Establishing nurse to patient ratio in haemodialysis care

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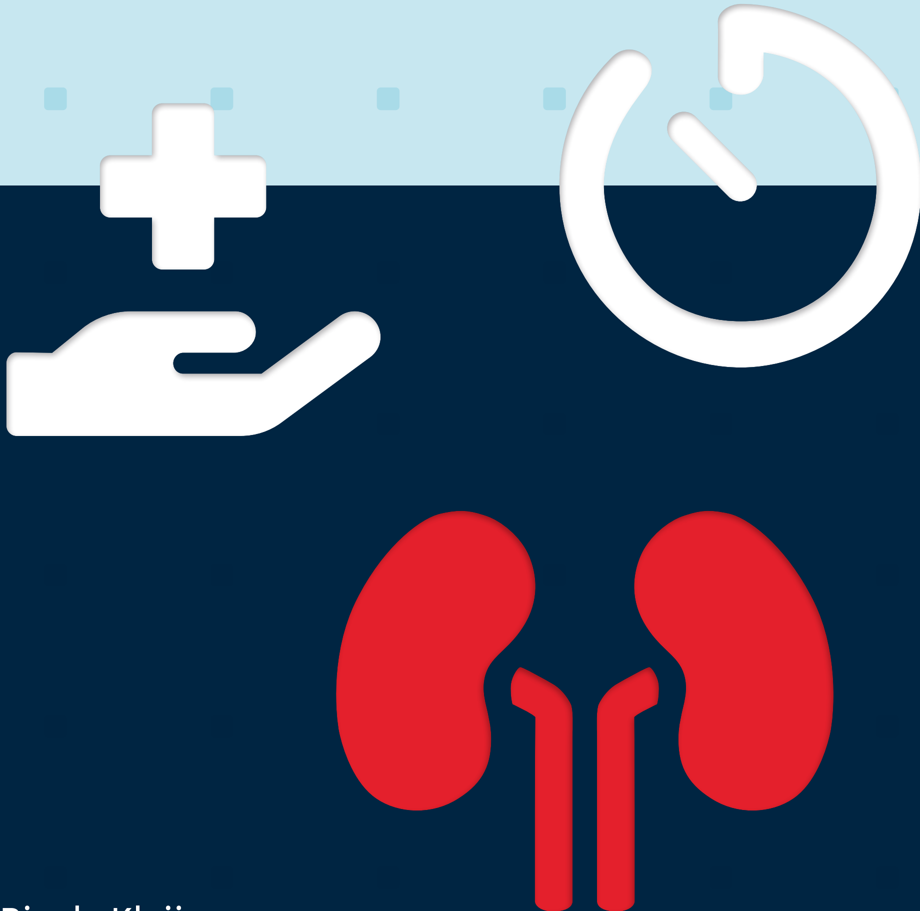

Ria de Kleijn

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Establishing nurse to patient ratio in haemodialysis care

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time in haemodialysis centres

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Chapter 1

General introduction and aim of this thesis

Introduction

Ongoing improvements in health care contribute to the world's population getting older. For example, in the Netherlands with 17.4 million inhabitants, the proportion of subjects over 65 years and older currently is 19.5% of the population, with 4.7% of the total population being even older than 80 years. The combination of a higher proportion of elderly, and the higher age they attain is referred to as double ageing [1].
As a consequence of the ageing of the population the number of patients with chronic diseases is also increasing, with many older patients having multiple diseases/ comorbidities.
Common chronic diseases in the elderly are cardiovascular disease (CVD) [2] and diabetes. As of 2019, in the Netherlands 1.5 million people with some kind of cardiovascular disease and 1.2 million diabetes patients were present [3]. These illnesses, but also hypertension and obesity, are risk factors for kidney, brain and other organ damage [4]. Chronic kidney disease (CKD) is a common health problem with a prevalence of approximately 10% in various countries across the world [2]. CKD is a health problem to consider: it is common and associated with increased cardiovascular morbidity and mortality, and with reduced life expectancy. CKD often results in the need for renal function replacement therapy, be it either renal transplantation, peritoneal dialysis or chronic intermittent haemodialysis [5]. In general, chronic intermittent haemodialysis is performed in a dialysis department with a minority of haemodialysis patients being treated at home.

Over the decades, the number of people who depend on renal function replacement treatment (RRT) in the Netherlands has steadily increased (Figure 1).

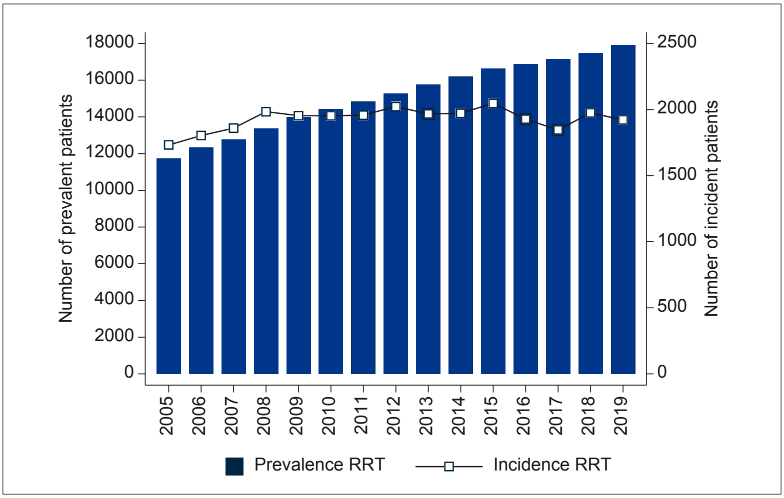

Figure 1. The number of patients in the Netherlands dependent on renal replacement therapy.
Source: https://www.nefrovisie.nl/nefrodata.

As of 31 December 2019, this number was about 18,000 people [6]. However, this rise in patients on RRT is especially due to the rise in number of patients with a functioning renal graft. The number of patients on intermittent haemodialysis was in fact virtually stable over the last 10 years (Figure 2).

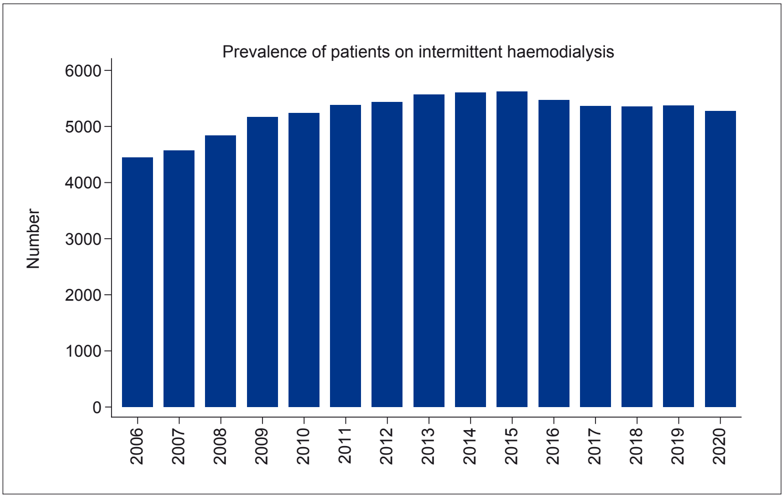

Figure 2. The number of patients in the Netherlands dependent on intermittent haemodialysis treatment.
Source: https://www.nefrovisie.nl/nefrodata.

Whereas up to 2009 there was a substantial increase in incident haemodialysis patients at the age of 75+, the incidence rate in this age group has stabilized since then and, interestingly, is steadily decreasing from 2012 on (Figure 3). This figure also shows that the incidence rate of haemodialysis in the other age groups has not changed over the last 15 years.

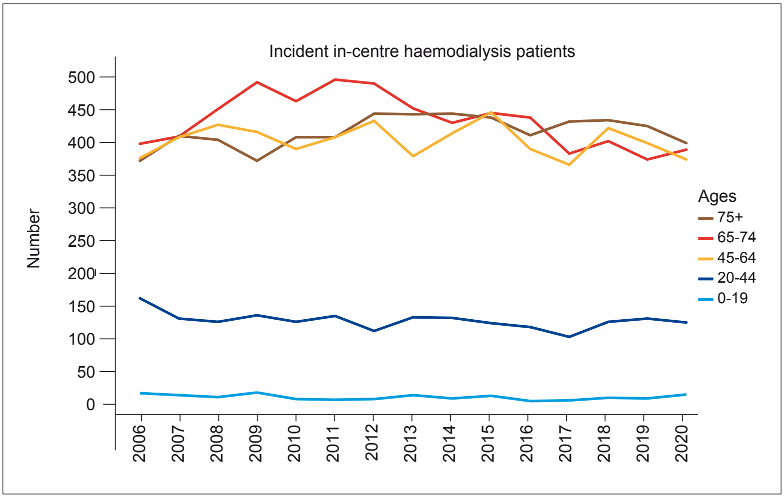

Figure 3. Age distribution of incident patients at start of intermittent haemodialysis treatment. Source: https://www.nefrovisie.nl/nefrodata.

In part this drop in number of elderly haemodialysis patients can be explained by the rise in number of transplants in this patient group (Figure 4) through the living related kidney transplant programme and through initiatives such as the old for old postmortal transplantation programme by Eurotransplant. From 2011 there was a substantial rise in the number of patients >65 years of age being transplanted, which had started already earlier in the 45-64 year age group. This figure also shows that there is a drop in transplants in 2020 most probably due to the covid-19 pandemic.

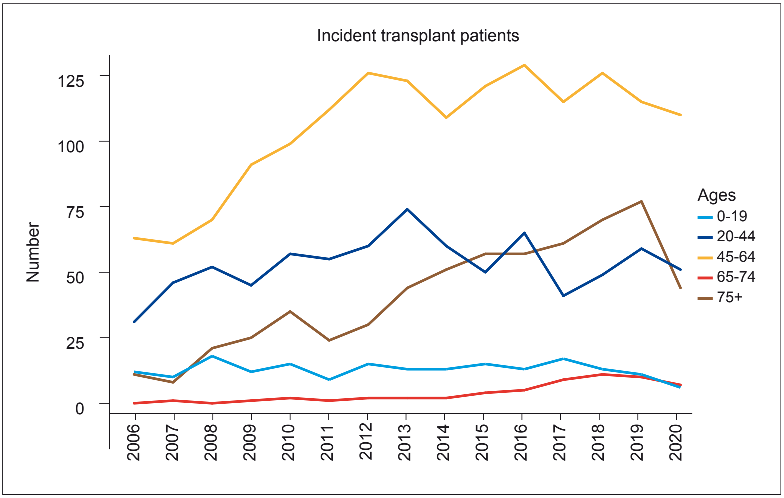

Figure 4. Age distribution of incident transplant patients.
Source: https://www.nefrovisie.nl/nefrodata.

With the increase in the number of older patients (often with multiple comorbidities), healthcare costs are also increasing. According to the National Institute for Public Health and the Environment (RIVM), one third of the increase in healthcare costs is due to ageing and growth of the population. The other part of the increase in healthcare costs can be attributed to other factors such as technological developments and introduction of new high-cost medications leading to more and more expensive treatments [7].

There is pressure on the health care budget, which means that choices have to be made. An increase in the number of patients does not automatically mean that there will be more budget. This means that hospitals are forced to organise patient care more efficiently while maintaining and/or improving its quality. Scarce resources therefore, must be used efficiently.
In addition, we are also faced with a shortage of nurses in the Netherlands. Effective deployment of resources forces efficient deployment of nurses, for they are the biggest cost driver in healthcare. Attempts should be made to provide the same level of care with fewer staff. Furthermore, vacancies are often left unfilled due to cutbacks, frequently resulting in nurses complaining about their increased workload. Results from research on this topic indicated that the work pressure could be significantly reduced if the demand for care and the supply of care are better matched [8]. According to this study, the increased workload was mainly an efficacy problem. There are days when

the demand for care from patients exceeds the availability of care provided by nurses, but on other days one could do with fewer nurses. With more insight into the demand for care and the required supply of care, the workload should be better manageable [8].

Already in the eighties, as a manager in a general hospital with a dialysis centre in my care unit, I was confronted with rising costs and therefore with cost-cutting measures. In my opinion, further cutbacks on staff in the dialysis department were not possible. After all, every dialysis treatment requires hands on presence of personnel. Efficient deployment of staff was the call to respond to already at that time.
Thus, in order to provide all dialysis patients with the care they require, it is important to match the supply of and the demand for care. Enquiries about this at Dutch dialysis centres revealed that several standards were used. Some centres used a ratio of 1:5 (i.e. one nurse for every five dialysis patients). Other centres used a ratio of 1:4, whereas the majority of centres used a ratio of 1:3. In university dialysis centres usually this ratio was even higher 1:2.
A dialysis nurse is assigned to a number of patients during each shift according to the department's norm. This assumes that every patient requires the same amount of care and has the same burden of care. However, by now we know from experience that in treating haemodialysis patients, there are differences in the level of care needed for each patient.
In order to be able to allocate nurses according to the patient's care load, research has been carried out into the relevant 'patient characteristics' that determine the care load, but also in order to develop a classification model that can predict the care load of chronic haemodialysis patients.
In this thesis, the basic definition of care load as described by Diericks & Sermeus [9] is used: "Care load is the time that the nurse actually spends on the patient".

Once the burden of care has been determined with the aid of an adequate patient classification model, a duty roster (nurse staffing) can be drawn up in which the deployment of nurses and the presence of patients are attuned to one another. Thus, a good duty roster supports the quality of care and makes care safer. A good duty roster also will enhance staff satisfaction [10]. Likewise, the presence of sufficient nurses will also increase patient satisfaction [11, 12].

A first form of patient classification was already applied by Florence Nightingale during the Crimean War in 1853-1856 [9, 13]. She grouped the patients who needed

the most care at the front of the ward, so that they were directly in sight of the nursing staff.
In the 1960s, a classification system was designed in the United States to determine the care needs of individual patients and to subsequently group them into categories. In this way, the workload of nurses could be determined and patient allocation improved [14].
Around the same time, specific staffing ratios in dialysis facilities were introduced in eight states in the USA [15]. On average the initial ratio in the USA was 1:8 nurses to patients and 1:3 for assistants. Dialysis was introduced into Saudi Arabia in the early 1970s. In Saudi Arabia, too, the costs of renal replacement therapies formed a social burden, partly as a result of the growing number of elderly people and innovative technologies. Therefore, a study was designed [16] with the aim to report by means of surveys on the distribution of dialysis networks in Saudi Arabia, their capacity, available equipment, number of staff and number of patients. All this to help with future planning in the different geographic regions in Saudi Arabia. The results showed that an 1:32 nephrologist to patient ratio and an 1:5 nurses to patients (range 4-6) ratio was applied in Saudi Arabia. The authors concluded that dialysis centres in Saudi Arabia had made progress in planning. In the future more emphasis should be placed on quality assurance through evaluating care [16]. In Belgium, Versweijveld examined the workload at six Flemish haemodialysis departments. This was done in response to the ageing of the population, a shortage of nurses and an increase in workload in the dialysis departments. The aim of this study was to find out what is important to include in a specific measuring instrument for care burden in haemodialysis. The study was conducted among chronic haemodialysis patients. No distinction between categories of dialysis centres was made. A large difference in the level of care was observed between the various dialysis centres. Complications (vascular access or technical complications) increased the workload by an average of 9 minutes per dialysis per patient [17].

Apart from an impending shortage of nurses and changes in the profile of dialysis patients (more and more elderly patients), currently another bottleneck in dialysis care is the rise in healthcare costs. Therefore, studies are being conducted to analyse the costs of renal replacement therapies and to determine whether efficiency improvements can be made.
From 2003 onwards, cost analyses of renal replacement therapies were done in several countries in the context of cost control. [18, 19, 20, 21, 22].

Salonen et al [18] conducted a study in Finland on the costs of treating patients with end-stage renal disease (ESRD). The direct costs of renal replacement therapy were unknown. The question was: what do the treatments actually cost? A retrospective file study was carried out over a five-year period. Two hundred and fourteen patients starting dialysis (138 in-centre haemodialysis, 76 continuous ambulatory peritoneal dialysis) were included. Ultimately, 55 patients underwent kidney transplantation. After transplantation, the annual costs for this group of patients dropped significantly. HD appeared to be the most expensive treatment.

