis modality is in-center Conventional Hemodialysis (National Institute of Diabetes and Digestive and Kidney Disease 2009, ESRD Treatment Modality). It is performed in-center thrice weekly three to five hours each session. It is typically offered during day time but some centers may also offer the service during the night. Short Daily Hemodialysis and Nocturnal Home Hemodialysis are both performed at home five to seven times a week. The difference is that short daily hemodialysis is carried out during the day while nocturnal home hemodialysis is performed during the night. Sessions between the two also differ. As the name suggest, short daily hemodialysis is a short modality of dialysis and is completed after two to three hours per session while nocturnal home hemodialysis lasts for six to eight hours each session when the patient is sleeping. (Glickman 2011, 4.) Finally, Satellite Hemodialysis is a form of conventional hemodialysis which may be defined differently by centers and countries. It can vary from a self-care hemodialysis to a branch of an in-center hemodialysis without self-care. (Malmström, Roine, Heikkilä, Räsänen, Sintonen, Muroma-Karttunen & Honkanen 2008, 1990.) Self-care hemodialysis is similar to home hemodialysis with the main difference that is not performed at home but in a center with the assistance of healthcare providers. This kind of center provides the patient the necessary autonomy to schedule their hemodialysis sessions during the opening hours as each patient has her/his own personal machine. Patient usually perform the hemodialysis independently under the supervision of a qualified health care provider providing assurance and help to the patients whenever necessary. (Arkouche, Traeger, Delawari, Sibai-Galland, Abdullah, Galland, Leittenne, Fouque & Laville 1999, 2270.)

## 4 Quality of Life (QoL)

*“WHO defines Quality of Life as individuals’ perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person’s physical health, psychological state, level of independence, social relationships, personal beliefs and their relationship to salient features of their environment”*

*(World Health Organization 1997, 1)*

Definitions of quality of life can vary according to whom defines it. There is no official definition of quality of life (Rapley 2003, 29). Definitions can range from objective estimations of individuals life circumstances to their own subjective appreciation of these circumstances (27). According to the Centers of Disease Control and Prevention (CDC), although the term quality of life has a meaning for every person or academic discipline, individuals and groups can define it differently (CDC 2016, What is Quality of Life?). Multiple authors have used a wide variety of adjectives in such as balance, equilibrium or true bliss (Kant 1798), prosperity, psychological well-being, the good life, enjoyment, unemployment (Socrates), full and meaningful existence (Sheldon 2000) and many more in order to define it (Rapley 2003, 27). Rapley (2003, 30) stated that the quality of research on quality of life, particularly in the area of renal disease, is at best mixed and unacceptably poor.

During the research of the articles phase, the authors encountered different tools for the researchers to provide quantitative data to compare their samples quality of life between the different modalities of dialysis. These tools are explained and shown below.

- Euroqol EQ-5D

The Euroqol EQ-5D is a generic instrument designed to measure overall quality of life. The first part, called the descriptive system, consists of five questions which seek to express the current state of health using the following dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety.

ety/depression. Currently two versions exist: EQ-5D-3L which gives three levels for each dimension: problems, some problems and extreme problems. The other version is EQ-5D-5L which displays 5 levels for each dimension: no problems, slight problems, moderate problems, severe problems, and extreme problems. The second part, called the visual analogue scale, is the same in both versions. It shows a vertical scale numbered from 0 to 100. 0 represents the worst health and 100 the best health. Respondents are asked to draw a line at the point where they see their current health status. (Van Reenen & Oppe2015, 3-9; Van Reenen & Janssen 2015, 4-11.)

- **36-Item Short Form Survey (SF-36)**

The SF-36 is a generic tool which is used to evaluate overall quality of life. It consists of 36 questions which are designed to evaluate eight dimensions: physical functioning, bodily pain, role limitations due to physical health problems, and role limitations due to personal or emotional problems, emotional well-being, social functioning, energy/fatigue, and general health perceptions. (Rand, 36-Item Short Form Survey (SF-36) Scoring Instructions.)

- **Kidney Disease Quality of Life Short Form (KDQOL-SF)**

The KDQOL-SF is a short version of the original KDQOL. It includes 43 kidney-disease targeted items and also the SF-36 that grants a generic score and overall health rating. (Hays, Kallich, Mapes, Coons, Amin, Carter & Clamberg 1997, 2). The developmental aim of the questionnaire was to assess the effect of kidney disease and its treatment on quality of life. Moreover, it has been used in hemodialysis population for a long time already. (Hays, Kallich, Mapes, Coons, & Carter 1994, 329-338). Many advantages has been seen over preference based techniques which helps in comparisons of quality of life across disease states. The numeric rating of quality of life is determined by kidney disease quality of life in many domains (McFarlane, Pierratatos, Bayoumi, & Redelmeier 2007, 477.) These domain are symptoms, effects of kidney disease, burden of kidney disease, work status, cognitive function, quality of social interaction, sexual function, sleep, social support, dialysis staff encouragement and patient satisfaction (Hays et al. 1997, 2).

- Time trade off (TTO)

Time trade off method involves determining the maximum proportion of remaining lifespan that a patient would be willing to trade off for perfect health (McFarlane et al. 2007, 477). Participants are given a choice between remaining in their present health status or accepting a hypothetical treatment that would cure the patient's renal disease by resolving all the medical problems and restore the best possible health with the drawback that it would reduce the patients remaining lifespan (478).

- Standard Gamble (SG)

The standard gamble method determines the maximum chance of death that a patient would be willing to gamble against the perfect health status. For the standard gamble, the patients are given a choice to remain in their existing health status or accept a hypothetical treatment that would resolve their medical problems and put them in best of health. However, there is a possibility that the hypothetical treatment might fail, in which case the patient would die immediately. (McFarlane et al. 2007, 477-478.)

- 15D

The 15D is a generic self-administered questionnaire for measuring health-related quality of life. It comprises of 15 dimensions which are mobility, vision, hearing, breathing, sleeping, eating, speech, excretion, usual activities, mental function, discomfort and symptoms, depression, distress, vitality and sexual activity. Each dimension contains one question and five different answers. Each answer to the question indicates statements of the respondents' current health status. The first answer is an optimal condition and the fifth is inadequate. It has been translated to 29 languages including English, Finnish, German, Spanish and Urdu. (Sintonen, 15D instrument).

## **5 Aim, purpose and research question.**

The authors aim is to obtain answers on how nocturnal home hemodialysis effects end-stage renal disease patient's quality of life through existing literature. The purpose is to understand the impact of nocturnal home hemodialysis on end-stage renal disease patients' quality of life by reviewing the existing literature. By identifying the impact of nocturnal home hemodialysis on quality of life, the authors believe that this information can be used by the nurses to empathize with the patient and determine if this method will be most beneficial. On the other hand patients can use this information to know the existence of nocturnal home hemodialysis and comprehend the impact of this method on their quality of life and possibly their lifestyle.

The research question intended to answer in this thesis is:

How does nocturnal home hemodialysis effect end-stage renal disease patient quality of life?

## **6 Methodology**

### **6.1 Literature Review**

A literature review can be defined as a written argument which is a critical synthesis of published material on a certain topic. It provides a comprehensive grasp on that particular research topic and aims to give a foundation to answer the study's research question. (Machi & McEvoy 2009, 4.)

Writing a literature review follows a certain process. Each step of the process is described as follows. The first step of writing a literature review is selecting the topic. It should arise from practical problem or be of particular interest for the researcher. In order to outline a research topic, the language used has to be determined, the academic point of view taken during the research and specify the emphasis of the research topic. The second step is the literature search which defines what information is included in the review. Practically, this step consists of reviewing, selecting and organizing the data leading to a documentation of the data relevant for the study. Dur-

ing the third step, the researchers plan and present the obtained information by organizing the relevant data and summarizing the results about the topic. The next step is the survey of the literature. In this step, the researcher collects, synthesizes and analyzes the data in order to create a summary of the current knowledge on the research topic. It is the foundation for answering the research question. Step five is the critical appraisal of the literature. At this stage the researchers collect the latest information about the topic and investigate how previous research has tried to give an answer to the research question. The last step is the writing of the review, consisting of transforming all the previous collected information into an understandable document. (Machi & McEvoy, 2009, 4-6.)

There are certain benefits in conducting a literature review which shall not be underestimated. It is an inexpensive method to collect information and since the research is not funded it is the best suited way. The location of conducting the research is not restricted to a certain place. Furthermore the authors can follow their own schedule without taking outsiders into account. Finally by conducting a literature review the authors are able to identify, by examining the existing literature the necessity of further research. (Marelli 2005, 43.)

## 6.2 Search

Manual search in the internet and books were used in order to provide the theory for the thesis. To answer the main research question of this thesis, Cinahl, Academic Search Elite and PubMed were the main databases used in order to obtain the necessary material. Manually search articles were also used. Manually searched articles were mainly identified through the references of literature review articles which were excluded when identified. For instance the use of Google Scholar and Elsevier ScienceDirect were considered at first but finally discarded due to the inability of filtering for free literature. Combinations of the keywords “home”, “nocturnal” and “hemodialysis” were used to find the relevant articles for the thesis. Inclusion criteria of the literature were as follows:

- English written articles: English is the only common language of the authors and due to the English nature of the studies, the authors decided to only use English literature.
- Abstract available: One of the inclusion criteria will be the potential information that one can gather in the abstract.
- Full text must be available: This is a literature based thesis and because it is not founded, only free literature will be used.
- The literature must study the quality of life of patients undergoing nocturnal home hemodialysis and address the research question.
- Scientific publication.
- Literature published between January 2005 and September 2016.

The remaining literature which does not meet the inclusion criteria shall be automatically excluded from the thesis.

### 6.3 Search results

Selection of the articles was made according to the chart below (Refer to fig 2). After obtaining the results using the combination of the keywords “home”, “nocturnal”, “hemodialysis” and “quality of life”, these were filtered using the inclusion criteria. In order to pass the next stage, the title of the article was first screened and if relevant, the abstract was read to ensure the article addresses nocturnal hemodialysis and quality of life. Because of the broad range of different modalities of hemodialysis, some articles were excluded since it was not clearly specified in the abstract whether the patients were undergoing nocturnal home hemodialysis. During this step literature review articles were also excluded automatically if stated in the abstract. Finally the articles were read in order to confirm whether they address the main research question. Thirteen articles in total were included in the final thesis. Ten of them were found through Pubmed database and three via manual search. No articles were included from Cinahl and Academic Search Elite. For a summary of the included articles refer to Appendix 1.



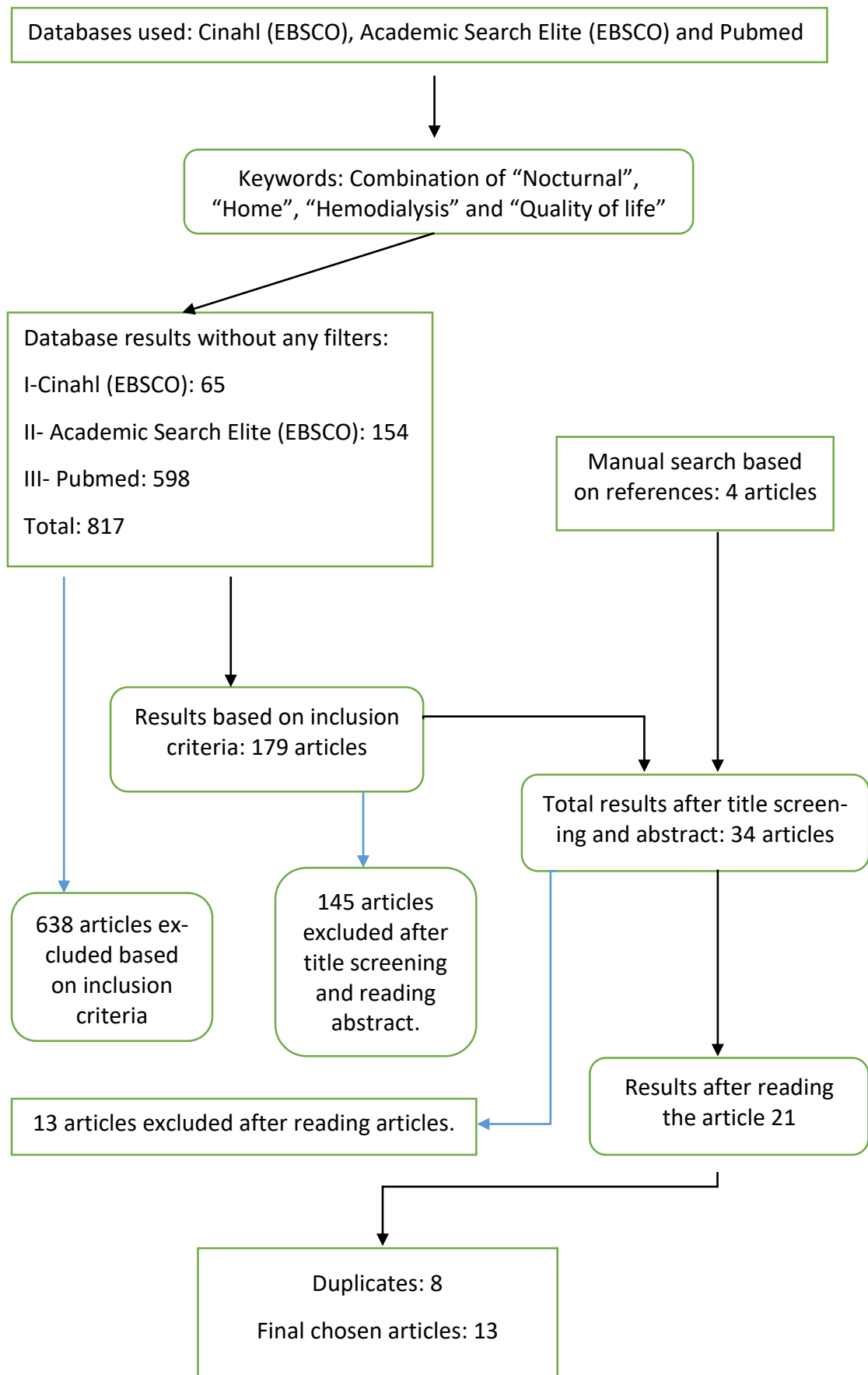


Figure 2: Selection Process.

## 6.4 Analysis and synthesis of data

Content analysis is the method used in order to analyze the obtained literature. While using this method the authors are able to synthesize the results of the published literature and identify dominant findings which will allow the authors to make content related themes or categories (Pope, Mays & Popay 2007, 48). According to Krippendorff (1980), the purpose of content analysis is to provide knowledge, new insights, representation of facts and a practical guide of action. The aim is to obtain a compact and full description of the matter that is being studied and finally gather themes or categories that englobes the matter being studied. (Elo & Kyngäs 2007, 108.)

Content analysis can be used either on qualitative or quantitative studies. Additionally it can be divided either in an inductive or deductive way. In the inductive content analysis the data is analyzed without having presumptions or a certain hypothesis beforehand. The obtained and analyzed data then provides the framework or theory carried out in a process which includes open coding, creation of categories and abstraction. (Aveyard 2010, 38; Elo & Kyngäs 2007, 109; Thomas 2006, 238.) Catanzaro (1988) describes that deductive content analysis is usually used when the author wants to retest already existing data such as hypothesis, models or concepts in a new environment or setting (Elo & Kyngäs 2007, 111). Because the main goal of this literature review is to understand how nocturnal home hemodialysis effects quality of life of the patient, the authors have decided to use an inductive content analysis.

Content analysis comprises of three phases during its process. These phases are the preparation phase, the organizing phase and finally the reporting phase. During the preparation phase the researcher must select the unit to analyze and make sense of the data by processing it all over again until it is completely understood. In this thesis the authors read the articles several times and marked important themes and categories. Thereafter organizing phase may start, which differentiates the inductive and the deductive way as inductive way focuses on coding, grouping and abstraction of the main ideas. In order to be able to identify main ideas the authors created a table (Refer to appendix 2) which categorizes the obtained information into categories, subcategories and main results. Finally the reporting phase includes a report of the

analyzing process and the obtained results. In this phase the authors converted the information of the table into text. (Elo & Kyngäs 2007, 109-112.)