Asgeirsdóttir et al [19] analysed and compared the cost-effectiveness of kidney transplantation and dialysis in Iceland. The researchers assessed the cost and effectiveness of renal replacement treatments using clinical records from the nephrology department and the billing system of Landspitali University Hospital. These authors came to the same conclusion as Salonen et al.: haemodialysis is an expensive treatment. Increasing the number of transplantations is cost-effective because it reduces the annual costs of haemodialysis.

Yang et al [20] did a cost-effectiveness analysis of three renal replacement therapies, haemodialysis, continuous ambulatory peritoneal dialysis (CAPD) and automated peritoneal dialysis (APD) in Singapore. Costs for haemodialysis were calculated using data from the healthcare provider. In Singapore, the healthcare provider is the National Kidney Foundation. To calculate the cost of CAPD and APD, the National University Hospital database was used. The analyses were done on a cohort of 60-year-old dialysis patients who did not have diabetes. A high-risk group of 60-year-old diabetic patients on dialysis was also studied. The analyses showed that for both groups of dialysis patients, starting with CAPD was the most cost-effective. The haemodialysis modality was much more expensive.

Haller et al [21] indicated that despite rising healthcare costs, few cost-effectiveness studies have been done on renal replacement treatments. Haller developed a model to compare costs, quality of life and survival of three renal replacement treatments (haemodialysis, peritoneal dialysis and kidney transplantation) in Europe. Patients who received renal replacement therapy between 1 January 2001 and 31 December 2008 were followed at the individual level. Patients younger than 18 years were excluded.

The total costs for the first 12 months, between 13 and 24 months and after 25 months were calculated per treatment (haemodialysis, peritoneal dialysis and kidney transplantation).

The conclusion of this study confirmed that haemodialysis is the most expensive treatment. Furthermore, the authors advised to give extra attention to living kidney transplantation as it was most cost-efficient.

In 2019 the Dutch Kidney Foundation [22] recalculated the average annual costs of the various renal function replacement therapies in the Netherlands. An update was necessary as the former calculation was based on 1990 figures. Vectis data (data of insured persons in the Netherlands) and data from the Dutch Kidney Register (Renine) were used [22]. The study population was defined as dialysis patients (≥ 19 years) known to the health insurer in 2014. The calculations [22] showed that haemodialysis is the most expensive treatment (€ 92.616 (average annual costs). The overall costs per patient would decrease if patients who need to start dialysis would start with CAPD initially (€ 77.566) and switch only when necessary to chronic intermittent haemodialysis [22].

Affordability of healthcare is high on the political agenda in the Netherlands. Numerous studies have shown that haemodialysis is an expensive renal replacement treatment. Therefore measures to improve efficiency in the process of haemodialysis are of utmost importance.
In the 1920s in Japan, Taiichi Ohno [23] started producing cars, founding Toyota. In order to create a fast and flexible process, he invented the Toyota Production System (TPS). In 2008, reports on adequate design of the industrial processes showed that the quality and efficiency of the production significantly improved with the implementation of the TPS [23].
Team members in this system were given clearly defined responsibilities. This system in fact became the basic of the concept of LEAN thinking, where five values (1. Identify the buyer's wishes. What value should the product have in the eyes of the customer; 2. Map out the Value Stream from start to finish of the process; 3. Create flow, so the customer doesn't wait; 4. Prevent overproduction; 5. Strive for perfection) were added to TPS.
Continuous improvement and preventing unnecessary waste are key points of their programs. Applying the TPS method would be valuable in a dialysis centre to deliver quality care at a lower cost.
Alquist and Bosch [24] wanted to have more insight into the steps that are taken in the processes of a haemodialysis procedure, to assess whether the processes are efficient. Therefore, they developed a method, inspired by the smart production process of Toyota and the Six Sigma method developed by Motorola, to analyse haemodialysis

treatment as a process. They investigated the various steps in the dialysis process: the patient pathway, dialysis treatment and the monitor pathway. This research was performed in 26 clinics within Gambro Healthcare International (France, Hungary, Italy, Portugal, Spain, Taiwan) and Gambro Healthcare US. The majority of the facilities were free standing, five were hospital-based. They measured the time needed for the dialysis process, not the time nurses needed to give care to their patients. Alquist and Bosch [24] write in their discussion that "the haemodialysis process can be seen as a combination of patients, caregivers, equipment, methods and the environment that work together to realize the outcome. This complex process is influenced by factors such as patient characteristics, clinical condition of the patient, procedures, equipment and facilities used, staffing and the clinical environment". Alquist and Bosch [24] concluded that the method can be used to analyse the haemodialysis process in dialysis centres and it can be used as a benchmark model. The results were not linked to nurse staffing levels.

Donald Berwick [25], a renowned scientist in the field of quality improvement aims at improving the American healthcare system by lecturing about the Triple Aim in healthcare that should be encompassed: care, health and cost. The concept of refining care addresses improving the patient's experience and satisfaction of the provided care. The second aim focusses on pursuing the best health outcome for (a part of) the patient population. The first and second aim should be pursued as cost effectively as possible thus reducing the costs of health care, the third aim. The moment an improvement is developed for one aim, it can have consequences for the other aims. For example, improving the health outcome for dialysis patients by extending dialysis time or frequency may enhance costs, while having different effects on the patient's experience (e.g. negative experience for spending longer time on dialysis, versus positive experience for feeling better).

At the end of the last century, Robert Kaplan and David Norton [26] developed the Balanced Scorecard (BSC). With the use of the BSC, four interrelated management processes can be investigated: Financial Perspective, Customer Perspective, Internal Process Perspective, Learning and Growth Perspective. Nowadays, the BCS is used by many companies as a management tool.

Hingwala et al [27] emphasised that an efficient method of providing care is becoming of utmost importance as a shortage of nurses is currently happening while the number of dialysis patients increases. Both the BCS and the Triple Aim (care, health and cost) are recommended by Hingwala et al. [27] to set up a quality improvement system. This system would then cover the aspects: Efficiency, Quality of Care and

Finance. To analyse the dialysis process, Hingwala et al. used Toyota's LEAN model. This led to the recommendation to improve the planning of when patients arrive at the dialysis department. In addition, it was recommended that non-nursing tasks be carried out by other staff. This study was a process approach and did not deal with nursing care time.

The aim of the research by Rokegem and Coussement [28] was to map two processes, the process of the patient and the process of the dialysis treatment. A third process was later added to this, namely the duties of the nurses in the dialysis unit. Their research focused on methods to optimize efficiency in the dialysis process. They recommend LEAN management to review and improve processes. In addition, these researchers described that high peak moments are alternated with moments of fewer tasks. Therefore, one of their recommendations is to spread the influx of patients. Interestingly, this study was also focused on the tasks nurses performed during dialysis treatment and the amount of time these treatments took. Rokegem and Coussement established that closing a fistula takes 15 minutes. However, the study by Rokegem and Coussement [28] does not include a classification model on how to staff the dialysis unit.

The dialysis department of a general hospital has the most staff working in the afternoon, while there are few or no patients present, concluded Ebrecht [29] in her research into the efficient deployment of nurses in the dialysis department. The amount of available care did not match the care demand. In addition to peak moments for the nurses, there were also moments when they have hardly anything to do. A nurse spends 18% of her time on non-patient-related activities and 4% on activities that can also be performed by an assistant. Ebrecht recommended setting up performance indicators related to the deployment of nurses, which can be clearly displayed in Balanced Score Cards. A second recommendation they made was to improve efficiency by letting the right person do the right thing.

The Netherlands has a quality improvement system for dialysis centres that includes, in addition to various laws and regulations, standards and guidelines established by the medical and nursing professional associations. In 2009, Schraa and Hagen [30] reported that the standard for nursing staff used in the Dutch quality improvement system is no longer up to date and was causing problems. In 2010, for example, members of the dialysis centre visitation committee indicated that the standard for nursing staffing was not being applied uniformly across the board. The heads of the

dialysis departments indicated at their meeting in 2009 [30] that there was an urgent need for a classification model to adjust nursing staffing to the patient population on the dialysis ward.
After the call for cost control in healthcare – based on the increasing demand for care – 'quality of care' and 'customised care' made their appearance in 2010. The increasing demand for care, partly due to the ageing population, also affects dialysis departments. Besides patients with diabetes and obesity, atherosclerosis in particular is one of the most common causes of chronic kidney disease [31] requiring renal function replacement therapy. Atherosclerosis of the kidney is often accompanied by damage to the cardiovascular system. As a result, the dialysis population consists of patients with a mix of comorbidities, with different care needs. Efficient care requires a good understanding of the composition of this mix, so that the staffing of the dialysis units can be adjusted accordingly.
In the Netherlands, there is as yet no gold standard for the creation of a duty roster for dialysis units.

Aim of the study

Within the scope of this research, we will develop a classification model that accurately can predict the burden of care of chronic haemodialysis patients. In addition, the model should be able to predict the number of nurses required for the daily provision of care as well as be applicable to all kind of dialysis facilities, categories of dialysis centres.
Category 1: dialysis centres in university hospitals;
Category 2: dialysis centres in general hospitals;
Category 3: independent dialysis centres, outside a hospital, with a nephrologist present;
Category 4: independent satellite dialysis centres, where a nephrologist is available only by demand or during weekly rounds.

Subsequently, we will
- Investigate whether the burden of care for dialysis patients is affected by certain patient characteristics and differs per category of dialysis centre.
- Investigate whether any change in the overall burden of care in a centre is the result of the increased age of the patients and the increased number of comor-

bidities in the dialysis population of that centre. Ageing is associated with less physical activity and a sedentary lifestyle. This has also been demonstrated in haemodialysis patients [31, 32]. The question is whether nursing care time has increased due to ageing?

Finally, we aim to study whether the clinical condition of dialysis patients has an impact on the burden of care. Chronic renal failure often impairs appetite. Patients undergoing haemodialysis frequently experience muscle weakness. When patients suffer from malnutrition and have poor hand grip strength, do they consequently require more nursing care time?

Chapter 2. Describes the development of the classification model. Nurses and nephrologists from various dialysis centres (university and general hospitals, categorical and independent centres and satellites of these centres) were approached and asked to cooperate. As it is known that the population varies in different regions (e.g., in the west of the Netherlands patients with a non-western background are overrepresented) the centres that participated were located in the different parts of the country.
Based on locally present inquiry lists and in collaboration with nurses from the participating centres, an easy-to-use classification model was developed. After doing some pilot studies with this provisional list, adaptations were made until the final query was ready to be used in the studies we subsequently performed.

Chapter 3. In the Netherlands different categories of dialysis centres exist. Ranging from dialysis centres in university hospitals to satellite dialysis centres that may or may not have a nephrologist present during the dialysis session. We investigated possible differences in burden of care between categories of dialysis centres. Furthermore, we investigated whether specific patient characteristics predicted the burden of care in the different categories of dialysis centres.

Chapter 4. Nurses are confronted with more and more elderly patients with different comorbidities in the dialysis population. Nurses say they are confronted with an increasing burden of care. We focused on the question whether, over time, the increasing age and the number of comorbidities of the haemodialysis patients increased nursing care time. Changes in patient's characteristic and dialysis characteristics were analysed, as well as the estimated nursing care time.

Chapter 5. We investigated why nurses in university hospitals needed more care time than in the other centers. And not only more care time, but also more care time than indicated in the classification model. We examined whether the clinical condition of patients influences the nursing care time for dialysis patients in the different categories of dialysis centres. Haemodialysis patients were divided into two groups for analysis: patients from university centres and patients from the other dialysis centres. Nursing care time was for a second time measured by independent observers using stopwatches. Nurses not only filled out the classification model but also a form with clinical data of the patient. The markers blood value, the nutritional status and the hand grip strength of the hemodialysis patient were analysed.

Chapter 6. Finally, a literature review was performed to investigate whether specific attention to exercise and nutritional status of dialysis patients can reduce the deterioration of the patient's condition. Active participation of dialysis patients in their own treatment could reduce the direct care time of nurses. The latter is especially important now that there is an (increasing) shortage of nurses.

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Chapter 2

Prediction of care burden of patients undergoing haemo-dialysis: Development of a measuring tool

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Chris Hagen

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Piet ter Wee

Journal of Renal Care 2015; 41(2): 119-125

Abstract

Background

The ageing of the population and new options for therapy have led to an increase in the number of patients undergoing dialysis. Rising costs in health care and new financial structures impose funding constraints on dialysis departments and force the departments to deploy nurses more efficiently. Therefore, predicting the nursing time spent on the care of dialysis patients is important.

Objective

Development of a classification tool to predict the burden of nursing care of patients undergoing dialysis.

Design

Observational study.

Participants

242 dialysis patients on dialysis in 12 centres.

Measurements

The time spent on nursing care within predefined areas, including patient independence, vascular access, psychosocial support, dialysis complexity, communication and specific nursing actions, was measured by observers. Average times and their standard deviations (SD) were calculated. Variation of patient characteristics was analysed.

Results

The average care time required for the four routinely investigated domains, namely independence, vascular access, psychosocial support and dialysis complexity, was 59.23 (SD = 24.30) minutes per treatment per patient.

Conclusion

Our study shows that it is possible to predict the burden of nursing care of patients undergoing dialysis by means of a classification model.

Introduction

The ageing of the population and the introduction of new options for therapy have led to an increase in the number of patients with long term conditions. Over the next few years, the demand for care may grow by 50% [1], and consequently, the demand for dialysis treatment will rise as well. However, the available number of nurses will not rise proportionally and may even decrease in the long term [1]. In addition, the rising costs of health care may give rise to new financial structures, which will also affect dialysis departments/centres. All of these developments make efficient deployment of nurses mandatory.

Adapting the availability of nursing time to the health needs of patients could be an option for enhancing treatment efficiency. For this adaptation to occur, the 'care burden' of individual patients needs to be quantified. In recent years, interest in the development of a classification system that enables prediction of the burden of care of patients has increased [2]. With this type of system, managers would be able to adjust the total nursing capacity to meet the daily health needs of patients [3].

In the Netherlands, several intensive care (IC) departments use the 'Therapeutic Intervention Scoring System' (TISS) that was specifically developed for IC departments [4]. Nursing homes use the 'San Joaquin model' to estimate the burden of care [5]. Eight Dutch dialysis departments/centres use a tool to classify patients, adapted to meet the needs of the individual departments. These instruments differ in their measurements and methods. The number of items ranges from 22 [6] to 67 [7]. Grouping of items and their allocation to the various categories differed also between the classification lists. Several international authors have tried to develop an instrument. However none of them objectively measured care time [8, 9, 10].

Purpose of the study

The aim of this study was to develop a classification tool that predicts the burden of care of long-term patients undergoing haemodialysis (HD). The basic definition of patient classification, given by Diericks [5] was used. In this study, 'burden of care' was specified as 'the time nurses actually spend with patients'. We developed the patient classification tool to be used to plan for the availability of nurses to treat patients on a day-to-day basis. Thus, it may be useful for justifying the number of nurses necessary to meet the needs of patients in specific centres.

Methods

The flow chart of the tool development is depicted in Figure 1. We inventoried and requested patient classification lists of burden of care measurements in all of the dialysis centres in The Netherlands. Based on these lists and a review of the literature, a draft list measuring patient characteristics and nursing workload was designed.

This list, consisting of 77 items was sent to five different dialysis centres as a pilot version (university, general and categorial centres). Nurses were asked to indicate which items were applicable to their patients and how much time (in multiples of 5 minutes) they spent per item. The list was adjusted in response to the comments received from the different centres.

The items were combined into six domains (Table 1). The items in the domains together covered all the nursing time scored by the nurses and are recognisable as either regular care (i.e. being treatment independent) or dialysis specific (vascular access and complex care). This second list, and the associated instructions, was sent to the same five dialysis centres and one new (independent) centre to obtain additional comments. After final adjustment, nurses were asked for their opinions on the applicability of the list.

Time measurement of care burden

The classification list as depicted in Figure 2, developed after the final version, was deployed at two university centres, two general hospitals, two specialised dialysis centres, and two independent centres, as well as at the satellites of these centres. The identification of centres was determined by the location and specific setting of the centres. We oversampled centres in the western (more urbanised) region of the country, assuming that immigrant dialysis patients would be more prevalent in this part of The Netherlands and that communication with immigrant dialysis patients would require more time.