## 7 Findings Results

### 7.1 Quantifying quality of life

According to Fong, Bargman and Chan (2007) patients on nocturnal home hemodialysis and peritoneal dialysis have similar results in KDQOL-SF. However, more perceived social support and less burden of kidney disease was measured in the peritoneal dialysis group. (1197.) According to Van Eps, Jeffries, Johnson, Campbell, Isabel, Mudge, and Hawley (2010, 33) through the kidney disease quality of life survey, patients' scores improved when it compared with baseline and 6 months following the conversion of patients from conventional hemodialysis to home nocturnal hemodialysis. The scores were higher in terms of general health, overall health rating, physical function, energy and fatigue, physical role and change in health over the last year. In addition, upgrading in the area of burden of kidney disease, ability to fulfill emotional roles, and effects of kidney diseases were noticed. (Van Eps et al. 2010, 33; Manns, Walsh, Culleton, Hemmelgarn, Tonelli, Schorr & Klarenbach 2008, 543.)

McFarlane et al. (2007, 479) collected data from five nocturnal home hemodialysis patients who responded at once that they wanted to live only until their next important event to happen. Moreover they were not willing to trade-off any time before that particular event, however, were eager to sacrifice all their remaining time after that occasion. Due to the small sample size, the time trade-off utility scores were lower who responded this way. In a research by McFarlane et al. (2007, 480) all participants were willing to gamble in response of getting perfect health, nevertheless, no statistically significant range was measured in nocturnal home hemodialysis patients.

In 15D instrument, no differences in health-related quality of life were seen in the results between nocturnal home hemodialysis and satellite hemodialysis (Malmström et al. 2008, 1993). Similar results were observed in the study conducted by Manns et

al. (2008, 543) using Euroqol EQ-5D and SF-36 when nocturnal home hemodialysis was compared to conventional hemodialysis.

## 7.2 Physical Functioning

There were no significant difference in patients  $VO_2$  peak 2 months after conversion from conventional hemodialysis to nocturnal home hemodialysis. However, exercise capacity was higher when measured three to six months after conversion from conventional to nocturnal home hemodialysis. No important differences were found two months after conversion to nocturnal home hemodialysis in exercise duration. Exercise duration increased when calculated three to six months after conversion to nocturnal home hemodialysis. (Chan et al. 2007, 3286-3287.)

In the same study conducted by Chan et al. (2007), records were kept about the time spent during sleep, and also in moderate, hard and very hard activities done in previous week. For each patient, they calculated total daily energy expenditure in Kcal/day or Kcal/kg/day. At any point in time, there was not much difference in total energy expenditure between conventional hemodialysis and nocturnal home hemodialysis values. (3288.)

Hall et al. (2012, 788) observed that the short physical performance battery score, which is a tool for measuring physical performance, did not differ much in subjects randomized to frequent dialysis when it was matched with conventional dialysis. Similar results were observed by Manns et al. (2009, 543) using composite scale of the SF-36 questionnaire which measures physical functioning.

Hall et al. (2012, 788) also did not notice much difference in self-reported physical health and functioning in subjects randomized to nocturnal home hemodialysis compared with the patients on conventional hemodialysis. However, Van Eps et al. (2010, 32) noticed that there was trend towards enhancement of overall health and physical functioning. After converting to nocturnal home hemodialysis, the distance covered by the patients in the six-minute' walk test improved notably. However, there was no specific correlation in physical functioning measured with six-minute' walk test and measured by parameters on kidney disease quality of life.

### 7.3 Medical outcomes

A randomized controlled trial conducted by Culleton, Walsh, Klarenbach, Mortis, Scott-Douglas, Quinn, Tonelli, Donnelly, Friedrich, Kumar, Mahallati, Hemmelgarn & Manns (2007, 1291), showed that nocturnal home hemodialysis significantly improved left ventricular mass compared to conventional hemodialysis. On the contrary, another randomized controlled trial conducted by Rocco, Lockridge Jr, Beck, Eggers, Gassman, Greene, Larive, Chan, Chertow, Copland, Hoy, Lindsay, Levin, Ornt, Pierratos, Pipkin, Rajagopalan, Stokes, Unruh, Star, Kliger & the Frequent Hemodialysis Network (FHN) Trial Group (2011, 1080) did not find a significant benefit of nocturnal home hemodialysis in terms of left ventricular mass compared to conventional hemodialysis.

Research shows an improvement of blood pressure management (less hypertensive medication and lower systolic blood pressure) in patients on nocturnal home hemodialysis compared to conventional hemodialysis. Nocturnal home hemodialysis has a positive effect on the management of hyperphosphatemia (lower phosphorus levels and reduction or discontinuation of oral phosphate binders). (Culleton et al. 2007, 1296; Fong et al. 2007, 1196-1197; Rocco et al. 2011, 1086.)

### 7.4 Cognitive function

By using various neuropsychological tests, Jassal, Devins, Bozanovic & Rourke (2006, 958) discovered that patients who changed from conventional hemodialysis to nocturnal home hemodialysis had significant improvement in their cognitive functioning after six months. On the other hand, Rocco et al. (2011, 1086) did not find any benefits of nocturnal home hemodialysis in terms of cognitive functioning compared to conventional hemodialysis. According to current research nocturnal home hemodialysis does not have significant benefit in terms of depression compared to conventional hemodialysis (Fong et al. 2007, 1197; Rocco et al. 2011, 1083).

## 7.5 Sexual Activity

Fong et al. (2007, 1197) observed a trend towards a better sexual function in nocturnal home hemodialysis patients compared to peritoneal dialysis patients. When comparing nocturnal home hemodialysis against conventional hemodialysis, there was no overall improvement in sexual activity (Bass, Ahmed, Klarenbach, Culleton, Hemmelgarn, & Manns 2012, 5-6). However this latter study also observed that women and patients under the age 60 may experience an improvement in sexual activity (6-7).

## 7.6 Cost effectiveness

In the hypothetical scenarios created by McFarlane, Bayoumi, Pierratos, & Redelmeier, (2006, 800), nocturnal home hemodialysis was dominantly more cost effective in a at least five years long-run compared to conventional hemodialysis, even though these scenarios were deliberately created to bias nocturnal home hemodialysis. Another economic evaluation of nocturnal home hemodialysis comparing to conventional hemodialysis conducted by Klarenbach, Tonelli, Pauly, Walsh, Culleton, So, Hemelgarn and Manns (2014, 588-589) observed that although nocturnal home hemodialysis has a higher initial cost, it is more cost saving over a lifetime horizon. This savings were true as long as there was less than 3.6% of the annual baseline risks of mortality or less than 6% of annual technique failure such as vascular access failures (589-590). When nocturnal home hemodialysis was compared to satellite hemodialysis no significant differences were seen in the overall results from Malmström et al. (2008, 1994). On the other hand, slightly better outcomes for nocturnal home hemodialysis were observed from Krarenbach et al. (2014, 591). Finally when nocturnal home hemodialysis was compared to peritoneal dialysis or short daily hemodialysis, cost effectiveness was very unfavorable towards nocturnal home hemodialysis (591).

## 8 Discussion

### 8.1 Discussion of main results

The aim of this study was to obtain information on how nocturnal home hemodialysis affects end-stage renal disease patient's quality of life through existing literature. This was to offer nurses and patient's alike information on this particular treatment and how it may affect the patient's everyday life. Initially the authors assumed that nocturnal home hemodialysis might be the optimal option for end-stage renal disease patients but the observed results were inconclusive. However, nocturnal home hemodialysis seemed to have improved some domains of quality of life when compared to the different types of available dialysis methods.