All relevant persons, patients, managers, specialists and staff were informed about the study. As the measurement by nurses themselves of time spent on care could be unreliable we chose to use independent observers, using a stopwatch, for timing the nursing care. During the study, the nurses filled out the classification form for their patients. To obtain a representative sample of patients, the observers were coupled with a different nurse on each measurement day, and the patients were randomly

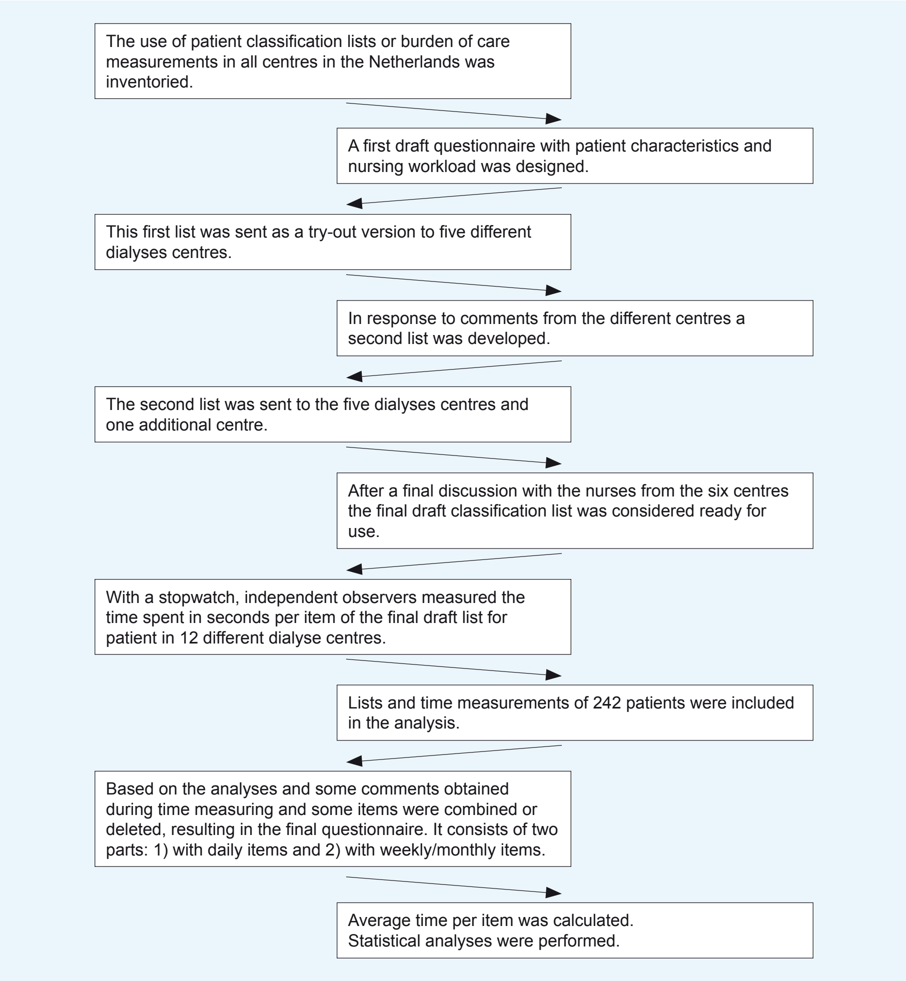

Figure 1. Step by step development of the burden of care questionnaire (flowchart).

Domain	Section
Independence	Mobility Necessary actions before and during dialysis Diet Excretion
Vascular access	Connecting Closing
Psycho-social support	
Dialysis complexity	Stable dialysis Unstable dialysis
Communication	
Nursing care	

Table 1. Domains and sections of the classification form.

INDEPENDENCE			
1 Mobility	a		Walking, no help
	b		Guided walking, wheelchair, bed
	c		Using chairlift, help in and out bed
2 Necessary actions before and during dialysis	a		Can independently perform actions
	b		Able to perform some actions
	c		Need of care, performs no actions
3 Diet	a		No help needed
	b		Need help with food and drink
	c		TPV (drip feed)
4 Excretion	a		No help needed
	b		Need help with toileting, use urinal/po/commode, incontinence care
VASCULAR ACCESS			
5 Connecting	a		Fistula category 1
	b		Fistula category 2
	c		Fistula category 3
	d		Catheter category 1
	e		Catheter category 2
	f		Combination fistula/catheter/graft
6 Closing	a		Patient applies pressure or use of clips
	b		Nurse applies pressure
	c		Catheter
	d		Combination fistula/catheter/and graft
PSYCHO-SOCIAL SUPPORT			
7	a		Patient does not need extra attention
	b		Patient needs extra attention e.g. fear for puncturing/pain
	c		Patient is agitated/aggressive/emotional
	d		Patient is depressed/demented/comatose
COMPLEXITY DIALYSIS			
8 Stable dialysis	a		Only standard checks necessary, part of the dialysis treatment controls at half hour, max. 1/week RR reduction, max 1/week bleeding
Unstable dialysis	b		Entire dialysis treatment controls or more
	c		Patient has > 1/week RR reduction
	d		Patient has > 1/week bleeding
COMMUNICATION			
9	a		Doctors visit
	b		Extra doctors visit / consultation (para) medical (dietetics, medical social work)
	c		Discuss / writing (in database) nursing action
	d		Write report (department / external care provider) or arrange admission in hospital
	e		Information and education directly to patient
	f		Information/education related through family / communication script
	g		Serious language barrier (need interpreter)
	h		Extra attention (different cultural background / other illness perception)

NURSING CARE			
10	a		Blood sampling
	b		Adminstering dialysis related medication
	c		Administering medication unrelated to dialysis
	d		Infuse / blood transfusions
	e		Wound care
	f		Chest pain, cardiac arrythmia and their interventions (e.g. O2 adminis-tration)
	g		Treatment for cramps
	h		Connecting of surveillance equipment
	i		>1 x blood sugar check
	j		Fistula flow measurement
	k		Connecting dialysis bicycle/laptop/tv set
	l		Isolation measures
	m		Helping vomiting patients

Figure 2. Classification form used for the time measurements.

assigned to nurses. The observers measured the time spent (in seconds per treatment) by nurses on each patient. Excluded from measurement were patients who were undergoing dialysis for the first time and patients treated on the Intensive Care unit, as well as patients in strict isolation and other patients receiving one-to-one care.

Analyses

Statistical analyses were performed using IBM SPSS 20 (New York, NY, USA) and Microsoft Excel 2007. For the care time, the means and standard deviations were calculated per item. We used Student's t-test or ANOVA to evaluate whether different response options within the various sections of the form yielded different care times if the Kolmogorov-Smirnov test showed a normal distribution. If care times were non-normality distributed we used Mann-Whitney or Kruskal-Wallis tests. A significance level of $p = 0.05$ was used.

Results

Items selection for the final draft questionnaire

We sent the first draft list to 200 dialysis nurses; 114 returned the forms with 113 useable responses. The responses indicated that the length and detail of the list were considered to be too extensive. Furthermore, some nurses suggested that some items were missing that should be included in the list.

The nurses were unable to provide accurate estimation of the required care time. Consequently, the estimated time per item varied considerably. Based on these results, the number of items in the second draft of the classification form was decreased, and the items were grouped into 7 domains. Of the six centres that subsequently were asked to provide comments, four responded 'list is good' and 'sufficient number of items'. The other two centres wanted to add the item 'assistance with vomiting' and were unhappy with the grouping of 'doctor's visit and extra doctor's visit' into a single item. After considering these comments, the list was finalised. The item '(extra) doctor's visit/consultation' was split into two items, and the item 'assistance with vomiting' was added. The final draft list thus consisted of 50 items organised into seven domains with a total of eleven sections. A final adjustment was made to clarify the definition of the fistula, catheter and its categories.

Measurement of care burden

Population

The study population consisted of 242 patients, 132 male (55%) and 110 female (45%), average age 66.0 years (SD 14.4), who underwent dialysis during two sessions between 08:00 and 21:00 hours. Care was provided to these 242 patients by the following staff: nurses with at least two years of experience (201 patients; 83.1%), less experienced nurses (27 patients; 11.2%), student nurses (12 patients; 4.9%), and dialysis assistants (2 patients; 0.8%). Because dialysis assistants only had a short dialysis training programme, they were grouped with the student dialysis nurses in the analyses.

In one of the satellites of the categorical centres, a change of dialysis machine was needed once, meaning that a machine was assembled and connected to a patient twice. The total care time for this patient was much higher than it was for the other patients. We included this time in the calculation of the average overall times, as a change of machine can occur in any centre.

Modifications to the classification list

On the basis of the first set of results, the original classification list (Figure 2) was modified further. The items 'able to perform some actions' and 'need of care, performs no actions' were combined into the item 'needs care'. Items that did not occur or occurred only rarely and items that added only very limited time were deleted.
The item 'total parenteral nutrition' (TPN) occurred only twice and took 2.1 minutes; therefore, this item was deleted, as was the item 'helping vomiting patients' that did not occur at all. These items were excluded from further analyses.

Due to the small number of occurrences of items b, c, and d of 'psycho-social support' and 'unstable dialyses', we decided to merge these items as well.
The items 'serious language barrier' and 'extra attention due to different cultural background' in the domain 'communication' occurred less frequently than expected. In addition, nurses indicated that they had chosen only one if both applied. These items were therefore combined.

The nurses indicated that a number of items did not occur during a specific dialysis session but did only occur weekly or monthly. For that reason, the form was divided into daily activities and weekly/monthly activities. Thus the finalized questionnaire was made. Table 2 shows the finalized form in which the measured number (n) per item, the average measured time (t), and the standard deviation of the time (SD) are depicted.

The last column summarises the results of the statistical tests (for the differences in time between options) for the domains 'independence', 'vascular access', 'psycho-social support', and 'complexity of dialysis'. As almost all times were non-normally distributed, non-parametric tests were used.

Time averages
For all 242 patients, the items in sections 1 to 8 (actions that occur in each dialysis session) were measured, and the average times were calculated. The items in section 9 (actions that occur in each dialysis session) and the items in sections 10 and 11 (actions that occur weekly/monthly) were measured to the extent that they occurred. The average time was calculated per item, not per patient.

The main factors that determined the direct care time were 'mobility' (because nurses needed more time for patients who were unable without help to sit in a dialysis chair) and 'vascular access'. In the 'connecting' section, significant time differences were measured between the various fistula and catheter categories. Applying pressure after fistula disconnection took twice as much care time when applied by a nurse than when applied by a patient or when using clips. This time exceeded the time needed to close a catheter.
The analysis of the four domains 'Independence', 'vascular access', 'psycho-social complexity', and 'dialysis care' yielded an average time of 59.23 minutes (SD = 24.30).
A positive association existed between the care needs reported by the nurses and the time measured by the observer.

DAILY ACTIVITIES			n	mean t	(sd)	over all	post hoc
INDEPENDENCE							
1 Mobility		a Walking, no help	166	0.83	(1.73)	*	$
		b Guided walking, wheelchair, bed	55	3.70	(4.14)		$
		c Using chairlift, help in and out of bed	21	11.39	(7.72)		$
2 Necessary actions before and during dialysis		a Can independently perform actions	64	9.70	(6.47)	*	
		b Needs care	178	11.52	(4.92)		
3 Diet		a No help needed	225	1.74	(1.76)	=	
		b Needs help	15	3.96	(5.61)		
4 Excretion		a No help needed	188	0.06	(0.44)	*	
		b Needs help with toileting, use of urinal/ po/commode, incontinence care	54	1.29	(3.82)		
VASCULAR ACCES							
5 Connecting	Fistula	a Fistula category 1	94	12.87	(7.16)	*	
		b Fistula category 2	71	13.36	(7.45)		
		c Fistula category 3	27	19.71	(11.71)		$
	Catheter	d Catheter category 1	33	12.43	(5.21)	=	
		e Catheter category 2	17	23.17	(22.21)		
6 Closing	Fistula	a Patient applies pressure or use of clips	122	17.20	(5.78)	*	
		b Nurse applies pressure	70	30.67	(8.60)		
	Catheter	c Catheter	50	22.40	(8.82)		
PSYCHO-SOCIAL							
7		a Patient does not need extra attention	195	0.00	(0.00)	*	
		b Patient needs extra attention	47	3.91	(3.65)		*
COMPLEXITY DIALYSIS							
8		a Stable dialysis, no extra checks	141	4.88	(5.46)	*	
		b Unstable dialysis, extra checks necessary	101	8.14	(9.54)		
OTHER							
9		a Discuss / record (in database) nursing action	238	10.00	(8.00)		
		b Information and education provided to the patient face to face	66	4.20	(6.10)		
		c Information and education provided to the family or through a communication booklet because of a language barrier	10	7.70	(12.80)		
		d Administering dialysis-related medication	196	2.60	(3.60)		
		e Connecting dialysis bicycle/laptop/TV set	72	1.70	(1.80)		

WEEKLY / MONTHLY ACTIVITIES				
		n	mean t	(sd)
COMMUNICATION				
10	a Doctors visit	105	6.40	(5.20)
	b Extra (para)medical doctors visit / consultation (dietetics, medical social work)	68	9.50	(9.20)
	c Multidisciplinary consultation	12	14.30	(15.30)
	d Write transfer (department / external care provider) or arrange admission to hospital	89	4.40	(3.70)
	e Serious language barrier (need interpreter)	10	3.80	(3.60)
NURSING CARE				
11	a Blood sampling	71	3.10	(3.10)
	b Administering medication unrelated to dialysis	39	4.80	(5.10)
	c Infusions/blood transfusions	3	30.70	(15.30)
	d Wound care	31	4.70	(4.20)
	e Chest pain, cardiac arrhythmia, and interventions (e.g. O2 administration)	9	2.30	(1.90)
	f Treatment for cramps	5	2.00	(1.50)
	g >1 x check of blood sugar	26	2.90	(3.00)
	h Fistula flow measurement	12	13.00	(9.40)
	i Contact isolation	11	3.70	(2.60)

*Table 2. Daily and weekly/monthly activities that were part of the final classification form. Including the number of patients and mean time per category. Only for daily activities: Overall tested with Kruskal Wallis or Mann-Whitney; *p≤0.05; =p>0.05. Posthoc Mann Whitney; $p<0.05 for comparisons with other categories.*

Discussion

Classification of patients is recommended as a rational method of planning nursing care. In the current study, we showed that it is possible to predict the care burden of patients on dialysis and time spent by the nurses. The results are difficult to compare with previous studies because none of those studies included all of the categories of dialysis centres that were included in the present study, and the care times were not actually measured in any studie.

A study in Saudi Arabia used a questionnaire on haemodialysis resources [9]. Time measurements were not performed in this study, and a classification model was not developed. In Connecticut, USA, a system was designed for the dialysis department of Rockville General Hospital [8]. The system is process-oriented and focuses on the physiological and psychological needs of the patient. The system aims to match daily staffing with patient needs. The model is simple to use, but has not been validated elsewhere. Versweyveld [10] performed a workload measurement in six Belgian dialysis centres. The measurement instrument consisted of a 3-page list, which was time-consuming to complete. Although it was tested in six centres, it is not clear which patient populations were included. This long list has not been reduced to a feasible number of items, which limits its usability in practice. Versweyveld [10] found that nurses needed very little time for patient emotional support. In our study, the item ‘patient needs extra attention’ also scored very low.

In our study, we first formulated items to predict the care burden on the basis of the available lists. Then, we combined the most relevant items and measured the actual time that nurses spent on these items during patient care. With this model, needed care time can be estimated and the required staff of dialysis nurses can be calculated more accurately. With the classification list filled out for each patient, the time needed for patient care can be predicted. Subsequently, the number of necessary staff can be calculated.

Future research needs to focus on the differences in patient populations and the variability in workload for nurses between different categories of dialysis centres, and the influence of patient characteristics (e.g. co-morbidities) on care times.

Conclusion

The aim of this study was to develop a classification tool that could predict the care burden (time) of chronic haemodialysis patients. Furthermore, the tool might serve as a planning instrument for patient scheduling by nursing staff. The results of this study show that it is possible to use the model to predict the care burden of haemodialysis patients.

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Chapter 3

Differences in care burden of patients undergoing dialysis in different centres in the Netherlands

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Abstract

Background

A classification model was developed to simplify planning of personnel at dialysis centres. This model predicted the care burden based on dialysis characteristics. However, patient characteristics and different dialysis centre categories might also influence the amount of care time required.

Objective

To determine if there is a difference in care burden between different categories of dialysis centres and if specific patient characteristics predict nursing time needed for patient treatment.

Design

An observational study.

Participants

Two hundred and forty-two patients from 12 dialysis centres.