Many studies indicated that different components of quality of life was enhanced when they used daily home hemodialysis (nocturnal and short daily) methods (Kooistra, Vos J, Koomans, & Vos P. 1998, 2856-2858; Brissensen, Pierratos, Ouwendyk, Roscoe 1998, 168A; Heidenheim, Muirhead, Moist, & Lindsay 2003, 37-39; Ting, Kjellstrand, Freitas, Carie, & Zarghamee 2003, 1024; Lockridge, Spencer, & Craft 2004, 66-67; Traeger, Galland, Delawari, Arkouche, & Hadden 2004, 155-158; Suri, Nesrallah, & Mainra 2006, 37-40). However, various indices of quality of life has been improved more with short daily hemodialysis trial compared with nocturnal home hemodialysis (Van Eps et al. 2010, 34). Moreover various studies did not observed a positive impact of nocturnal home hemodialysis on quality of life when compared to other modalities (Malmström et al. 2008, 1993; Manns et al. 2008, 543).

Preference methods for example standard gamble and time trade-off were good tools to determine the quality of life of patients with end stage renal disease. These methods provided a more personal opinion of the patient's thoughts of their current situation as they were willing to trade money and time but not gamble into a perfect health or dead. This could suggest that their current situation is better than dying. (McFarlane et al. 2007, 481-482.)

It is important to remember that self-reported quality of life is very personal and several aspects can have an impact on its measurement. Therefore results can be influenced by the patient's current life situation, social and emotional state and several

other external factors. Additionally the lack of one standardized questionnaire to measure quality of life makes it more difficult to compare results.

Physical capability and energy level seemed to be improved by nocturnal home hemodialysis, but exact mechanism of improvement is unknown. Enhanced peak oxygen intake in dialysis patients helps them to train more. (Van Eps et al. 2010, 34.) However, significant improvement in exercise duration and maximum oxygen intake could not be seen immediately after transferring the patients to nocturnal home hemodialysis (Chan et al. 2007, 3288). Determining overall physical performance is not an easy task since it happens through a complex interaction of cardiovascular, musculoskeletal, sensory, neurological structure, yet, it depends on patients' motivation level. (Harada, Chiu, & Stewart 1999, 839.) Although the improvement of exercise duration and capacity is noticed after converting from conventional hemodialysis to nocturnal home hemodialysis, total daily energy expenditure remain unchanged (Chan et al. 2007, 3289). In Frequent Hemodialysis Network Nocturnal Trial, there was no improvement in self-reported physical functioning, health and performance (Hall et al. 2012, 789). However, in few randomized trials of short daily hemodialysis, short physical performance battery score and self-reported physical health and functioning improved substantially (Pahor, Blair, Espeland, Fielding, Gill, Guralnik, Hadley, King, Kritchevsky, Maraldi, Miller, Newman, Rejeski, Romashkan, & Studenski 2006, 1160; Guralnik, Simonsick, Ferrucci, Glynn, Berkman, Blazer, Scherr, & Wallace 1994, 89).

The aim of this study was to evaluate the impact of nocturnal home hemodialysis on quality of life. However, undeniable clinical parameters always have an effect on quality of life. There are various studies which address the impact of nocturnal home hemodialysis on clinical parameters. However, to this date only two randomized controlled trials have been conducted. According to both studies nocturnal hemodialysis improves blood pressure management and mineral metabolism. Patient not only had lower systolic blood pressure but were also able to reduce their blood pressure medication. (Culleton et al. 2007, 1296; Rocco et al. 2011, 1086) However, in terms of left ventricular mass Culleton et al. (2007, 1296) did find a reduction caused by nocturnal home hemodialysis whereas Rocco et al. (2011, 1086) did not. In both studies the author's stated that the used sample size was seen as a limitation since much higher



numbers of patients would be needed in order to provide more solid data. (Culleton et al. 2007, 1298; Rocco et al. 2011, 1086.)

The contradicting results of the studies about cognitive function might be due to the different designs, methods and study samples. First of all, Jassal et al. (2006, 958) used a longitudinal study design in which patients cognitive function was tested at baseline and six months after conversion to nocturnal home hemodialysis. On the other hand, Rocco et al. (2011, 1086) implemented a randomized controlled trial in which patients were randomly assigned to either conventional hemodialysis or nocturnal hemodialysis and cognitive functioning was tested at baseline and after approximately 12 months. Jassal et al. (2006, 956) used ten different neuropsychological test in order to evaluate patients cognitive functioning whereas Rocco et al.(2011, 1086) used only one neuropsychological test. This might increase the likelihood that Jassal et al. (2006) study is more reliable. Furthermore in Rocco et al. (2011, 1080) study cognitive functioning was a secondary outcome. Sample size was also different between the two studies. In Rocco et al. (2011, 1080) study the sample size was almost four times the sample size of Jassal et al. (2006, 956) study which might lead to the assumption that the data provided by the first one is more reliable.

Results in the sexual activity category were not conclusive. Even though, Fong et al. (2007, 1197) observed a trend towards a better sexual function in nocturnal home hemodialysis patients in comparison to peritoneal dialysis this study was not created specifically for this purpose and was obtained as a secondary result. Contrarily, when Bass et al. (2012, 5-6) compared nocturnal home hemodialysis to in-center conventional hemodialysis, they concluded that there is no difference in sexual activity between the two groups unless the nocturnal home hemodialysis patient is a woman and under 60 years of age and has been using the method for a minimum of six months. This specific outcomes were not specifically measured in their study and the authors stated their uncertainty why this sub category may sexually benefit from nocturnal home hemodialysis (6). It is also worth considering that tools such as KDQOL-SF (Hays et al. 1997, 2) or 15D (Sintonen, The health state descriptive system (questionnaire)) have specific domains for scoring the client's sexual health condition. Unfortunately apart from the two articles mentioned above, none of the chosen

articles provided data in this specific domain. This may have been due to the particular domain being irrelevant to their study.

Cost effectiveness of nocturnal home hemodialysis is relative to which method is compared to (conventional hemodialysis or peritoneal dialysis)(Klarenbach et al. 2014, 589, 591,), the location (home, in-center or satellite) (ibid. 592), the period of usage (McFarlane et al. 2006, 800-801), risks and failures of use (ibid. 590) and finally the country as different countries provide different financial supports for the modality used (Malmström et al. 2008, 1991-1992). Nocturnal home hemodialysis has a relatively higher initial cost than any other method as it requires an installation in the patients home (Klarenbach et al. 2014, 591) but seems to be more cost effective compared to in-center conventional hemodialysis when using it for longer periods of time (McFarlane et al. 2006, 800). It is also important to understand the definition of satellite hemodialysis when comparing as different countries may define it differently and therefore effect its cost effectiveness (Malmström et al. 2008, 1990). It appears that travel costs directly related to the treatment have a great impact in the final cost calculations as the other methods performed at home outshined the cost effectiveness of nocturnal home hemodialysis (Klarenbach et al. 2014, 591).

## 8.2 Ethical considerations, Reliability and Validity

According to the Ethical Principles for JAMK University of Applied Sciences 2013 every student engaged in research and development is obliged to act accordingly to the guidelines "Responsible conduct of research and procedures for handling allegations of misconduct in Finland (2012)" published by the Finnish advisory board on research integrity. Furthermore certain principles and rules of conduct should be followed. It is crucial to conduct the research in an honest, thorough and precise manner. Moreover the data collection and the methods used are supposed to be justified and ethically sustainable. The planning, reporting and recording of the data in a scientific way are essential parts of conducting a research. All these principles and rules of conduct are to be applied in order to impede research misconduct which are fabrication, falsification, plagiarism and misappropriation. (JAMK University of Applied Sciences Academic Board 2013, 6-10.)

The search of this thesis was conducted in an open and replicable manner. The same search words were used for all the databases. In order to acknowledge the authors who have undertaken previous research on the same topic it is vital to cite their publication appropriately. This is carried out by using the JAMK project reporting instructions. The authors of this thesis were precise in citing other researchers work in order to respect and acknowledge their work. Moreover the results of the chosen studies were described in an exact and open manner.

According to Evidence Based Medicine Toolkit Clinical Epidemiology Glossary (2008, Validity) validity is defined as *“degree to which the results of a study are likely to be true, believable and free of bias”*. Bias are systematic errors which are factors that can lead to a wrong conclusion (Malone, Nicholl & Tracey 2014, 279). Objectivity is a must in order to obtain as much validity as possible. The validity of the conducted research can be jeopardized by various kinds of bias. These include publication bias, selection bias, language bias, availability bias and cost bias (Dickersin 1997, 18-20; Felson, 1992, 889-890; Gregoire & Derderian 1995, 158-161; Lexchin, Bero, Djulbelovic & Clark 2003, 7-8).