Measurements

In 12 dialysis centres, nurses filled out the classification list per patient and completed a form with patient characteristics. Nephrologists filled out the Charlson Comorbidity Index. Independent observers clocked the time nurses spent on separate steps of the dialysis for each patient. Dialysis centres were categorised into four types. Data were analysed using regression models.

Results

In contrast to other dialysis centres, university centres needed 14 minutes more care time per patient per dialysis treatment than predicted in the classification model. No patient characteristics were found that influenced this difference. The only patient characteristic that predicted the time required was gender, with more time required to treat women. Gender did not affect the difference between measured and predicted care time.

Conclusion

Differences in care burden were observed between university and other centres, with more time required for treatment in university centres. Contribution of patient characteristics to the time difference was minimal. The only patient characteristics that predicted care time was previous transplantation, which reduced the time required, and gender, with women requiring more care time.

Introduction

The number of patients undergoing haemodialysis (HD) in the Netherlands is increasing, although this increase has slowed in recent years [1]. Amongst other factors, this increase reflects a growing number of patients with long-term clinical conditions, such as diabetes or vascular disease, and the ageing population [2]. Consequently, the number of patients undergoing HD with comorbidities has increased [3]. The latter is due to the fact that renal failure occurs as a secondary complication of other non-renal disease, for example, cardiovascular disease or diabetes mellitus, or because of the late complications of longstanding chronic kidney disease and HD treatment [4]. In addition, relatively healthy patients receive kidney transplants [1]. Little data are available to ascertain to what extent these comorbid conditions or other specific patient characteristics contribute to the care burden of patients in the dialysis unit.

Increasing healthcare costs and new financing structures have negatively affected the funding of dialysis centres [5]. This finding highlights the need to maximise the efficiency of nursing staff [6]. Therefore, adequate and universally applicable planning tools are needed. Such tools should be based on the care burden of each patient [7].

Several international authors have proposed patient classification models. However, few studies have assessed the influence of patient characteristics and comorbidities on the burden of care [8, 9, 10]. Recently, we described the development of a classification form [11] to be used in dialysis unit planning, which was based on the average times required for dialysis-related tasks.

In the Netherlands, Belgium, United Kingdom and the United States, different categories of dialysis centres exist, ranging from university in-hospital dialysis units to satellite dialysis centres that may or may not have a nephrologist present during dialysis sessions. In the current study, we investigated potential differences in the burden of care between categories of dialysis centres. Furthermore, we examined whether specific patient characteristics predicted the care burden in the different categories of dialysis centres.

Methods

A total of 242 patients in 12 centres were included in the present study.
Four categories of dialysis centres were identified:

Category 1: dialysis centres in universty hospitals (n = 45 patients),

Category 2: dialysis centres in general hospitals (n = 49 patients),

Category 3: non-hospital dialysis centres with a nephrologist present (n = 77 patients),

Category 4: non-hospital dialysis centres, where a nephrologist is available only on demand or during weekly rounds (n = 71 patients).

Observers measured with a stopwatch, the time nurses spent on each step of the dialysis procedure. The nurses in the dialysis centres filled out the classification list [11] per patient and completed a form assessing the following characteristics per patient: gender, age, body mass index (BMI), number of years of dialysis treatment, immigrant or native Dutch citizenship, previous kidney transplantation and previous treatment with peritoneal dialysis (PD). The nephrologists were asked to fill out the Charlson Comorbidity Index (CCI), assigning points to a set of nine comorbidities as listed in the patient's medical history [12].

Data analyses

To study the diversity of the care burden in different dialysis centres, we first calculated the average time spent per patient based on measured time for each category of dialysis centre. Differences between categories were tested using ANOVA. Second, the predicted time needed per patient based on the model with dialysis characteristics was calculated. Differences were tested with ANOVA. Third, the average difference between the measured and predicted time was calculated to evaluate discrepancies between the two so as to validate the model for all types of centres. Differences were tested with ANOVA. Subsequently, we investigated potentially important patient and dialysis characteristics as predictors for the time needed for dialysis. Finally, we built a multivariable model to evaluate independence of determinants of care time.
Statistical analysis was performed using IBM SPSS 21 (Armonk, New York, USA). To test the distribution of time across patient characteristics in the different dialysis centres, either ANOVA or Chi-square and Post-hoc tests were used followed by a multiple comparisons Bonferroni's test in case of statistical significance. Univariate and multivariate regression analyses were performed.

Results

Description of the study population in the different types of dialysis centres

Table 1 shows the number of patients and their characteristics in the four categories of dialysis centre. There were no differences in gender between the four categories. On average, 55% of the patients were male. Overall, the patients in non-hospital dialysis centres (Category 4) were older than average, and there were fewer immigrant patients in these centres.

In university and non-hospital centres (Category 3), a higher percentage of patients was underweight (BMI < 19). In university centres, a higher percentage of patients received dialysis for less than one year, a higher percentage of patients had a previous transplant, and also the number of comorbidities per patient was higher.

Description of the dialysis characteristics in the different types of dialysis centres

Table 2 shows the dialysis characteristics of patients in the four categories of dialysis centres. In the university centres, 50% of the patients were immobile, and 46% of the patients had a central venous catheter for vascular access. Only 13% of the patients in university centres self-applied pressure or used clips for closing the fistula, and 31% of the patients required additional psychosocial support.

Average measured time per category dialysis centre

The measured care time (Table 3) differed significantly between the centre categories ($p < 0.05$). For treatment in university dialysis centres, an additional 20 minutes of time was required per patient compared with the average for all patients.

Average predicted time per category dialysis centre

The predicted care time (Table 3) differed significantly between the centre categories ($p < 0.05$). According to the post-hoc test (for two-sided $\alpha = 0.05$) with Bonferroni's correction, the difference in the predicted time between university and non-hospital centres was statistically significant, with eight minutes more time needed per patient in university centres than in non-hospital centres. Dialysis centres in general hospitals did not differ significantly from university or non-hospital centres. This might indicate that more complex dialysis treatments occur more frequently in university and somewhat more in general centres than in non-hospital centres, as expected.

N	Total 242	Cat 1 45	Cat 2 49	Cat 3 77	Cat 4 71	Overall	Post-hoc
Gender							
Female (%)	45.9	48.9	42.9	45.5	46.5	=	
Male (%)	54.1	51.1	57.1	54.5	53.5		
Age							
Mean [year] (SD)	66 (14.40)	62 (13.96)	67 (12.65)	65 (15.25)	69 (14.37)	*	Cat1 $ Cat4
≤70 (%)	53.3	64.4	59.2	57.1	38.0	*	Cat1 $ Cat4
>70 (%)						*	Cat1 $ Cat4
Ethnicity							
Native (%)	70.8	71.4	61.2	62.7	85.3	=	
Immigrant (%)	29.2	28.6	38.8	37.3	14.7		
BMI							
Mean (SD)	25.39 (4.70)	24.65 (4.82)	25.71 (4.74)	24.61 (4.34)	26.43 (4.85)	=	
Underweight (%)	3.4	7.5	2.0	8.5	1.5	=	
Normal weight (%)	43.0	42.5	55.1	43.7	38.8	=	
Overweight (%)	31.2	37.5	26.5	33.8	38.8	=	
Obese (%)	20.5	12.5	16.3	14.1	20.9	=	
Number of years HD							
Mean [year] (SD)	3.44 (3.69)	2.71 (4.03)	2.69 (2.93)	4.57 (4.17)	3.19 (3.17)	*	Cat2 $ Cat3
0 (%)	13.3	32.6	20.4	2.6	8.5	*	Cat1 $ Cat3,4 Cat2 $ Cat3
1 (%)	22.1	23.3	24.5	15.6	26.8	=	
2-3 (%)	31.3	18.6	26.5	37.7	35.2	=	
≥4 (%)	32.9	25.6	28.6	42.9	29.6	=	
Previous NTX							
Yes	8.7	17.80	4.1	11.7	2.9	*	Cat1 $ Cat4
Previous PD							
Yes	13.1	18.6	16.3	12.0	8.5	=	
Number of comorbidities							
Mean (%)	1.80 (1.33)	2.33 (1.30)	2.08 (1.22)	1.47 (1.43)	1.64 (1.18)		Cat1 $ Cat3,4
0 (%)	17.0	4.8	8.2	29.7	17.1	*	Cat1 $ Cat3 Cat2 $ Cat3
1 (%)	28.1	19.0	26.5	28.4	34.3	=	
2 (%)	26.8	40.5	26.5	23.0	22.9	=	
3 (%)	17.9	19.0	30.6	8.1	18.6	*	Cat2 $ Cat3
≥4 (%)	10.2	16.7	8.1	10.9	7.1	=	

Table 1. Patient characteristics per category dialysis centre.
*Including number (per category) and % (per item) of patients. Overall tested with ANOVA and Chi-square; *p<0.05; =p>0.05. Post-hoc multiple comparisons Bonferroni; $p<0.05.*

N	Total 242	Cat 1 45	Cat 2 49	Cat 3 77	Cat 4 71	Overall	Post-hoc
Independence							
1 Mobility							
a. Walking, no help (%)	68.6%	48.9%	63.3%	72.7%	80.2%	*	Cat1 $ Cat3,4
b. Guided walking, wheel-chair, bed (%)	22.7%	28.9%	28.6%	20.8%	16.9%	=	
c. Using chairlift, help in and out of bed (%)	8.7%	22.2%	8.2%	6.5%	8.7%	*	cat1 $ cat3,4
2 Necessary actions before and during dialysis							
a. Can independently perform actions (%)	26.4%	37.8%	20.4%	36.4%	12.7%	*	Cat1 $ Cat4 Cat3 $ Cat4
b. Needs care (%)	73.6%	62.2%	79.6%	63.6%	87.3%	*	Cat1 $ Cat4 Cat3 $ Cat4
3 Diet							
a. No help needed (%)	93.4%	86.7%	95.9%	93.5%	93.4%	=	
b. Needs help (%)	6.6%	13.3%	4.1%	6.5%	6.6%	=	
4 Excretion							
a. No help needed (%)	77.7%	64.4%	73.5%	77.9%	88.7%	*	Cat1 $ Cat4
b. Needs help with toileting, or incontinence care (%)	23.3%	35.6%	26.5%	22.1%	11.3%	*	Cat1 $ Cat4
Vascular access							
5 Connecting							
Fistula							
a. Fistula Category 1 (%)	38.8%	26.7%	34.7%	50.6%	36.6%	*	Cat1 $ Cat3
b. Fistula Category 2 (%)	29.3%	20.0%	20.4%	36.4%	33.8%	=	
c. Fistula Category 3 (%)	11. 2%	6.7%	20.4%	3.9%	15.5%	*	Cat2 $ Cat3
Catheter							
d. Catheter Category 1 (%)	13.6%	33.3%	20.4%	2.6%	8.5%	*	Cat1 $ Cat3,4 Cat2 $ Cat3
e. Catheter Category 2 (%)	7.0%	13.3%	4.1%	6.5%	5.6%	=	
6 Closing							
Fistula							
a. Patient applies pressure or use of clips (%)	50.4%	13.3%	42.9%	59.7%	69.0%	*	Cat1 $ Cat2,3,4 Cat2 $ Cat1,4
b. Nurse applies pressure (%)	28.9%	40.0%	32.7%	31.2%	16.9%	*	Cat1 $ Cat4
Catheter							
c. Catheter (%)	20.7%	46.7%	24.5%	9.1%	14.1%	*	Cat1 $ Cat2,3,4 Cat2 $ Cat1,4
Psycho-social							
a. Patient does not need extra attention (%)	79.8%	68.9%	75.5%	85.7%	83.1%	=	
b. Patient needs extra atten-tion (%)	20.2%	31.1	24.5%	14.3%	16.9%	=	
Complexity dialysis							
a. Stable dialysis, no extra checks (%)	58.3%	57.8%	63.3%	53.2%	60.6%	=	
b. Unstable dialysis, extra checks necessary (%)	41.7%	42.2%	36.7%	46.8%	39.4%	=	

Table 2. Dialyses characteristics per category dialysis centre.
*Including number (per category) and % (per item) of patients. Overall tested with ANOVA and Chi-square; *p<0.05; =p>0.05. Post-hoc multiple comparisons Bonferroni; $p<0.05.*

N	Total 242	Cat 1 45	Cat 2 49	Cat 3 77	Cat 4 71
Measured time					
Mean time (SD)	59.06 (23.45)	79.04 (25.19)	53.23 (14.27)	57.73 (23.02)	51.86 (21.08)
Predicted time					
Mean time (SD)	59.92 (9.97)	65.08 (10.05)	61.19 (9.19)	58.44 (10.58)	57.38 (8.50)
Measured – Predicted time					
Mean time (SD)	-0.86 (18.77)	14.02 (21.11)	-7.69 (13.10)	-0.87 (17.37)	-5.52 (16.96)

Table 3. Difference between measured time and predicted time.

Difference between measured and predicted times

The average difference between measured and predicted times (Table 3) per category dialysis centre were significantly different for the various categories ($p = 0.000$). Post-hoc analysis with Bonferroni's correction revealed that the only statistically significant differences were between university centres and each of the other centre categories.

Academic centres required 14 minutes more time per patient than predicted with the classification model. For the other centres, the predicted time was sufficient. This extra time in university centres was distributed equally across almost all aspects of dialysis (Table 4). Notably, variation in measured time was much higher in university centres than in the other centres. However, not all patients in university centres required more time.

Influence of patient characteristics and comorbidities on the difference between measured and predicted times

Univariate regression analysis showed that underweight patients required more care time than normal weight and overweight patients. Patients with a previous kidney transplant required significantly less time than those without.

After correction for all patient characteristics (multivariate regression analysis, Table 5), the differences in care time for all dialysis centres persisted. In particular, university centres required nearly 14 additional minutes per patient, despite similar dialysis and patient characteristics. Underweight patients required more time (9.3 minutes) than others, and patients with a history of renal transplants required significantly less care time (9.5 minutes).

Other indicators for disease severity

We analysed other variables in 242 patients. Amongst these individuals, 5.4% (n = 13) were hospitalised, of whom 77% (n = 10) were admitted to an university hospital and 23% (n = 3) to a general hospital.

Notably, 50% (n = 5) of hospitalised patients in an university hospital died within three weeks after the study. No hospitalised patients in dialysis centres in general hospitals died within three weeks of the study. Further analysis revealed that a significant difference in the severity of the comorbidities was observed with most severe comorbidities in university centres.

Discussion

In the present study, we reveal differences in the burden of care between university and non-university dialysis centres. Nurses in university hospitals required on average 14 additional minutes of care time for their patients. We could not explain this measured difference using the patient and treatment characteristics between these centres. It did seem that extra time was specifically needed for patients in the most severe categories of the classification model. This would suggest that the severity in these categories was not uniform across centres. We tried to further substantiate this by evaluating other indicators of severity. These also suggested that the most severely ill patients with highly complex care were dialysed in the university centres. Furthermore, patients in university and hospital centres were more frequently new to dialysis, potentially needing more attention of the nurses.

Differences between patients in university centres and the other three dialysis centre categories have not previously been determined. Patients in university centres in the Netherlands and other countries fall in one of three categories: (1) patients without recovery of renal function after acute kidney disease. These patients often have a lengthy and/or complex stay in the ICU and are generally in a moderate condition during the first month of chronic HD treatment; (2) patients with significant comorbidities, such as complicated infections or systemic disease; and (3) patients who undergo elective (living) kidney transplant soon after the start of HD treatment and also patients after kidney transplant who have delayed graft function.