Whenever an investigator, reviewer or editor decides to publish an article based only on the expected or favorable outcomes, a publication bias occurs (Dickersin et al. 1997, 19). Selection bias appear when the inclusion criteria during the research are not specific enough, leaving the author to choose or reject freely the desired literature (Felson 1992, 889). The authors of this thesis tried to avoid selection bias by formulating their inclusion criteria as specific as possible. Cost bias arise when the research or article results are conditioned by the sponsors (Lexchin et al. 2003, 7). Since this thesis is not sponsored, cost bias is not applicable. However, the article availability was restricted due to exclusion of articles which were not for free. Language bias take place when the language is chosen intentionally to fit the obtained results (Higgins & Green 2011, Addressing reporting biases). Although the authors could have used their mother tongues (Urdu, German or Spanish) the language of instruction of the authors degree programme is English, therefore only English literature was taken into account.

Bryman (2001) describes reliability as the repeatability in obtaining similar results in a study even with different circumstances as long as anything else has changed. Furthermore Stiles (1993) describes reliability as the trustworthiness of the procedures and data generated. By making notes of all the decisions made during the whole process and describing it accordingly, the authors add more repeatability to their work and therefore a more reliable final product. (Roberts & Priest 2006, 43.) In order to produce a reliable thesis the authors used the same search words for the databases used and described the article search and thesis process in a precise manner.

### 8.3 Limitations and considerations

The authors realize that they had to eliminate plenty of articles because of the time frame since the inclusion criteria of the chosen articles was for the last ten years. Although ten years may seem a long period of time, many articles were published before the time frame used. These articles could have provided more domains such as nutrition, sleeping habits, social interaction and possibly more. Furthermore the decision to only include literature written in English and free literature limited the amount of articles encountered. Naturally, these hindered the authors to have an even deeper insight of the effects of nocturnal home hemodialysis on quality of life.

### 8.4 Conclusions and future recommendations

Before conducting the research, the authors believed that nocturnal home hemodialysis may improve the quality of life. However, to date only two randomized controlled trials about the effects of nocturnal home hemodialysis on quality of life have been conducted. Neither of them discovered benefits of nocturnal home hemodialysis in terms of general quality of life when compared with conventional hemodialysis. Improvement in functional independence is possible only if patients adopt this regimen for longer periods of time.

In several of the studies the authors have encountered contradicting results. This may have been due to the wide range of dialysis modalities available, each of them with their own advantages and disadvantages. Further research in future, preferably

randomized controlled trials with much larger sample sizes might be needed in order to provide more solid data on this topic and to generalize the results.

It is the health care providers duty to be well informed in order to provide the relevant information to the patients according to his/her current medical state and style of living. In the end, it is the patient who chooses the modality according to availability, his/her needs and lifestyle.

## References

- Akoh, J. A. & Hakim N. S. 2001. *Dialysis Access – Current Practice*. Imperial College Press. UK
- Arkouche, W., Traeger, J., Delawari, E., Sibai-Galland, R., Abdullah, E., Galland, R., Leittenne, P., Fouque D. & Laville M. 1999. Twenty-five years of experience with out-center hemodialysis. *Kidney International*, 56, 2269-2275
- Aveyard, H. 2010. *Doing A Literature Review In Health And Social Care. A Practical Guide*. 2nd ed. Berkshire, GB: Open University Press.
- Bass, A., Ahmed, S. B., Klarenbach, S., Culleton, B. & Hemmelgarn, B. R. 2012. The impact of nocturnal hemodialysis on sexual function. *BMC Nephrology*, 13:67, 1-7
- Bleichrodt, H., & Johannesson, M. 1997. Standard gamble, time trade-off and rating scale: Experimental results on the ranking properties of QALYs. *Journal of Health Economics*, 16, 155-175
- Bleichrodt, H. 2002. A new explanation for the difference between time trade-off utilities and standard gamble utilities. *Health Economics*, 11, 447-456
- Blumenschein, K., & Johannesson, M. 1998. Relationship between quality of life instruments, health state utilities, and willingness to pay in patients with asthma. *Annals of Allergy, Asthma & Immunology*, 80, 189-194
- Brissensen, J., Pierratos, A., Ouwendyk, A., & Roscoe, J. 1998. Improvement in quality of life with nocturnal hemodialysis. *Journal of American Society of Nephrology*, 9, 168A
- Centers for Disease Control and Prevention (CDC). What is Quality of life? Accessed on 25<sup>th</sup> of October 2016. Retrieved from: <http://www.cdc.gov/hrqol/concept.htm>
- Chan, C. T., Notarius, C. F., Merlocco, A. C. & Floras, J. S. 2007. Improvement in exercise duration and capacity after conversion to nocturnal home hemodialysis. *Nephrology Dialysis Transplantation*, 22, 3258-3291
- Cook, W. L. & Jassal, S. V. 2008. Functional dependence among the elderly on hemodialysis. *Kidney International*, 73, 1289-1295
- Culleton, B. F. & Asola, M. R. 2011. The impact of short daily and nocturnal hemodialysis on quality of life, cardiovascular risk and survival. *Journal of Nephrology*, 24, 4, 405-415
- Culleton, B. F., Walsh, M., Klarenbach, S. W., Mortis, G., Scott-Douglas, N., Quinn, R. R., Tonelli, M., Donnelly, S., Friedrich, M. G., Kumar, A., Mahallati, H., Hemmelgarn, B. R. & Manns, B. J. 2007. Effect of frequent nocturnal hemodialysis vs Conventional hemodialysis on left ventricular mass and quality of life. A randomized control trial. *Journal of the American Medical Association*, 298, 11, 1291-1299
- DeOreo, P. B. 1997. Hemodialysis patient-assessed functional health status predicts continued survival, hospitalization, and dialysis-attendance compliance. *American Journal of Kidney Disease*, 30, 2014-212

- Dickersin, K. 1997 How important is publication bias? A synthesis of available data. *AIDS Educ Prev*, 9, 15-21
- Dolan, P., Gudex, C., Kind, P., & Willian, A. 1996. Valuing health states: A comparison of methods. *Journal of Health Economics*, 15, 209-231
- Elo, S. & Kyngäs, H. 2007. The qualitative content analysis process. *Journal of Advanced Nursing*. 62(1), 107-115
- Evidence Based Medicine Toolkit Clinical Epidemiology Glossary. Accessed on 07<sup>th</sup> of December 2014. Retrieved from: <http://www.ebm.med.ualberta.ca/Glossary.html#V>
- Felson, D. T. 1992. Bias in meta-analytic research. *J Clin Epidemiol*, 45, 885-892.
- Fong, E., Bargman, J. M. & Chan, C. T. 2007. Cross-sectional comparison of quality of life and illness intrusiveness in patients who are treated with nocturnal home hemodialysis versus peritoneal dialysis. *Clinical Journal of the American Society of Nephrology*, 2, 1195-1200
- Glickman, J. D. 2011. Options for renal replacement therapy: Comparison of modalities. *International Society of Peritoneal Dialysis*. 1-47
- Gregoire, G., Derderian, F., & Le, L. J. 1995. Selecting the language of the publications included in a meta-analysis: is there a Tower of Babel bias? *J Clin Epidemiol*, 48, 159-163
- Guralnik, J.M., Simonsick, E.M., Ferrucci, L., Glynn, R.J., Berkman, L.F., Blazer, D.G., Scherr, P.A., & Wallace, R.B. 1994. A short physical performance battery assessing lower extremity function: Association with self-reported disability and prediction of mortality and nursing home admission. *Journal of Gerontology*, 49, 85-94
- Gurdex, G. M. 1995. Health-related quality of life in endstage renal failure. *Quality of Life Research*, 4, 359-366
- Hall, Y.N., Larive, B., Painter, P., Kaysen, G.A., Lindsay, R.M., Nissenson, A.R., Unruh, M.L., Rocco, M.V., Chertow, G.M. and Frequent Hemodialysis Network Trial Group. 2012. Effects of six versus three times per week hemodialysis on physical performance, health, and functioning: Frequent hemodialysis network (FHN) randomized trials. *Clinical Journal of American Society of Nephrology* 7, 782-794
- Harada, N., Chiu, V., & Stewart, A. 1999. Mobility-related function in older adults: Assessment with a 6-minute walk test. *Archives of Physical Medicine and Rehabilitation*, 80, 837-841
- Hays, R.D., Kallich, J.D., Mapes, D.L., Coons, S.J., & Carter, W.B. 1994. Development of the kidney disease quality of life (KDQOL) instruments. *Quality of Life Research*, 3, 329-338
- Hays, R. D., Kallich, J. D., Mapes, D. L., Coons, S.J., Amin, N., Carter., W. B. & Kamberg, C. 1997. Kidney disease quality of life short form (KDQOL-SF), Version 1.3: A manual of use and scoring. Rand. Accessed on 20<sup>th</sup> of October 2016. Retrieved from: <https://www.rand.org/content/dam/rand/pubs/papers/2006/P7994.pdf>
- Heidenheim, A., Muirhead, N., Moist, L., & Lindsay R. 2003. Patient quality of life on quotidian hemodialysis. *American Journal of Kidney Disease*, 42, 36-41