	Cat 1	Cat 2	Cat 3	Cat 4
N	45	49	77	71
Mean time (SD)	n (%) tm (sd)	n (%) tm (sd)	n (%) tm (sd)	n (%) tm (sd)
Independence				
1 Mobility				
a. Walking, no help (%)	22 (48.9) 1.02 (1.69)	31 (6.3) 0.65 (2.21)	56 (72.7) 1.08 (1.91)	57 (80.3) 0.61 (1.20)
b. Guided walking, wheelchair, bed (%)	13 (28.9) 2.90 (2.05)	14 28.6 3.08 (5.72)	16 (20.8) 3.95 (3.15)	12 (16.9) 4.94 (4.93)
c. Using chairlift, help in and out of bed (%)	10 (22.2) 10.98 (7.96)	4 (8.2) 9.02 (6.47)	5 (6.5) 9.78 (2.60)	2 (2.8) 12.19 (6.09)
2 Necessary actions before and during dialysis				
a. Can independently perform actions (%)	17 (37.8) 14.15 (7.62)	10 (20.4) 7.52 (1.84)	28 (36.4) 9.00 (5.97)	9 (12.7) 5.89 (4.81)
b. Needs care (%)	28 (62.2) 15.15 (5.96)	39 (79.6) 8.57 (2.88)	49 (63.6) 13.12 (5.49)	62 (87.3) 10.49 (3.31)
Vascular access				
5 Connecting				
Fistula				
a. Fistula Category 1 (%)	12 (26.7) 18.92 (7.96)	17 (34.7) 16.80 (10.32)	39 (50.6) 11.89 (5.20)	26 (36.6) 9.02 (2.96)
b. Fistula Category 2 (%)	9 (20.0) 22.88 (11.63)	10 (20.4) 12.26 (3.03)	28 (36.4) 12.75 (5.68)	24 (33.8) 10.95 (6.13)
c. Fistula Category 3 (%)	3 (6.7) 24.22 (13.93)	10 (20.4) 25.25 (14.32)	3 (3.9) 13.67 (2.81)	11 (15.5) 15.10 (7.78)
Catheter				
d. Catheter Category 1 (%)	15 (33.3) 13.44 (4.86)	10 (20.4) 12.85 (5.97)	2 (2.6) 5.70 (2.81)	6 (8.5) 11.43 (4.46)
e. Catheter Category 2 (%)	6 (13.3) 30.10 (27.44)	2 (4.1) 12.90 (6.65)	5 (6.5) 15.34 (8.59)	4 (5.6) 19.69 (15.16)
6 Closing				
Fistula				
a. Patient applies pressure or use of clips (%)	6 (13.3) 21.75 (11.36)	21 (42.9) 18.22 (5.71)	46 (59.7) 17.63 (5.80)	49 (69.0) 15.60 (4.68)
b. Nurse applies pressure (%)	18 (40.0) 36.04 (7.44)	16 (32.7) 27.10 (10.13)	24 (31.2) 30.53 (6.50)	12 (16.9) 26.74 (6.74)
Catheter				
c. Catheter (%)	21 (46.7) 24.43 (10.14)	12 (24.5) 17.44 (1.88)	7 (9.1) 27.36 (10.17)	10 (14.1) 20.59 (7.55)
Psycho-social				
a. Patient does not need extra attention (%)	31 (68.9) - -	37 (75.5) - -	66 (58.7) - -	59 (83.1) - -
b. Patient needs extra attention (%)	14 (31.1) 3.04 (3.00)	12 (24.5) 2.65 (3.28)	11 (14.3) 3.69 (2.00)	12 (16.9) 5.41 (4.97)
Complexity dialysis				
a. Stable dialysis, no extra checks (%)	26 (57.8) 7.24 (4.96)	31 (63.3) 3.89 (5.24)	41 (53.2) 4.48 (6.74)	43 (60.6) 4.36 (3.70)
b. Unstable dialysis, extra checks necessary (%)	19 (42.2) 8.66 (5.84)	18 (36.7) 3.49 (3.73)	36 (46.8) 7.81 (7.68)	28 (39.4) 10.65 (11.03)

Table 4. Analysis of dialysis characteristics in 4 categories dialysis centres.
Including the total number of patients (N) per category. For each category per item the number (n and %) of patients and the average measured time (tm) and standard deviation (sd

Patients, N = 242	Univariate			Multivariate		
	B	Standard error	Significance	B	Standard error	Significance
Dialysis centres						
Academic	14.90	3.239	0.000	14.69	3.603	0.000
General	-7.090	3.154	0.026	-7.57	3.353	0.025
Non-hospital with a nephrologist	Ref					
Non-hospital without a nephrologist	-4.65	2.840	0.103	-5.17	2.970	0.083
Patient characteristics						
Gender						
Female	3.27	2.225	0.143	2.89	2.336	0.217
Age						
>70	1.22	2.275	0.591	1.03	2.519	0.684
Number of comorbidities						
0	3.25	3.368	0.336	4.81	3.415	0.161
1	Reference					
2	1.34	3.029	0.658	0.73	3.035	0.809
3	-1.70	3.399	0.617	-1.41	3.482	0.686
≥4	-2.53	4.085	0.536	-2.74	4.287	0.523
Ethnicity						
Immigrant	0.98	2.440	0.690	-0.44	2.575	0.866
BMI						
Underweight	9.66	5.484	0.79	9.31	5.642	0.100
Normal	Reference					
Overweight	-1.15	2.529	0.650	-0.97	2.553	0.704
Obese	2.15	3.241	0.508	2.74	4.287	0.523
Number of years HD						
0	4.46	3.898	0.245	1.97	4.039	0.626
1	Reference					
2-3	-1.46	3.071	0.634	-3.06	3.255	0.348
≥4	-3.52	3.041	0.248	-4.39	3.312	0.186
Previous NTX						
Yes	-8.20	3.999	0.041	-9.54	4.570	0.038
Previous PD						
Yes	2.37	3.343	0.479	4.54	3.524	0.19

Table 5. Univariate and multivariate regression analyses on differences between measured and predicted time.

In 1998, Freund [8] developed a classification model for dialysis centres in the United States, and he predicted the care time for long-term patients based on the type of dialysis centre and the associated costs. Five levels of care burden were defined. All these levels were observed in each of the three types of centres examined in this study (free standing non-profit, free standing for profit and hospital based). The overall average time spent by caregivers ranged from 61 care minutes per dialysis treatment for level 1 patients to 97 minutes per dialysis treatment for level 5 patients. These authors also showed that the costs-per-dialysis-treatment were not significantly different. However, this study did not examine the effects of patient characteristics and comorbidities on nursing time.

Some studies [8, 9, 10] have used costs to estimate the burden of care. Beddhu et al. [13] used the CCI to determine whether clinical outcomes and costs in HD or PD could be predicted. They demonstrated that a modified CCI could be used to predict costs for dialysis. This index would be useful to determine the appropriate payment for the care of patients undergoing HD.

In the Netherlands, studies have been conducted to develop an instrument to determine trends in the demand for the care of patients undergoing surgery [14]. The focus of these studies was the development of an instrument for general surgical departments. The results are, therefore, only applicable to trends in the demand for the care of patients having surgery. Moreover, these studies were performed in an university hospital.

Sankarasubbaiyan & Holley [15] compared the interventions required by social workers, dieticians and nurses caring for two demographically matched patient groups undergoing dialysis in either a step-down or an ambulatory unit. Not surprisingly, the results showed that dialysis care increased in elderly patients who were no longer independently functioning and had several comorbidities.

With the increased use of renal replacement therapy in the United Kingdom, the number of dialysis satellite units has increased. These dialysis satellites are largely nurse-run units associated with a main renal unit, similar to the Category 4 centres examined in the present study. Roderick et al. [10] compared the outcomes, care and costs in dialysis satellite units with the main units. The satellite units were as cost-effective as the main units.

No studies have focused on the differences in care time between university and non-university centres, and these studies did not compare the influence of patient characteristics and comorbidities on the burden of care and type of facility. Using the classification model employed in the present study, the required care time was adequately predicted for dialysis centres in categories 2-4. However, nurses working in dialyses centres in university hospitals required more time than predicted in this model.

The classification model used in the present study can be applied to most centres in the Netherlands and might also be valid in other countries. Further research is needed to consider the clinical conditions of patients to increase general implementation, particularly for patients in university centres, as the predicted burden of care was approximately 14 minutes less than the measured nursing time. This finding might indicate additional issues in patients treated in university centres, which are not adequately determined using the developed form and/or CCI, and is likely to reflect the fact that patients dialysed in university centres experience more comorbidities. The observation that these patients are underweight is consis¬tent with this assumption, as patients on HD with a higher BMI have better survival rates [16, 17]. Similarly, this idea is consistent with the fact that these patients are younger and have more comorbidity.
Additional tests, such as the malnutrition inflammation score (MIS) [18], or tests that measure disease comorbidity might be used to further examine this hypothesis. However, as of yet, unrecognised university centre-related issues of workflow seem to be responsible for this time difference. More research into the causes for this discrepancy may help improve the model for universal application.

Conclusion

This study shows that the care burden predicted by the classification model was adequate for a non-university hospital and all non-hospital dialysis centres. The care time needed in university centres was highest, with more time needed than that predicted. This can be only partially explained by severity of comorbidities and complexity of care.

Underweight patients required nine minutes more care time per dialysis on average, and patients with a previous transplant required nine minutes less. Gender influenced care time, with more time required to treat women.

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Chapter 4

Changing nursing care time as an effect of changed characteristics of the dialysis population

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Abstract

Background

The population of dialysis patients is ageing. Dialysis nurses are confronted with geriatric patients with multiple comorbidities. Nurses are confronted with an increasing burden of care.

Objectives

The present study focused on the question of whether, over time, the increasing age and comorbidities of the haemodialysis population increased nursing care time. Furthermore, we studied potential changes in the predictors of the required nursing time.

Design

Observational study.

Participants

A total of 980 dialysis patients from 12 dialysis centres were included.

Measurements

Nurses filled out the classification tool for each patient and completed a form for reporting patient characteristics for groups of relevant haemodialysis patients at baseline and after 1 and four years. Changes in patient and dialysis characteristics were analysed, as well as the estimated nursing care time needed.

Results

An increase in the nursing time needed for dialysis was largely due to decreased mobility, closing of the vascular access and a greater need for psychosocial attention and was most strongly present in incident dialysis patients. The time needed for dialysis decreased as patient participation increased and vascular access changed from catheters to fistulae. Over the four-year period, the average overall needed nursing care time per haemodialysis session did not change.

Conclusions

Our study shows that the average nursing time needed per patient did not change in the four-year observation period. However, more time is required for incident patients; thus, if a centre has high patient turnover, more nursing care time is needed.

Introduction

The population of western societies is ageing, and this trend is associated with a rise in the number of patients with chronic diseases who increasingly have multiple comorbidities [1]. Likewise, the age of dialysis patients worldwide is increasing, as is the number of disabilities they have [2].
In December 2016, there were 5,450 haemodialysis patients in the Netherlands, which has a total population of over 16.9 million people. Of these patients, 67.6% were over 65 years old, and within that group, 40.0% were older than 75 years. The absolute influx of patients into dialysis has been stable in recent years, but the influx of patients aged 75 years and older is increasing [3].
In Belgium, the numbers are similar: 4,248 haemodialysis patients were counted in December 2016, of a total population of over 11.2 million people. Of these patients, 66.7% were over 65 years old [4]. In this ageing population, the frequent underlying causes of endstage renal disease are type 2 diabetes mellitus, hypertension and/or atherosclerotic vascular disease [5, 6].
In addition to the increasing age of dialysis patients, it is well-known that this patient population is characterised by the presence of multiple comorbidities. As the dialysis population is ageing and has an increasing number of comorbidities, dialysis nurses must increasingly treat elderly patients who may need more nursing care time. This potentially increases the burden of dialysis care for the individual patient and for the dialysis department, enhanced by a shortage of qualified nurses and increasing costs. We previously developed and validated an instrument that can be used to measure the burden of nursing care for patients receiving haemodialysis [7]. The instrument has been shown to be a good predictor of the time needed in various types of dialysis centres [8].

Literature review

Adequate staffing in a dialysis department is crucial to provide high-quality care [9], a statement that is based on the classic framework of Donabedian [10]. Adequate staffing asks for alignment with the characteristics of the patient population that is being treated and should be flexible to adapt to changing patterns of the population. Although patient classification systems have been reported to improve the quality and efficiency of nursing care [8], studies in the literature that describe a patient classification system for dialysis nurses are scarce [11].

Brady et al. [12] argued that nursing care is labour-intensive and service-oriented and therefore difficult to measure. Conversely, Kane et al. [11] concluded that better deployment of nurses results in better care results, especially in high-risk departments such as the dialysis unit. Aiken et al. [13] also argued that a pleasant working environment, well-trained nurses and better staffing, benefit healthcare provision. Sloane et al. [14] additionally concluded that improvements in the working environment of nurses and better deployment of staff increased the quality of care and patient safety.

Sutherland Boal and Silas [15] developed an evidence-based, safe nurse staffing toolkit to determine the direct care time of nurses. These authors highlighted that safe staffing starts with knowing the needs of your patients, how these needs can be met and which components should be part of staff planning, for example, realtime assessment of patients' needs and workload measurements, multidisciplinary consultation, and adequate models for organising the delivery of optimal care by the right persons.

In the study 'Dialysis department 2.0.', the efficient deployment of nurses was investigated [16, 17]. This study did not focus on the burden of care for the individual dialysis patient, but on planning of the staff and connecting the planning to the daily life of the HD patient.

During the past 20 years there has been a dramatic increase in elderly patients on dialysis and nowadays more than 50% of dialysis patients is older than 65 years in most western countries. Therefore, knowledge of geriatric problems and specific needs of elderly patients has become increasingly important for nurses [18]. Major problems in the elderly are a decrease in mobility increasing the risk of falling [19] and cognitive decline and dementia [20].

The aim of the present study was to investigate whether the average nursing care time needed per haemodialysis patient changed over four years as a result of changes in the characteristics of the dialysis population in this period.

Material and methods

We investigated the possible changes in the average nursing care time per dialysis session for in-centre haemodialysis patients by utilising, at three different time points, a previously time-validated classification form [7]. Patients were selected from four categories of dialysis facilities: dialysis centres in university medical centres, those in general hospitals, independent dialysis centres and dialysis units without the continuous presence of physicians. We visited the same dialysis centres over a four-year period.

We included chronic dialysis patients. Excluded from measurement were patients who were undergoing dialysis for the first time and patients in an intensive care setting, as well as patients in strict isolation.

At baseline, 385 patients receiving haemodialysis were studied (all patients: baseline = AP:BL). The measurement tool was applied after one year to 538 patients (AP:BL + 1). After four years, another 476 patients (AP:BL + 4) were studied (Tables 1 and 2).
As a subgroup, incident haemodialysis patients (IP) were analysed at these time points. These were patients who had started haemodialysis a maximum of four months before the measurement point. There were 56 incident patients at baseline (IP:BL), 61 after one year (IP:BL + 1) and 60 after four years (IP:BL + 4) (Tables 1 and 2).
In a second subgroup analysis, we studied 90 patients from the baseline group who had survived a four-year follow-up period and were included in all measurements (longitudinal patients, LP) at baseline (LP:BL), after one year (LP:BL + 1) and after four years (LP:BL + 4) (Tables 1 and 2).

At all three study moments, the following patient characteristics were measured: gender, age, body mass index, length of time on dialysis, previous kidney transplantation, and previous treatment with peritoneal dialysis. The classification form to estimate nursing care time was developed with a focus on different issues that occupy nurses during a dialysis session [7]. In brief, those issues are related to patients' mobility and active participation in their own treatment (e.g. preparing the dialysis machine and applying pressure to the fistula), difficulty with vascular access, the need for psychosocial attention and haemodynamic stability during the dialysis session.