Higgins, J. P. T. & Green, S. 2011. Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. Chapter 10. The Cochrane Collaboration. Accessed on 16<sup>th</sup> of December 2014. Retrieved from: <http://handbook.cochrane.org/>

JAMK University of Applied Sciences Academic Board 2013. Ethical Principles for JAMK University of Applied Sciences. Accessed on 7<sup>th</sup> of December 2014. Retrieved from: <http://www.jamk.fi/globalassets/tietoa-jamkista--about-jamk/esittely/ethical-principles-20130513.pdf>

Jassal, S. V., Devins, G. M., Bozanovic, R. & Rourke, S. 2006. Improvement in cognition in patients converting from thrice weekly hemodialysis to nocturnal hemodialysis: A longitudinal pilot study. *Kidney International*, 70, 956-962

Kar Neng, L. 2009. *Practical manual of renal medicine: Nephrology, Dialysis and Transplantation*. World Scientific Publishing Co. USA

Klarenbach, S., Tonelli, M, Pauly, R., Walsh, M., Culleton, B., So, H., Hemmelgarn, B. & Manns, B. J. 2014. Economic evaluation of frequent home nocturnal hemodialysis based on a randomised controlled trial. *Journal of the American Society of nephrology*, 25, 587-594

Kooistra, M., Vos, J., Koomans, H., & Vos, P. 1998. Daily Home hemodialysis in the Netherland: Effects on metabolic control, hemodynamics, and quality of life. *Nephrology Dialysis Transplantation*, 13, 2853-2860

Levy, J., Brown, E. & Daley, C. 2009. *Oxford Medical Handbooks : Oxford Handbook of Dialysis*. Oxford, GB: Oxford University Press.

Lexchin, J., Bero, L. A., Djulbegovic, B., Clark, O. 2003. Pharmaceutical industry sponsorship and research outcome and quality: systematic review. *BMJ*, 326, 1167-1170

Lockridge, R., Spencer, M., & Craft, V. 2004. Nightly home hemodialysis: Five and one-half years of experience in Lynchburg, Virginia. *Hemodialysis International*, 8, 61-69

Machi, L. A. & McEvoy, B. T. 2009. *The Literature Review*. Corwin Press

Manns, B. J., Walsh, M. W., Culleton, B. F., Hemmelgarn, B., Tonelli, M., Schorr, M. & Klarenbach, S. 2008. Nocturnal hemodialysis does not improve overall measures of quality of life compared to conventional hemodialysis. *Kidney International*, 75, 542-549

Mareli, A. F. 2005. The Performance Technologist's Toolbox: Literature Reviews. *Performance Improvement*, 44, 7, 40-44

Malone, H., Nicholl, H. & Tracey, C. 2014. Awareness and minimization of systematic bias in research. *British Journal of Nursing*. Mark Allen Publishing Ltd, 23:5, 279-282

Malmström, R. K., Roine, R. P., Heikkilä, A., Räsänen, P., Sintonen., H. Muroma-Karttunen, R. & Honkanen E. 2008. Cost analysis and health-related quality of life of home and self-care satellite haemodialysis. *Nephrology Dialysis Transplantation*, 23, 1990-1996



McFarlane, P. A., Bayoumi, A.M., Pierratos, A.& Redelmeier, D. A. 2006. The impact of home nocturnal hemodialysis on end-stage renal disease therapies: A decision analysis. *Kidney International*, 69, 798-805

Mcfarlane, P. A., Pierratos, A., Bayoumi, A. M. & Redelmeier, D. A. 2007. Estimating preference scores in Conventional and Home nocturnal Hemodialysis patients. *American Society of Nephrology*, 2, 477-483

National Institute of Diabetes and Digestive and Kidney Disease 2016. Treatment methods for kidney failure: Hemodialysis. Accessed on 25<sup>th</sup> of October 2016. Retrieved from: <https://www.niddk.nih.gov/health-information/health-topics/kidney-disease/hemodialysis/Pages/facts.aspx>

National Institute of Diabetes and Digestive and Kidney Disease 2009. ESRD Treatment Modality. Accessed on 26<sup>th</sup> of October 2016. Retrieved from: <https://www.niddk.nih.gov/health-information/health-statistics/Pages/kidney-disease-statistics-united-states.aspx#10>

Pahor, M., Blair, S.N., Espeland, M., Fielding, R., Gill, T.M., Guralnik, J.M., Hadley, E.C., King, A.C., Kritchevsky, S.B., Maraldi, C., Miller, M.E., Newman, A.B., Rejeski, W.J., Romashkan, S., & Studenski, S. 2006. LIFE study investigators: Effects of physical activity intervention on measures of physical performance: Results of the lifestyle interventions and independence for elders pilot study. *Journals of Gerontology Series A: Biological Science and Medical*, 61, 1157-1165

Pierratos, A., McFarlane, P.A. & Chan, C.T. 2006. Daily hemodialysis 2006. State of the art. *Minerva Urologica E Nefrologica*, 58, 99-115

Pope, C., Mays, N. & Popay, J. 2007. *Synthesizing Qualitative And Quantitative Health Evidence: A Guide to Methods*. Buckingham. US: Open University press.

Rand.org. 36-Item Short Form Survey (SF-36) Scoring Instructions. Accessed on the 20<sup>th</sup> of October 2016. Retrieved from: [http://www.rand.org/health/surveys\\_tools/mos/36-item-short-form/scoring.html](http://www.rand.org/health/surveys_tools/mos/36-item-short-form/scoring.html)

Rapley, M. 2003. *Quality of Life Research: A critical introduction*. Sage Publications Ltd. London, UK.

Roberts, P. & Priest, H. 2006. Reliability and validity in research. *Nursing Standard*, 20, 44 41-45

Rocco, M. V., Lockridge Jr, R. S., Beck, G. R., Eggers, P. W., Gassman, J. J., Greene, T., Larive, B., Chan, C. T., Chertow, G. M., Copland, M., Hoy, C. D., Lindsay, R. M., Levin, N. W., Ornt, D. B., Pierratos, A., Pipkin, M. F., Rajagopalan, S., Stokes, J. B., Unruh, M. L., Star, R. A., Klinger, A. S. & the Frequent Hemodialysis Network (FHN) Trial Group. 2011. The effects of frequent nocturnal home hemodialysis: the frequent hemodialysis network nocturnal trial. *Kidney International*, 80, 1080-1091

Schneider, B., & Varghese, R. K. 1995. Scores on the SF-36 scale and the Beck Depression Inventory in assessing mental health among patients on hemodialysis. *Psychological Research*, 76, 719-722

Sietsema, K.E., Amato, A., Adler, S.G. 2004. Exercise capacity as a predictor of survival among ambulatory patients with end-stage renal disease. *Kidney International*, 65, 719-724.