	All patients (AP)			Incident patients (IP)			Longitudinal patients (LP)		
	BL	BL + 1	BL + 4	BL	BL + 1	BL + 4	BL	BL + 1	BL + 4
N	385	538	476	56	61	60	90	89	90
Gender									
Male (%)	56.0	59.0	61.0	66.1	59.0	64.4	53.3	53.3	53.3
Age									
Mean (years)	64	64	67	60	63*	65*	67	68	71
SD	15.3	15.9	14.9	16.2	14.0	15.4	14.6	14.1	14.5
≥75 years (%)	31.4	32.6	38.2*	19.6	19.7	38.3*	38.9	39.3	46.7
BMI									
Mean	26.2	26.0	26.2	25.3	26.0	25.6	26.4	26.5	25.7
SD	5.6	5.4	5.3	5.0	4.0	4.9	5.4	5.4	5.4
HD vintage									
Mean	3.4	3.5	4.0	0	0	0	2.8	3.8	6.8
SD	4.7	4.7	7.7	0	0	0	4.0	4.0	4.0
Previous Tx (%)	9.7	11.4*	11.2	8.9	3.3*	3.4*	7.8	7.8	10
Previous PD (%)	14.5	11.2	8.2	23.2	9.8*	8.3*	7.8	7.8	7.8
Number of comorbidities									
Mean	1.7	1.5	2.1†	1.8	1.5	2.0	1.7	1.9	2.4*†
SD	1.3	1.3	1.5	1.4	1.3	1.6	1.1	1.2	1.4

Table 1. Patient characteristics.
Including number (N) per measurement.
BMI: body mass index, PD: peritoneal dialysis, SD: standard deviation, Tx: transplantation.
*Post hoc multiple comparisons—Bonferroni: *p ≤ 0.05 versus BL; †p ≤ 0.05 versus BL + 1.*

	All patients (AP)			Incident patients (IP)			Longitudinal patients (LP)		
	BL	BL + 1	BL + 4	BL	BL + 1	BL + 4	BL	BL + 1	BL + 4
N	385	538	476	56	61	60	90	89	90
Independence									
Mobility (%)									
Walking, no help	70.1	71.7	69.5	71.4	73.8	61.7	77.8	73.0	57.8*
Needs help	29.9	28.2	30.5	28.6	26.2	38.3	22.2	27.0	42.2*
Patient participation before and during dialysis (%)	27.5	43.1*	60.3*	23.2	37.7	60.0*	21.1	40.4*	47.8*
Vascular access									
Connecting (%)									
Fistula category 1	36.4	48.3	38.0	16.1	18.0	15.0	38.9	55.1	55.6
Fistula category 2	27.5	27.5	30.5	5.4	16.4	13.3	27.8	28.1	27.8
Fistula category 3	15.8	11.2	13.2	17.9	13.1	13.3	16.7	10.1	8.9
Catheter category 1	13.5	8.7	10.1	50.0	36.1	30.0	12.2	6.7	6.7
Catheter category 2	6.8	4.3	8.2	10.7	16.4	28.3	4.4		1.1
Disconnecting (%)									
Pat. pressure	53.8	63.4*	55.9	33.9	29.5	18.3*	56.7	70.8*	60.0
Nurse pressure	26.0	23.6	25.8	5.4	18.0*	23.3*	26.7	22.5	32.8
Closing catheter	20.3	13.0	18.3	60.7	52.5	58.3	16.7	6.7*	7.8*
Extra psychosocial attention (%)									
	33.8	34.6	36.1	32.1	36.1	61.7*	31.1	28.8	32.1
Complexity dialysis: Symptomatic RR dip, extra checks (%)									
	34.5	29.7	35.3	32.1	27.9*	46.7*	32.2	32.6	40.0

Table 2. Dialysis characteristics.
Including number per measurement.
*Post hoc multiple comparisons Bonferroni: *$p \leq 0.05$ versus BL; †$p \leq 0.05$ versus BL + 1.*

Data analyses

Statistical analysis was performed using IBM SPSS 23 (Armonk, New York, USA). To test for significant differences, either analysis of variance and chi-square tests with post hoc analyses were applied. For multiple comparisons, Bonferroni's corrections were performed.

Results

General

On average, the haemodialysis patients had become significantly older after four years. In the AP group, an average age gain of three years was observed after four years, whereas the average length of time on dialysis did not change (Table 1). The increasing age of patients was also observed in the IP groups: the age of patients starting dialysis at time point BL + 4 was on average five years older than that of patients at BL (Table 1).

The number of comorbidities per patient increased significantly over time from 1.7 to 2.4 in the 90 LPs (Table 1). In the AP groups, the number of comorbidities increased from 1.7 to 2.1 (significant), but in the IP groups, the difference was not significant (Table 1).

All patients

The average time required by nurses to perform the dialysis procedure did not significantly change over a four-year period in the AP groups (Figure 1).
The dialysis characteristics contributing to the overall need for nursing time are shown in Table 3 and can be divided into nursing time-consuming and nursing time-saving activities. More patients actively participated in their treatment, which was time-saving, but this was counterbalanced by more time-consuming catheter-related problems during both the connection and disconnection of catheters. As a result, the average time calculated in the AP groups did not change over time (Figure 1).

Incident patients

In the IP groups, the average nursing time did increase over time. This could be attributable to a rise in the time-consuming characteristics of this patient group, including decreased patient mobility, a higher percentage of haemodynamically unstable dialysis procedures, more time needed for psychosocial attention, more catheter connectivity problems and more nursing time needed for applying pressure to fistulas. These time-consuming characteristics could not be offset by a decrease in the needed nursing time due to the more active participation of the IPs at BL + 4 years (Table 3) and are probably related to the increasing age and comorbidities of incident dialysis patients. The mean time nurses needed to care for IPs increased significantly over four years (Figure 1).

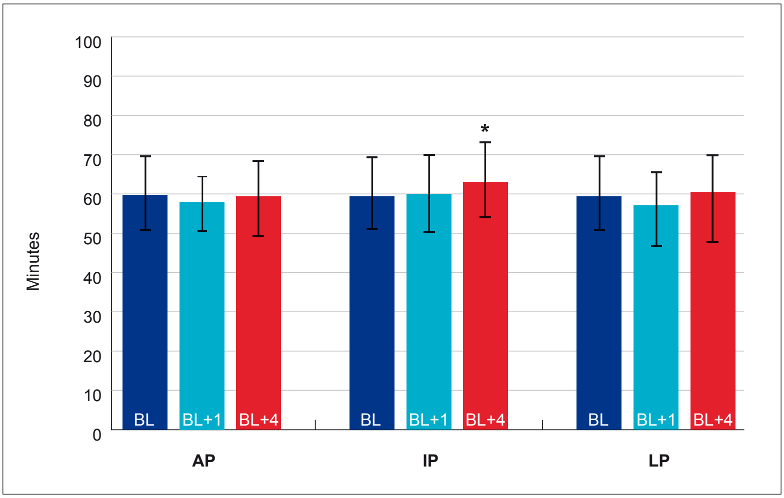

Figure 1. Mean nursing care time. Mean (±SD) time.
*AP: all patients, IP: incident patients, LP: longitudinal patients, SD: standard deviation. Analysis of variance and χ2: *p ≤ 0.05 versus BL.*

Longitudinal patients

In the LP:BL + 4 group, mobility had decreased compared to that in the LP:BL group, as the percentage of patients walking independently had dropped and the number of patients needing wheelchairs had increased. These factors contributed to the need for more nursing time per patient after four years. Furthermore, there was a trend of increased time due to nurses needing to apply pressure to the fistula after the dialysis session, and the number of unstable dialysis sessions increased (both consuming more time). On the other hand, there was an increase in the number of patients actively participating in their treatment and in the number of patients with less difficult fistulae and catheters (time-saving factors). Therefore, the average needed nursing minutes per patient over time did not change in the LP group.

The lower mobility and the trend towards a higher percentage of unstable dialysis procedures may be compatible with an increase in patients' age and comorbidities.

The average care time that nurses needed for the 90 LPs remained the same, despite the fact that the patients were older and had a greater number of comorbidities (Figure 1).

	All patients (AP)			Incident patients (IP)			Longitudinal patients (LP)		
	BL	BL + 1	BL + 4	BL	BL + 1	BL + 4	BL	BL + 1	BL + 4
N	385	538	476	56	61	60	90	89	90
Independence									
Mobility (%)									
Walking, no help	1.0	1.0	1.0	1.0	1.0	0.8a	1.1	1.1	0.8*†a
Needs help	2.8	2.7	2.7	2.5	2.3	2.6a	1.8	2.2a	4.3*†a
Patient participation before and during dialysis (%)	85.9	88.6*b	92.2*†b	84.9	88.0	92.8*†b	84.4	87.7*b	89.8*b
Vascular access									
Connecting (%)									
Fistula category 1	7.9	10.9b	8.4	3.5	3.9	3.0b	8.6	12.7b	12.2b
Fistula category 2	6.2	6.4	7.0	1.2	3.7	2.8	6.4	6.7a	6.3
Fistula category 3	5.3	3.8	4.5	6.0	4.3	4.1b	5.6	3.6b	3.0b
Catheter category 1	2.8	1.9	2.1b	10.6	7.5	5.9b	2.6	1.5b	1.4b
Catheter category 2	2.6	1.7	3.3a	4.2	6.4	10.3a	1.8	0.0b	0.4b
Disconnecting (%)									
Pat. pressure	15.6	19.0b	16.5	10.0	8.5	5.0	16.7	21.8*b	17.5
Nurse pressure	13.4	12.6	13.6	2.8	9.3	11.2a	14.0	12.3	16.8a
Closing catheter	7.7	5.1	7.0	23.2	19.7	20.5b	6.4	2.7*b	3.0b
Extra psychosocial attention (%)									
	2.2	2.4	2.4	2.1	2.4	3.8*†a	2.1	1.8	2.1
Complexity dialysis: Symptomatic RR dip, extra checks (%)									
	4.7	4.2	4.9	4.5	3.8*	6.0*†a	4.5	4.7	5.5a

Table 3. Average percentage of time that nurses need per dialysis characteristic.
a *More nursing-time-consuming.*
b *Less nursing-time-consuming.*
*Post hoc multiple comparisons Bonferroni: *$p \leq 0.05$ versus BL; †$p \leq 0.05$ versus BL + 1.*

Discussion

In the current study, we were able to demonstrate that the nursing care time needed per haemodialysis session had not changed in a four-year period, despite the fact that after four years, both the average age and the mean number of comorbidities of patients had increased. This can be explained by the fact that the characteristics of the nurses' job content over the years had changed in such a way that time-consuming characteristics due to, for example, the increasing age and comorbidity of dialysis patients, were counterbalanced by time-saving characteristics largely in the form of the more active participation of the patients in their treatment.

Older age in dialysis patients is often associated with frailty, which has been shown to be associated with impaired mobility and increased risk of falling in these patients. [21, 22]. In our study, we confirm that impaired mobility is present in elderly patients receiving dialysis as in the incident and the longitudinal patients at BL + 4 immobility is highest leading to more needed nursing time (Table 2). Likewise, has been demonstrated that elderly patients undergoing haemodialysis suffer from cognitive impairment [23], which we did measure as an increased need psychosocial attention in the incident patient group at BL + 4 (Table 2). As on the other hand over time the active participation of patients increased, resulting in a reduction of nursing time needed, overall needed nursing time did not change (particularly seen in the LP group, Figure 1).

Similarly, it could be anticipated that over time patients longer treated with haemodialysis become more experienced with the treatment and need less care time. Indeed, we see in all groups over time a rise in patient participation with the highest number at BL + 4 (Table 2), which could result in less needed nursing care time. This gain, however, is offset by the rise in needed nursing time due to increased immobility, number of comorbidities and need for physical attention in all patients and in the longitudinal patients.

In incident patients, the total nursing time had increased significantly at BL + 4 (Figure 1) despite the abovementioned counterbalancing effect of time-saving and time-consuming effects on nursing care time. Most likely, this can be explained by the persistent presence of catheters as dialysis access (Table 2: vascular access).

Despite current and long-standing guidelines focussing on timely vascular access placement for patients starting dialysis, incident patients still started in the majority of cases (approximately 60%) with a catheter as vascular access, resulting in more time spent connecting and disconnecting.

Ageing is associated with less physical activity and a sedentary lifestyle. This has also been demonstrated in patients receiving haemodialysis [24]. Thus, it is an interesting observation that over a four-year period, haemodialysis patients participated more actively in their treatment. This can be attributed to the successful implementation of recent Dutch guidelines, which call for more patient participation in their treatment. The Dutch dialysis quality improvement system is increasingly promoting dialysis guidelines. In line with Hoekstra et al. [25] who demonstrated improved care for exit sites in the Netherlands after widespread guideline implementation.

Accurate staff planning is of utmost importance to achieve optimal patient outcomes. An imbalance between available nursing staff and the number of tasks per nurse leads to detrimental patient outcomes [26, 27, 28, 29]. Especially in acute and general hospital settings, it has been demonstrated that a shortage of nurses and the concomitant high number of patient care tasks per nurse results in higher 30-day mortality rates and failure to rescue [27, 29], as well as higher burnout rates and more job dissatisfaction among nurses [26, 27]. An insufficient number of nursing staff was associated with more infections resulting from less hand hygiene and more medication errors [9]. Thomas-Hawkins et al. [29] showed that in chronic haemodialysis units, high patient-to-registered nurse ratios resulted in higher numbers of tasks left undone by the nurses. This was associated with an increased likelihood of hypotensive periods during dialysis, skipped or shortened dialysis treatments and higher numbers of patient complaints. Gardner et al. [30] revealed that in dialysis units, high nurse turnover rates related to impaired job satisfaction resulted in increased patient hospitalisation rates. Thus, appropriate nurse staffing is an essential factor to achieve optimal patient outcomes. In the present study, we demonstrate no changes in needed care time over a four-year interval. Sufficient availability of nurses will contribute to greater patient engagement [31] and, probably, to the more active participation of patients in their treatment, thus reducing the nursing care time.

Conclusion

In summary, we measured the average nursing care time needed per haemodialysis session in a large cohort of Dutch haemodialysis patients with a time-validated classification form. We were able to demonstrate that the average needed nursing time over a four-year period did not change because the time-consuming characteristics of the nursing care needed due to increasing age and comorbidity of the haemodialysis patients were counterbalanced by the time-saving characteristics, mainly as a result of more active participation of the patients in their treatment.

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Chapter 5

Do differences in clinical conditions affect the nursing care time of dialysis patients?

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Abstract

Background
In a classification model that predicts the required nursing care time for patients in dialysis centres, the clinical condition and some other characteristics of patients were not included.

Aim
To investigate whether the clinical condition of patients affects nursing care time in dialysis centres.

Method
Dialysis nurses filled out the classification model as well as a form on patients' characteristics and clinical conditions. Nursing care time was measured with stopwatches by observers.

Findings
In university dialysis centres per patient an average of 10 minutes more was measured than predicted with the classification model. In non-university dialysis centres predicted and measured nursing care time were corresponding. Patients in university centres had lower serum albumin, grip strength and Subjective Global Assessment outcomes, suggesting that these patients had a higher burden of disease. No specific clinical measures improved the prediction of nursing care time.

Conclusion
Patients in university dialysis centres appear to be more severely ill contributing to increased nursing time compared to non-university dialysis centres.

Introduction

The number of patients in western societies with chronic kidney disease has slowly increased in recent years [1]. However, the number of in-centre haemodialysis patients in the Netherlands has stabilised [2, 3], partly due to a higher number of renal transplants in the Netherlands. As a result of increased renal transplants, the dialysis population has changed in recent years to an older population with multi-morbidity, which means that nurses who work in dialysis centres are working with older patients who need more nursing care time [4]. Furthermore, older patients (over 75 years) with end-stage renal disease are at increased risk for cognitive decline [5] and, additionally, there is an increasing shortage of (renal) nurses.

These challenges mean that generally applicable planning tools for nursing resources are needed. Several studies have shown that there is a link between staffing, workload and the occurrence of medical errors [6, 7]. Appropriate staffing of nurses is important to improve the quality and safety of care [8].

In the Netherlands, there are eight university medical centres that combine a medical faculty with tertiary hospital care and dialysis for patients. Furthermore, general hospitals and independent speciality clinics also offer dialysis for patients. Post-transplant patients, acutely ill patients, complex patients and patients who have many comorbidities, that make them less suitable for treatment in the other hospitals or independent clinics, are treated in the dialysis units of the university medical centres. A classification model has been developed [9] that focuses on the dialysis routine: vascular access, connecting and closing the fistula and/or the catheter, the independence of the patient, the complexity of the dialysis and whether patients need extra psychological attention. Additionally, the time needed for weekly/monthly activities, such as doctor visits, blood sampling and fistula flow management that nurses work on during a dialysis session, is included. The model has adequately predicted the required care time of a patient for three categories of dialysis centres: general hospitals, satellites of the general hospitals and independent specialty clinics. The classification model is already being used in a number of dialysis centres. Other dialysis centres have indicated that they will start using this model in 2021.

However, nurses in dialysis centres of university hospitals need not only more care time compared to other dialysis centres [10], but also more time than predicted by the model. A possible explanation for this is that university hospitals treat highly complex dialysis patients and/or more patients who are starting dialysis treatment for the first time. The turnover of patients in university hospitals was also higher than in other centres. Another observation for this assumption was the fact that 10% of patients admitted to a university hospital died within 3 weeks of the study [10], while none of the patients admitted to other centres died during the same period [10].