Sintonen, H. 15D instrument. Accessed on 19<sup>th</sup> of October 2016. Retrieved from: <http://www.15d-instrument.net/15d/>

Stein, A. & Wild, J. 2002. *Kidney Dialysis And Transplants - The 'At Your Fingertips' Guide : The 'At Your Fingertips' Guide*. Class Publishing. London, GB

Suri, R., Nesrallah, G., & Mainra R. 2006. Daily hemodialysis: A systematic review. *Clinical Journal of American Society of Nephrology*, 1, 33-42

Ting, G., Kjellstrand, C., Freitas, T., Carie, B., & Zarghamee S. 2003. Long-term study of high-comorbidity ESRD patients converted from conventional to short daily hemodialysis. *American Journal of Kidney Disease*, 42, 1020-1025

Thomas, D. R. 2006. A General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation*, 27: 2, 237-246

Traeger, J., Galland, R., Delawari, E., Arkouche, W., & Hadden, R. 2004. Six years experience with short daily hemodialysis: Do the early improvement persist in the mid and long term? *Hemodialysis International*, 8, 151-158

Twardowski, Z. 2003. We should strive for optimal hemodialysis: A criticism of the hemodialysis adequacy concept. *Hemodialysis International*, 7, 5-16

Unruh, M., Benz, R., Greene, T. 2004. Effects of hemodialysis dose and membrane flux on health-related quality of life in HEMO study. *Kidney International*, 66, 355-366

Van Eps, V., Jeffries, J. K., Johnson, D. W., Campbell, S. B., Isbel, N. M., Mudge, D. W. & Hawley, C. M. 2010. Quality of life and alternate nightly nocturnal home hemodialysis. *Hemodialysis International*.14, 29-38

Van Reenen, M. & Janssen, B. 2015. EQ-5D-5L User Guide. Version 2.1. EuroQol Research Foundation. Accessed on 18<sup>th</sup> of October 2016. Retrieved from: [http://www.euroqol.org/fileadmin/user\\_upload/Documenten/PDF/Folders\\_Flyers/EQ-5D-5L\\_UserGuide\\_2015.pdf](http://www.euroqol.org/fileadmin/user_upload/Documenten/PDF/Folders_Flyers/EQ-5D-5L_UserGuide_2015.pdf)

Van Reenen, M. & Oppe, M. 2015. EQ-5D-3L User Guide. Version 5.1. EuroQol Research Foundation. Accessed on 18<sup>th</sup> of October 2016. Retrieved from: [http://www.euroqol.org/fileadmin/user\\_upload/Documenten/PDF/Folders\\_Flyers/EQ-5D-3L\\_UserGuide\\_2015.pdf](http://www.euroqol.org/fileadmin/user_upload/Documenten/PDF/Folders_Flyers/EQ-5D-3L_UserGuide_2015.pdf)

World Health Organization 1997. Measuring Quality of Life. Accessed on 25<sup>th</sup> of October 2016. Retrieved from: [http://www.who.int/mental\\_health/media/68.pdf](http://www.who.int/mental_health/media/68.pdf)

## Appendices

Appendix 1: Summary of chosen articles.

Author(s)	Year & Country and Database.	Title	Purpose and Aims of the Study	Research Methods or Instruments	Sample	Main Results
Bass, A., Ahmed, S. B., Klarenbach, S., Culleton, B., Hemmelgarn, B. R. & Manns, B.	2012, Canada. Pubmed.	-The impact of nocturnal hemodialysis on sexual function.	-To determine if frequent NHHD is associated with an improvement in sexual activity and responses to sexual related questions in KDQOL-SF	-Sexual activity and responses to sexual related questions were assessed through KDQOL-SF questionnaire	-51 patients (26= randomized to NHHD; 25= randomized to CHD).	-NHHD is not associated with improvement in sexual activity in all patients. -NHHD might have an effect on the burden of kidney disease on sex life on women and patients less than 60 years of age.
Chan, C. T., Notarius, C. F., Merlocco, A. C. & Floras, J. S.	2007, Canada. Pubmed.	-Improvement in exercise duration and capacity after conversion to nocturnal home hemodialysis.	-The main purpose of the study was to document the changes in exercise duration and exercise capacity before conversion to	-Consecutive ESRD patients and healthy normal subjects matched for age and body mass index exercised to peak effort (VO <sub>2</sub> peak) as determined	-13= Consecutive ESRD patients -14= Healthy	-Exercise was performed before, 2 and 3–6 months after conversion from conventional hemodialysis.

			NHHD and after conversion. Also the aim was to compare these with values obtained in normal control subjects matched for age and body size.	by open-circuit spirometry during a graded cycle ergometer test with a ramp increase in work rate (by 17 watts/min).	Normal subjects	a) Exercise duration increased progressively from 617 (CHD) to 634 (NHHD) in 2 months duration and to 682 with NHHD in 3–6 months' time. b) Exercise capacity, expressed as percent of predicted (based on age, sex and body size) from 66 to 72 in 2 months and to 75 in 3–6 months' time period.
Culleton, B. F., Walsh, M., Klarenbach, S. W., Mortis, G., Scott-Douglas, N., Quinn, R. R., Tonelli, M., Donnelly, S., Friedrich, M. G., Kumar, A., Mahallati, H., Hemmelgarn, B. R. & Manns, B. J.	2007. Canada. Manually searched.	-Effect of frequent nocturnal hemodialysis vs Conventional hemodialysis on left ventricular mass and quality of life. A randomized control trial.	-To compare the effects of NHD versus CHD on change of left ventricular mass, HRQOL, blood pressure and mineral metabolism.	-Left ventricular mass was measured via cardiovascular magnetic resonance two weeks after baseline visit and six months. -HRQOL questionnaire were provided at baseline and after six months. -Blood pressure was measured by physicians.	-51 patients (26= randomized to NHHD; 25= randomized to CHD).	-NHHD improved left ventricular mass, reduced blood pressure medication, improved some measure of medical metabolism and improved selected measure of quality of life in comparison to CHD.

Fong, E., Bargman, J. M. & Chan, C. T.	2007, Canada. PubMed.	-Cross-sectional comparison of quality of life and illness intrusiveness in patients who are treated with nocturnal home hemodialysis versus peritoneal dialysis.	-The authors hypothesized that NHHd was associated with improved QoL but higher illness intrusiveness than PD.	-Assessment of QoL using KDQOL-SF version 1.3 -Blood test obtained via standardized protocols. -Assessment of depression using BDI questionnaire. -Intrusiveness rating scale to measure dialysis method perceived intrusiveness.	-96 patients (36= NHHd; 57 = PD)	-NHHd and PD patients had similar QoL, depressive symptoms and illness intrusive scores
Hall, Y. N., Larive, B., Painter, P., Kaysen, G. A., Lindsay, R. M., Nissenson, A. R., Unruh, M. L., Rocco, M. V., Chertow, G. M. & the Frequent Hemodialysis Network Trial Group.	2012, USA. Pubmed.	-Effects of six versus three times per week hemodialysis on physical performance, health, and functioning: Frequent hemodialysis network (FHN) randomized trials.	- To examine changes in physical performance and self-reported physical health and functioning between subjects randomized to NHHd (nocturnal trial) and SDHD (daily trial) compared to CHD	- Changes in scores over 12 months on the short physical performance battery (SPPB), RAND 36-item health survey physical health composite (PHC), and physical functioning subscale (PF)	-n= 87 Baseline: CHD: 42 NHHd: 45 n= 68 Follow-up: CHD: 36 patients, NHHd: 32 patients	- NHHd does not improve physical performance and self-reported physical health and functioning compared to CHD
Jassal, S. V., Devins, G. M., Bozanovic, R. & Rourke, S.	2006, Canada. Pubmed.	-Improvement in cognition in patients converting from thrice	-To quantify the degree of improvement, if any, in three domains of cognitive	-Patients underwent a battery of 10 psychometric tests at baseline and 6 months after conversion to NHHd.	14 patients	-NHHd may be associated with improved general cognitive efficiency as measured by psychomotor efficiency

		weekly hemodialysis to nocturnal hemodialysis: A longitudinal pilot study.	function (learning efficiency, attention and working memory and psychomotor efficiency and processing speed) when converting patients from CHD to NHHH.			and attention and working memory.
Klarenbach, S., Tonelli, M, Pauly, R., Walsh, M., Culleton, B., So, H., Hemmelgarn, B. & Manns, B.	2014, Canada. Pubmed	-Economic evaluation of frequent home nocturnal hemodialysis based on a randomized controlled trial.	-To find out the cost-utility analysis of Frequent NHHH compared with CHD.	-Randomized control trials	n=Not mentioned. Only mentioned about cohort group.	-Frequent NHHH is attractive compared with in-center CHD. However, the attractiveness of frequent NHHH varies by technique failure rate, training time, and dialysis modalities.
Malmström, R. K., Roine, R. P., Heikkilä, A., Räsänen, P., Sintonen., H. Muroma-Karttunen, R. & Honkanen E.	2008, Finland. Pubmed.	-Cost analysis and health-related quality of life of home and self-care satellite hemodialysis.	-Purpose of the study was to analyses costs and HRQoL of HHD and SHD.	-Cost data were collected from those study patients who were on dialysis the whole calendar year 2004. -HRQoL was measured by the generic 15D instrument (questionnaire).	n=65 HHD=33 SHD=32	-Direct medical costs of dialysis and hospital treatment were higher in HHD than in SHD. -On the other hand, travel costs were lower in HHD than in SHD. -Costs of pharmaceuticals did not differ significantly.