Malnutrition and inflammation are frequently present in haemodialysis patients worldwide [11, 12]. Zaki et al. [12] investigated the nutritional status of haemodialysis patients using Subjective Global Assessment (SGA) — a tool to measure malnutrition. It was found that a decrease in SGA, increase in age, the number of years of dialysis, C-reactive protein (CRP) and a lower level of albumin were associated with a higher prevalence of malnutrition [13]. Rezeq et al. [11] suggested that dietitians should assess the nutritional status of haemodialysis patients through SGA to monitor the quality of life for these patients. It was also concluded that having diabetes and cardiovascular disorders, as well as the level of education and the profession of the patient, have a significant effect on the nutritional status of the patient undergoing dialysis. Grip strength also appears to be a useful nutritional parameter for evaluating the nutritional status of these patients [14]. Stenvinkel et al. [15] researched nutritional factors other than albumin, because albumin is also lowered by inflammation. They found that SGA measurement in itself is a good predictor of malnutrition. Grip strength is another useful marker of malnutrition [16]. The malnutrition inflammation complex syndrome (MICS) [17] is another predictor of poor outcome and increased number of hospital admissions for a patient. In haemodialysis patients, exposure to dialysis tubing and dialysis membranes, poor water quality, inefficient dialysis and foreign bodies in dialysis access can contribute to inflammatory symptoms. Patients with inflammatory symptoms are more likely to suffer from a loss of appetite, and dietary supplements result in beneficial outcomes of patients undergoing haemodialysis [18, 19].

The primary aim of this research was to investigate whether the clinical conditions of the dialysis patients affected nursing care time, beyond the dialysis-related activities included in the model. The secondary aim was to confirm the appropriateness of the nursing care time prediction model [9], given the recent change in the patient population receiving dialysis, and to evaluate whether the discrepancy of measured and predicted time in university dialysis centres versus other dialysis centres can be explained by the difference in clinical characteristics of the patients.

Methods

Classification model development

In 2014, 242 chronic dialysis patients were included in a study in which dialysis characteristics (independence of patients, vascular access, psycho-social aspects, complexity of the dialysis, communication and nursing care) were scored, and time spent on each step of the dialysis procedure was measured with a stopwatch by independent observers, who each followed one nurse during a shift. This resulted in a classification model that adequately predicted the average nursing care time, both in general [9] and independent dialysis centres [10].

Study design

For the current study, data were collected in the same way as our previous study [9]. Nurses filled out the classification model. Again, independent observers used a stopwatch and scored in seconds how much time the nurses needed to treat the dialysis patient.

In total, 90 chronic haemodialysis patients were included. A total of 45 patients were included in two university dialysis centres. The other 45 patients were selected from a general hospital (n=15 patients), an independent centre with a nephrologist present (n=15 patients) and an independent centre where a nephrologist was only present once a week or on call (n=15 patients).

In the morning or evening dialysis sessions, the observers were matched with a different nurse. Patients were randomly assigned to nurses. This meant that patients had an equal chance of being included. All patients signed a consent form. Not all of the patients and nurses were observed. Patients who underwent dialysis for the first time and patients in an intensive care setting or in strict isolation were excluded from the research.

Patients were divided into two groups for the analysis: patients from university centres and patients from other dialysis centres.

Measurements

Observers were instructed to measure the time that the nurses spent on various tasks during dialysis procedures using a stopwatch. Nurses filled out a form with patient characteristics, such as gender, age, body mass index (BMI), previous transplantation, previous peritoneal dialysis and comorbidities.

A number of other patient characteristics were recorded: laboratory data, SGA measurement, grip strength, current prescriptions and the number of hospital admissions in the past year, including the duration of and reason for admission. The reasons for admission to a hospital were categorised (Table 1).

Finally, the nephrologists were asked to complete the Charlson Comorbidity Index (CCI) for each patient [20]. The CCI is used as a measure of comorbidity for a patient population. The index is developed based on the predictive value for mortality after 1 year for various conditions. The CCI is based on ICD-09 codes, and defines 17 comorbidities. Each comorbidity is assigned a weighted score based on the relative risk of mortality after 1 year.

	University dialysis centres (n=44)	Non-university dialysis centres (n=45)	P-value
Indication, n (%)			
Renal	8 (17.8)	2 (4.4)	0.04
Cardiovascular	8 (17.8)	7 (15.6)	0.78
Respiratory	4 (8.9)	6 (13.3)	0.50
Oncological	4 (8.9)	1 (2.2)	0.17
Surgical/vascular access	10 (22.2)	13 (28.9)	0.47
Infectious diseases	8 (17.8)	4 (8.9)	0.22
Other	11 (24.4)	15 (33.3)	0.35

Table 1. Indication for hospital admission.
Variables are presented as number (%). P-values were calculated with Chi-square test.
Abbreviations: n, number.

Statistical analyses

Analyses were performed using the statistical package IBM SPSS Statistics for Windows, version 23 (IBM Corp., Armonk, NY US). First, we tested whether the current cohort was comparable to the cohort in which the nursing care prediction model was developed. Therefore, differences in patient characteristics, measured care time and predicted care time were tested using an independent t-test in case of normal distribution, a Mann-Whitney U test in case of non-normal distribution and a Chi-square test for categorical variables.

The average difference between measured and predicted time was calculated to evaluate discrepancies between university dialysis centres and other dialysis centres in the current cohort.

Second, the possible differences in characteristics between patients from university dialysis centres versus other dialysis centres were tested. The analyses included age as a continuous variable. Patients over 75 years of age are not a specific item in the analysis [4, 10].

Subsequently, the authors tested if there were patient characteristics that could possibly explain the differences in measured care time between university dialysis centres and other dialysis centres. Therefore, the authors first tested whether variables were univariable associated with measured care time using linear regression analysis. Thereafter, multivariable linear regression analyses were performed, including variables that had a univariate chi-square of 0.25. Subsequently, a stepwise backward analysis was performed with the variables from the multivariable regression analysis until only variables remained that were statistically significant. A two-sided $p<0.05$ was considered statistically significant.

Results

Of the 45 patients included in the university dialysis centres, one patient was excluded, as this patient had acute kidney injury and had been dialysed only once.

Patient and dialysis characteristics: comparison between the first study and the current study

Table 2 shows characteristics of patients and dialysis characteristics, as well as the number of patients for both the former [10] and the current study. There were no differences in gender, age, BMI and the average number of years on haemodialysis (HD) treatment between the two study groups. Likewise, the percentage of patients with previous kidney transplantation (NTX) and the percentage of patients with previous peritoneal dialysis (PD) was not significantly different between the two groups.
Compared to the first study [9, 10], a significantly higher percentage of patients needed help with their mobility in the current study (31.4% and 49.4%, p=0.002). Furthermore, a significantly higher percentage of patients actively participated in their treatment (26.4% and 53.9%, p=0.000). Significantly fewer patients needed psychosocial attention in the present study (79.8% and 43.8%, p=0.000). Overall, the predicted care time was similar in both studies, and the actual care time was properly predicted in other dialysis centres, but not in university dialysis centres (Table 3).

Comparison of classification aspects between university dialysis centres and other dialysis centres

In both studies, the average difference between actual and predicted care time was significantly higher in university dialysis centres than in other dialysis centres (Table 3).

	First study (n=242)	Current study (n=89)	P-value
Patient characteristics			
Gender (male), n (%)	131 (54.1)	46 (51.7)	0.69
Age (y) (sd)	66 (14.4)	67 (16.4)	0.83
Age ≥ 75y, n (%)	87 (36.0)	31 (35.2)	0.83
BMI (kg/m2)	25.4	25.6	0.67
Number years HD	3.5 (1-24)	3.1 (1-16)	0.27
Previous NTX, n (%)	21 (8.7)	11 (12.6)	0.29
Previous PD, n (%)	31 (12.9)	6 (7.0)	0.13
Number of comorbidities	1.8 (1-6)	2.2 (1-6)	0.41
Dialysis characteristics Independence			
Mobility, walking, n (%)	166 (68.6)	45 (50.6)	0.002
Patient participation, n(%)	64 (26.4)	48 (53.9)	0.000
Vascular access Connecting			
Fistula, n (%)	192 (79.3)	70 (78.7)	0.69
Catheter, n (%)	50 (20.7)	19 (21.3)	0.93
Closing by pressure			0.51
Pressure by patient, n (%)	122 (50.4)	41 (46.1)	
Pressure by nurse, n (%)	70 (28.9)	29 (32.6)	
Need for psychosocial attention, n (%)	193 (79.8)	39 (43.8)	0.00
Symptomatic blood pressure drop, n (%)	101 (41.7)	43 (48.3)	0.29
Difference between actual and predicted time			
Actual time mean (sd)	59.06 (23.45)	62.08 (25.26)	0.791
Predicted time mean (sd)	59.92 (9.97)	59.58 (11.92)	0.312
Actual – predicted time mean (sd)	-0.90 (18.77)	2.50 (21.20)	0.159

Table 2. Patient- and dialysis characteristics and difference between actual and predicted time.
P-values were calculated with an independent t-test.
Abbreviations: n, number; y, year; BMI, body mass index; HD, haemodialysis; NTX, kidney transplantation; PD, peritoneal dialysis; sd, standard deviation.

	University dialysis centres		**Non-university dialysis centres**		P-value
	First study (n=45)	Current study (n=44)	First study (n=197)	Current study (45)	Current study
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Actual time	75.8 (22.0)	70.3 (28.8)	52.3 (19.9)	54.0 (19.0)	0.003
Predicted time	62.5 (9.31)	63.5 (10.6)	56.6 (9.18)	55.7 (12.0)	0.002
Actual – Predicted time	13.3 (18.2)	6.89 (26.6)	-4.3 (16.3)	-1.7 (13.1)	0.06

Table 3. Comparison university dialysis centres vs non-university dialysis centres.
Variables are presented as mean ± SD. P-values were calculated with an independent t-test.
Abbreviations: n, number; SD, standard deviation.

	University dialysis centres (n=44)	Non-university dialysis centres (n=45)	P-value
Variable	Current study	Current study	
Patient characteristics			
Gender (male), n (%)	21 (47.7)	25 (55.6)	0.46
Age (y) (sd)	65 (16.2)	69 (16.5)	0.24
Age ≥ 75y, n (%)	10 (22.7)	21 (46.7)	0.01
BMI (kg/m2)	24.9 (4.71)	26.4 (5.55)	0.18
Number years HD	1 (1-4)	3 (1.5-5.0)	0.13
Previous NTX, n (%)	6 (13.6)	5 (11.1)	0.66
Previous PD, n (%)	1 (2.3)	5 (11.1)	0.12
Number of comorbidities	2.5 (1-4)	2 (1-3)	0.16
Dialysis characteristics			
Independence			
Mobility, walking, n (%)	21 (47.7)	25 (55.6)	0.002
Patient participation, n (%)	16 (36.4)	26 (57.8)	0.000
Vascular access			
Connecting			
Fistula, n (%)	31 (70.5)	39 (86.7)	0.59
Catheter, n (%)	13 (29.5)	6 (13.3)	0.06
Closing by pressure			
Pressure by patient, n (%)	10 (22.7)	31 (68.9)	0.000
Pressure by nurse, n (%)	21 (47.7)	8 (17.8)	0.000
Need for psychosocial attention, n (%)	25 (56.8)	14 (31.1)	0.02
Symptomatic blood pressure drop, n (%)	24 (54.5)	19 (42.20)	0.25

Table 4. Patient- and dialysis characteristics.
Categorical variables are presented as number (%). P-values were calculated with an independent t-test in case of normal distribution, Mann-Whitney U test in case of non-normal distribution and Chi-square for categorical variables.
Abbreviations: n, number; y, year; BMI, body mass index; HD, haemodialysis; NTX, kidney transplantation; PD, peritoneal dialysis.

The variation in actual time was also larger in university dialysis centres than in other dialysis centres.

The average age of patients was similar, but more patients were older than 75 in the other dialysis group compared to the university dialysis group (Table 4). Analysis of dialysis characteristics showed statistically significant differences for the type of vascular access, closing of vascular access and need for psychosocial attention between university dialysis centres and other dialysis centres. In the other dialysis centres, significantly more patients participated in their treatment (Table 4). All of these differences resulted in a higher predicted care time in the university dialysis centres, but this did not fully explain the longer average actual time needed per patient in the university dialysis centres (Table 3).

Analysis of clinical conditions and their effect on nursing care time

The laboratory results show a lower mean albumin level for patients in university dialysis centres compared to other dialysis centres patients (34.3 versus 36.7 g/L, p=0.06). Significantly more patients received antibiotics (38.6% and 13.3%, p=0.006) (Table 5). There were no differences in number of hospital admissions (median 1 (0–3) versus median 1 (0–2) p=0.46), or duration (number of days the last year) of hospital stay (median 11.0 (0.0–19.5) versus median 6.0 (0.0–12.5) p= 0.26) between the groups. However, in university dialysis centres, a greater number of patients were admitted to the hospital for renal indications (17.8% versus 4.4%, p=0.04) (Table 1). Other indications for hospital admission, for example, cardiovascular, respiratory, surgical/ vascular access or oncological, did not differ significantly. Infectious diseases admissions tended to be higher in university dialysis centres, but this was not statistically significant.

	University dialysis centres (n=44)	Non-university dialysis centres (n=45)	P-value
Lab value			
Albumin (g/L)	34.3 (6.80)	36.7 (4.83)	0.06
Creatinine (μmol/L)	652 ± 283	724 ± 269	0.23
CRP (mg/L)	11.0 (4.5-26.0)	7.0 (3-28)	0.44
Haemoglobin (mmol/L)	6.6 ± 0.86	6.7 ± 0.62	0.30
Leucocytes (*10^9/L)	8.0 (5.5-9.8)	7.8 (5.8-9.0)	0.91
Subjective Global Assessment			
N	27	25	
SGA	5.3 ± 1.3	6.3 ± 0.85	0.001
Medicine			
Antibiotics n (%)	17 (38.6)	6 (13.3)	0.006
Beta blockers n (%)	31 (77.3)	24 (53.3)	0.09
ARB' s n (%)	2 (4.5)	2 (4.4)	0.98
Calcium channel blockers n (%)	12 (27.2)	7 (15.6)	0.18
Diuretics n (%)	18 (40.9)	13 (28.9)	0.23
ACEi' s n (%)	10 (22.7)	3 (6.7)	0.03

Table 5. Clinical conditions.
Variables are presented as mean ± SD in case of normal distribution, or as median (IQR) in case of non-normal distribution. P-values were calculated with an independent t-test in case of normal distribution, Mann-Whitney U test in case of non-normal distribution.
Variables are presented as mean ± SD.
Abbreviations: n, number; CRP, C-reactive protein; SGA, subjective global assessment; SD, standard deviation; ARB, angiotensin receptor blocker; ACEi, angiotensin converting enzyme inhibitors.

In the university dialysis centres, the subjective global assessment was significantly lower compared to other dialysis centres (5.3 versus 6.3, p=0.001) (Table 5). The number of patients with SGA nutritional status measurement was low, because not every dialysis centre routinely performs this measurement. No difference was seen in grip strength of the dominant hand of patients.

Association between patient characteristics and actual care time

Univariate analysis showed that an increased number of comorbidities means that more care time is needed per patient (St. β 0.27 p< 0.01). Furthermore, a low albumin level correlated with an increase in care time (St. β –0.30 p=0.005). Another factor that increased measured care time was a decrease in grip strength (St. β –0.25 p< 0.03). When multivariable analysis was performed, none of these factors remained statistically significant. However, in the stepwise backward analysis, only albumin remained significant, indicating that this is the strongest predictor of measured care time during dialysis (Table 6).

Discussion

This research re-evaluated the appropriateness of the 2015 classification model for estimating the nursing care time needed per dialysis session by recording the nursing time spent per session. In non-university dialysis centres, the predicted care time still equalled the actual measured care time [10]. Although patients had become older, less mobile and asked for more psychosocial attention (time-consuming characteristics), which lead to more of nurses' time being spent with each patient, this was counterbalanced with time-saving characteristics, because most patients participated actively in their treatment and required less time from the nurses [4]. As a result, both the actual and predicted time were similar to the first study [10]. This confirmed that the most care time for patients was needed in the university dialysis centres. Similar to the results in the first study [10], the predicted time underestimated the actual measured time in university dialysis centres, although somewhat less than in the first study.

The decrease in the time spent in this study compared to our previous study was mainly due to increased participation of patients in their own treatment [4]. However, the difference had not fully disappeared. Therefore, we investigated whether medical indicators of disease severity were able to explain the remaining difference.