						-On the whole, HHD and SHD are equally effective in providing health from the patient's perspective.
Manns, B. J., Walsh, M. W., Culleton, B. F., Hemmelgarn, B., Tonelli, M., Schorr, M. & Klarenbach, S.	2008, Canada. Pubmed.	-Nocturnal hemodialysis does not improve overall measures of quality of life compared to conventional hemodialysis.	-To compare the quality of life of patients undergoing NHD and CHD	-Quality of life was measured using a KDQOL-SF and the preference-based Euroqol EQ-5D questionnaire. -Performed additional analyses comparing change in quality of life from pre-randomization to 6 months. Other analyses considered the impact of NHD on four pre-selected KDQOL-SF domains, and the longer term impact of NHD on quality of life.	n= 52	-Primary quality of life analysis did not demonstrate a statistically significant change between NHD and CHD, although statistically significant and clinically important changes in some secondary kidney-disease-specific measures were observed.
McFarlane, P. A., Bayoumi, A. M., Pierratos, A. & Redelmeier, D. A.	2006, Canada. Pubmed.	-The impact of home nocturnal hemodialysis on end-stage renal disease therapies: A decision analysis.	- Examine the relative cost-effectiveness of NHD and CHD, projecting future costs and health effects over a lifetime with end-stage renal disease	- Calculating QALY and lifetime costs using decision analysis techniques (Markov state-transition model, one-way sensitivity analyses and Monte Carlo simulations)		- NHD improves quality-adjusted survival and cost-effectiveness ratio compared to CHD

McFarlane, P. A., Pieratos, A., Bayoumi, A. M. & Redelmeier, D. A.	2007, Canada. Pubmed.	-Estimating preference scores in Conventional and Home Nocturnal Hemodialysis patients.	- Estimate preference for current health of NHHH and CHD patients	- Preference for current health was estimated using the standard gamble (SG), time trade-off (TTO), and modified willingness to pay (WTP) methods	- NHHH: 24 patients - CHD: 20 patients	- NHHH patients showed a larger preference for current health than CHD patients
Rocco, M. V., Lockridge Jr, R. S., Beck, G. R., Eggers, P. W., Gassman, JJ., Greene, T., Larive, B., Chan, C. T., Chertow, G. M., Copland, M., Hoy, C. D., Lindsay, R. M., Levin, N. W., Ornt, D. B., Pierratos, A., Pipkin, M. F., Rajagopalan, S., Stokes, J. B., Unruh, M. L., Star, R. A., Klinger, A. S. & the Frequent Hemodialysis Network (FHN) Trial Group.	2011, USA. Manually searched.	-The effects of frequent nocturnal home hemodialysis: the frequent hemodialysis network nocturnal trial.	- Study the effects of NHHH compared to CHD on left ventricular mass, physical health, cognitive performance, depression, nutrition, mineral metabolism and anemia, blood pressure and rates of hospitalization, and vascular access interventions	- Randomized controlled trials - left ventricular mass was measured by MRI, physical health by RAND Physical health composite, cognitive performance and depression by BDI, nutrition by laboratory markers, mineral metabolism and anemia by measuring pre-dialysis albumin and pre-dialysis phosphorus, BP by measuring it.	- n=87 - Baseline: CHD: 42 NHHH: 45 - n=68 - Follow-up CHD: 36 NHHH: 32	- NHHH does not improve left ventricular mass nor physical health - NHHH does improve control of hyperphosphatemia and hypertension



Van Eps, C. L., Jeffries, J. K., Johnson, D. W., Campbell, S. B., Isbel, NM., Mudge, D. W. & Hawley, C. M.	2010, Australia. Manually searched.	-Quality of life and alternate nightly nocturnal home hemodialysis.	-Explore the effects of an alternate NHHD on QoL. - Assess reliability of improvements in physical functioning.	-Assessment of QoL through AQoL version 1 and KDQOL-SF version 1.3 -6-minutes' walk test.	-63 patients converted from CHHD to NHHD	-Significant improvement in general QoL and specific areas of energy and fatigue, physical function and physical role.
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Abbreviations: AQoL = Assessment of quality of life; BDI = Beck depression inventory; BDS = Beck depression score; KDQOL-SF = Kidney disease quality of life short form; CHD = Conventional hemodialysis; CHHD = Conventional home hemodialysis; HRQOL = Health related quality of life; QALY = Quality-adjusted life years; QoL = Quality of life; PD = Peritoneal dialysis; NHD = Nocturnal hemodialysis; NHHD = Nocturnal home Hemodialysis; SHD = Satellite hemodialysis; SDHD = Short Daily Hemodialysis

#### Appendix 2: Resulted categories and subcategories

Main Category	Sub Category	Main Results
Quantifying Quality of Life	Kidney Disease Quality of Life Short Form (KDQOL-SF)	-Similar results compared to PD. -Improvement in the domains of effect of kidney disease and burden of kidney disease compared to CHD.
	36-Item Short Form Survey (SF-36)	-Results are contradicting.
	Time Trade-Off (TTO)	-Live until next important event to happen -Not willing to trade off time before the important event

		-Willing to sacrifice time after important event
	Standard Gamble (SG)	-All willing to gamble in order to get perfect health
	15D Instrument	-No differences in HRQoL between NHHD and SHD patients
	Euroqol EQ-5D	-No differences in QoL between NHHD and CHD patients
	Perceived intrusiveness of ESRD	-Similar scores for patients on NHHD and PD
Physical Functioning	Exercise Capacity	-Exercise capacity increased after conversion from CHD to NHHD
	Exercise duration	-Exercise duration increased after conversion from CHD to NHHD
	Energy Expenditure	-Same energy expenditure after conversion from CHD to NHHD
	Short Physical Performance Battery Score (SPBB)	-No difference in physical performance was seen between NHHD and CHD
	Self-Reported Physical Health and Functioning (SF-36)	-No difference in physical health and functioning between NHHD and CHD
	Assessment of Quality of Life (AQOL)	-Trend towards enhancement of overall health and physical functioning -Improvement in the 6 minutes' walk test
	Left Ventricular Mass	-Results of the benefit of NHHD on left ventricular mass are contradicting

Medical Outcomes	Blood Pressure	-NHHH improves blood pressure control (reduction of medication and lower blood pressure)
	Mineral Metabolism	-Positive effect on management of hyperphosphatemia.
Cognitive Function		-Cognitive functions results when compared to CHD are inconclusive. -When compared to CHD no benefits were seen towards depression.
Sexual Activity		-Better sexual function when compared to PD. -No overall improvement when compared to CHD. -Women and under 60 may experience improvement in sexual activity.
Cost Effectiveness		-More cost effective than in-center CHD if used more than five years. -Higher initial cost than in-center CHD -Savings are only plausible if NHHH has less than 3.6% annual baseline risks of mortality or less than 6% annual technique failure when compared to in-center CHD. -Cost effectiveness when compared to SHD is inconclusive. -Not cost effective when compared to PD or home CHD