	Univariate			Multivariate			Stepwise backward		
Variable	B	St. β	p-val.	B	St. β	p-val.	B	St. β	p-val.
Dialysis centre (non-university vs. university)									
Mobility (%)									
Gender (Male)	-0.88	-0.02	0.87						
Age	-0.01	-0.01	0.96						
BMI	0.17	0.03	0.76						
Number years HD	0.67	0.09	0.39						
Previous NTX	-2.52	-0.03	0.76						
Previous PD	2.32	0.02	0.83						
Number of comorbidities	4.20	0.27	0.01	0.73	0.05	0.81			
Albumin	-1.27	-0.30	0.005	-0.78	-0.18	0.27	-1.27	-0.30	0.005
Creatinine	-0.01	-0.06	0.61						
Leucocytes	0.78	0.15	0.18	0.53	0.10	0.52			
CRP	0.07	0.12	0.35						
Cholesterol	0.34	0.06	0.63						
Haemoglobin	-0.22	-0.06	0.57						
Hospital admissions									
- Number last year									
- Days last year									
Indication hospital admission									
Renal	-7.61	-0.10	0.38						
Cardiovascular	2.03	0.03	0.78						
Respiratory	8.28	0.10	0.34						
Metabolic/endocrine	-	-	-						
Oncological	4.37	0.04	0.71						
Surgical/vascular access	-6.44	-0.11	0.30						
Infectious diseases	-0.25	-0.003	0.98						
Other	3.41	0.06	0.58						
SGA	-5.47	-0.27	0.06	-3.07	-0.15	0.38			
Grip strength	-0.51	-0.25	0.03	-0.34	-0.17	0.33			

Table 6. Association between patient characteristic, clinical conditions and actual care time.
Betas, standardised betas and p-values were calculated using univariate linear regression. Dependant variable is measured care time.
Variables that had a univariate α of 0.25 were included in the multivariable analysis.
Abbreviations: BMI, body mass index; HD, haemodialysis; NTX, kidney transplantation; PD, peritoneal dialysis; SGA, subjective global assessment.

Analysis of the clinical data of patients undergoing dialysis showed that patients in university dialysis centres had lower SGA measurements and hand grip strength than patients in other dialysis centres. Additionally, the level of serum albumin was lower compared to patients receiving dialysis in other dialysis centres. In the linear regression analysis, grip strength and albumin were shown to be univariately associated with measured care time. Albumin was associated with the difference in actual and predicted care time, although this did not reach formal statistical significance. This suggests that, compared to patients in other dialysis centres, patients treated in university dialysis centres were more severely ill, and had more signs of protein energy wasting and muscle loss, which could be a possible underlying explanation for the higher actual than predicted care time.

It is possible that improvement of dietary intake will reduce the time that nurses are required to spend caring for each individual patient. This could be investigated in future studies. This might lead to an adaptation of the classification model. In the meantime, a standard amount of time of 10 minutes could be added to the care of each patient for the model to be adequate for use in centres with more complex patients.

The classification model can be of value by matching the nursing time needed with the patients presenting for treatment, thus contributing to the efficacy of dialysis centres, especially where there is a shortage of nursing staff.

Conclusion

The classification tool to predict dialysis care time adequately estimates the nursing care time needed, even in a changing population of patients. It is especially suitable for patients receiving dialysis in non-university dialysis centres. It underestimates care time for patients at university dialysis centres. This may be explained by the fact that patients treated in university dialysis centres have a higher burden of disease, represented in part by a higher prevalence of protein energy wasting, as indicated by lower SGA measurements, a reduced grip strength and lower serum albumin levels.

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Chapter 6

Effect of malnutrition on nursing care time in patients undergoing haemodialysis

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Abstract

The number of elderly patients undergoing dialysis treatment in the Netherlands has stabilized over the last decade. This population shows specific conditions such as fragility, malnutrition, protein energy wasting and loss of muscle strength.
As there is an (increasing) shortage of (dialysis) nurses, active participation of dialysis patients in their own treatment may reduce the burden of direct care time for nurses. The aim of this literature review is to find out whether specific attention to the nutritional status of dialysis patients may slow down the decline in the patient's condition. This may result in an improved independence relating to dialysis treatment.
Using a literature review, Malnutrition, Handgrip strength, Muscle mass, Physical functioning aspects of the dialysis patient were summarized. A search strategy was used.
Our review showed that better physical functioning is associated with extended independence of the patient, while the ability to carry out daily activities remained present and personal participation in the dialysis treatment sustained for a longer period of time.

Conclusion

When dialysis patients have a good nutritional status and hand grip strength, they should be able to participate in their own treatment. Attention for these aspects may allow for stable nursing care time despite the increasing age of the dialysis populations.

Introduction

The world's population is getting older and with age the number of patients with chronic diseases is increasing [1]. Similarly, the age of the dialysis population is increasing together with the number of comorbidities in these patients [2, 3].
In the Netherlands, until 2015 there was an increase in the number of elderly people on intermittent haemodialysis. This number has stabilised since then [4]. In 2014, 3.530 patients of 65 year and older were on haemodialysis treatment and in 2020, there were 3.262 patients. The total number of patients on haemodialysis treatment in the Netherlands amounted to 5.601 in 2014 and 5.260 in 2020 [4].
Over 60% of people on haemodialysis treatment are 65 years of age or older, an age group in which the number of comorbid diseases is usually high. Further, we are also

confronted with an (increasing) shortage of (dialysis) nurses in the Netherlands. Consequently, the burden of care for the nursing staff is increasing.
It would be helpful to be able to estimate the burden of care for individual patients in order to adjust the availability of personnel to the patients or vice versa.

In 2015, a classification model was developed to measure the care need in dialysis patients [5]. This model focuses on the dialysis routine: vascular access, the connection and closure of fistula and/or catheter, the independence of the patient, dialysis complexity and whether the patient needs additional psychological attention. In addition, the time needed for the weekly/monthly nurse activities which the nurses work on during a dialysis session such as accompanying doctor's visits, blood sampling and the shunt flow measurements is included. When the burden of care of patients (defined as the time a nurse actually spent on the patient) [6] is known, the number of nurses needed as well as their deployment can be adjusted to the actual patient care requirements.
The model appeared to be especially a good predictor of the level of care in non-university dialysis centres (general hospitals, satellites of the general hospitals and independent specialty clinics). For university centres, the predicted time should be increased by 10 minutes [7, 8]. This difference in estimated and actual care time could not be sufficiently explained by the patient and dialysis characteristics as formulated in the classification model, but was mainly related to a higher acute disease burden of patients in the university dialysis setting. In the other dialysis settings, the item 'independence of the patient', in this case representing active participation in their treatment (i.e., entering the dialysis room and sitting in the chair independently, preparing items required for dialysis treatment and closing the fistula yourself) decreased needed nursing care time. Older dialysis patients took less actively part in their dialysis treatment, partly due to decreased physical functioning, leading to an increase in care times [7].
An additional study [8] examined whether the clinical condition (and a number of other patient characteristics) influenced the care time. This study showed that patients in university hospitals had a lower serum albumin. In addition, the SGA (Subjective Global Assessment) value was lower, and their hand grip strength was less than in patients in non-university hospitals. These observations may be explained by a poorer nutritional status. Poor nutritional status, for which serum albumin is a commonly used marker, is associated with poor physical functioning of dialysis patients [9,10]. Several studies indicate that hand grip strength is a useful measure in

assessing the nutritional status of haemodialysis patients [11, 12]. Especially in older dialysis patients, a loss of hand grip strength means a loss of independence [12].

The aim of this review is to find out whether there are studies in the literature that examine the role of nutrition of dialysis patients in preventing the deterioration of physical fitness and thus may inform us on how to reduce the dependence on nursing staff support during dialysis.

In this paper the focus will be on the effect of malnutrition in dialysis patients, as pertains to the associations of malnutrition and inflammation, malnutrition and physical fitness and malnutrition and hand grip strength.

Methods

Search strategy

Electronic databases (PubMed, Cohrane and CINAHL) were searched in two steps. After an initial screening with the keywords haemodialysis and malnutrition it turned out that there were too few articles focused on the question. The keywords for the second screening were haemodialysis, malnutrition, physical functioning, hand grip strength. The search was limited to clinical (cohort and research) studies published between January 2005 and December 2020. Articles were selected by screening results on title and abstract. The articles had to discuss haemodialysis and malnutrition, whether in combination with physical function or hand grip strength. Reviews, protocols, and guidelines were excluded as well as articles on peritoneal dialysis or kidney transplantation. All papers identified were English-language, full-text papers. We also searched the reference list of identified articles.

Narrative Results

In Table 1 the number of search hits and the consequent selection of papers are presented. The results are subsequently reviewed in their relation to five topics: malnutrition, malnutrition and inflammation, malnutrition and physical fitness, malnutrition and hand grip strength, and malnutrition and interventions.

Database	Search String	Results
Cochrane	Dialysis patients AND Malnutrition AND Physical Functioning	0 articles
CINAHL	Dialysis patients AND Malnutrition AND Physical functioning	69 articles, possibly suitable results 20
PubMed	Dialysis patients AND Malnutrition AND Physical functioning AND Handgrip strength	13 articles possibly suitable result 5
	Haemodialysis AND Malnutrition AND Handgrip strength AND Muscle Mass	26 articles, possibly suitable results 14

Table 1. Search strings used for CINAHL and PubMed.

Malnutrition

The search strategies resulted in 108 papers on malnutrition and its impact on dialysis patients, of which 39 were useful for this review. Most unsuitable papers included patients on peritoneal dialysis or transplant patients.

The characteristics of malnutrition include low Body Mass Index (BMI), loss of muscle mass and low serum albumin [13].
Already in 1995, Ikizler et al.[14] concluded that a decrease in kidney function changed the nutritional needs and appetite of dialysis patients. Advanced age, diabetes and heart failure were also associated with poor nutritional status in dialysis patients, protein malnutrition being especially mentioned [15]. Malnutrition is increasingly cited as a risk factor for morbidity, mortality in dialysis patients and longer hospitalisation [16, 17].
De Araújo et al. [18] evaluated the impact of nutritional parameters at the start of haemodialysis on mortality. Dialysis patients who were on haemodialysis for three months or less were included in this study. They concluded that low energy intake at the start of dialysis is a risk factor for mortality.
Malnutrition in chronic dialysis patients is strongly associated with mortality [19]. Nurses should routinely perform nutritional assessments on dialysis patients and dietitians and nurses should work with the dialysis patient on methods to increase appetite [20, 21]. Saxena [21]: "Patients should maintain adequate caloric intake". Six studies described the interventions nurses may perform to reduce patients' malnutrition, but they did not mention anything about increasing the direct care time for the nurse.

Malnutrition and inflammation

Mutsert & Krediet [13] identified two types of malnutrition: type 1 is caused by inadequate food intake; type 2 is due to inflammation, a common condition among dialysis patients. The combination of both is a predictor of poor outcomes in haemodialysis patients [22]. Inflammation is defined as an increased concentration of C-reactive protein (CRP). In addition, biocompatibility of dialysis materials and fluids, increased the inflammatory process [23]. Inflammation also affects the patient's hormonal balance, causing the patient to have a reduced appetite [24].
Another approach to malnutrition focuses on the loss of body protein, fat mass and energy reserves, for which the term PEW (Protein Energy Wasting) is used [21, 24].
PEW and inflammation are common and concurrent conditions in dialysis patients and associated with poor outcomes, often as heart failure [25, 26] and significantly increased risk of death [9, 24, 27, 28].

In dialysis patients, it is suggested that malnutrition is secondary to inflammation; however, the evidence is inconclusive. Therefore, the term "malnutrition-inflammation complex syndrome" (MICS) was created to include this clinical entity, regardless of its original causes. MICS has been described in several studies [29, 30]. The syndrome is an accelerator of atherosclerosis and thus increases mortality. These studies are therefore aimed at early recognition and treatment of MICS to improve the clinical outlook of dialysis patients.
Stenvinkel [31] and Caglar [32] previously suggested that the treatment should include supporting actions to provide an integrated therapy against this complication.
None of the researchers mentioned the effect of the therapies on the care time of nurses.

Malnutrition and physical fitness

Loss of muscle mass (sarcopenia) and muscle function is one of the main causes of functional decline and loss of independence in older adults. It is believed that the loss of muscle mass and muscle function results from neurological decline, hormonal changes, activation of inflammatory mechanisms, decrease in activity, chronic disease, fat infiltration, and malnutrition [33]. As a result of malnutrition, the body is deficient in nutrients, including protein, which prevents the body from producing muscle tissue.
Compared to other peers, sarcopenia, appears to be more common and more severe in dialysis patients. Muscle wasting, defined as unintentional loss of body weight, is considered a common problem in chronic kidney disease. The renal damage and loss

of renal function that characterize chronic kidney disease (CKD) cause several complex systemic changes that affect muscle homeostasis, leading to loss of muscle mass and eventually muscle atrophy [34, 35]. Other authors [36, 37] also mention that loss of muscle mass is a common complication of dialysis. Loss of muscle mass increases the risk of comorbidities in patients with renal failure and lowers quality of life [38]. Loss of muscle mass combined with the common comorbidities in dialysis patients causes a decrease in mobility and a decrease in functional independence [27, 35]. Where the reduction in mobility in turn results in additional loss of muscle strength [27].
Although various studies mention a decrease in mobility in dialysis patients and a decrease in functional independence, the association of these with selfmanagement of the dialysis patient and a corresponding decrease in care time for the nurse has not been studied.

Malnutrition and hand grip strength

Reduced muscle mass and muscle strength are common conditions in dialysis patients. However, muscle strength and muscle mass are not congruent. Muscle strength may decrease while muscle mass remains the same or even increases [39].
The amount of muscle mass in the body affects hand grip strength. Reduction of muscle mass reduces grip strength [40]. Non-changeable factors on hand grip strength are gender and age. The hand grip strength in men is higher than in women, in both the hand grip strength decreases after the age of 60 [12, 41].
There appears to be a relationship between nutritional status and hand grip strength. According to Normen et al. [12] hand grip strength is a marker of nutritional status because muscle function responds to nutritional status. Pieterse et al. [40] concluded that impaired nutritional status is associated with reduced hand grip strength. Giglio et al. [37] investigated whether reduced muscle mass and reduced muscle strength are associated with poor nutritional status and poor quality of life. A random sample showed that both items were associated with poor nutritional status in elderly dialysis patients. In Malawi, the relationship between nutritional status and hand grip strength in the elderly was investigated. The results of this study support that poor nutritional status is associated with low hand grip strength [41].
From these data can be concluded that patients with malnutrition and lower hand grip strength have been in a worse general condition making it likely that they depend on more nursing care time.

Malnutrition and interventions

Countering malnutrition and its complex complications requires an integrated approach. Important issues are adequate dialysis treatment and nutritional status [13]. Nutritional screenings of patients undergoing haemodialysis for the first time often demonstrate malnutrition. Patients starting dialysis often have a reduced appetite for some time [20]. Patients undergoing haemodialysis also have a reduced appetite [42]. Steiber [20], Burrowes et al. [42] and Jadeja & Kher [26] recommend continuing to monitor the nutritional status of dialysis patients. One intervention to stimulate appetite in haemodialysis patients is the frequent serving of small calory-rich meals [20]. To improve muscle mass and reduce mortality, adequate nutritional supplements are vital [43].

Patients undergoing haemodialysis experience weakness, mostly due to muscle wasting, which has a negative effect on physical functioning [44]. Moderate strength training improves the physical performance and muscle mass of dialysis patients.

It appears that active exercise is not easily achievable for dialysis patients. Therefore, exercise programmes for haemodialysis patients are receiving increasing attention. Results of various studies indicate that low-intensity strength training is safe and beneficial for dialysis patients and statistically ignificantly increases muscle strength [34, 43, 44, 45].

It can be concluded from these results that if muscle strength increased, so did patient independence. Therefore, it is likely that personal participation in dialysis treatment may remain possible for a longer period of time. One would expect that when patients are participating in their own treatment (i.e., entering the dialysis room and sitting in the chair independently, preparing items required for dialysis treatment and closing the fistula themselves) the nursing care time may decrease. However, this has not been described in any study.

Discussion

Sixty years after the first haemodialysis treatment in a dialysis centre, nutrition in dialysis patients is still a recurring issue. Multiple studies have shown that protein and energy wasting affect many dialysis patients [24]. However, progress has been made in understanding the importance of nutrition goals in patients with chronic kidney disease. Now, it has also been shown that exercise is good for kidney failure patients in the dialysis phase [43, 44, 45]. Blood values improve, condition improves and muscle strength increases.

Sostisso et al. [46] concluded in their study that hand grip strength is a valid screening tool to identify patients at risk of malnutrition and inflammation.

Over the years, dialysis patients have become older and less mobile, requiring more psychosocial attention from the nurses. On the other hand, many patients actively participate in their treatment, which is time saving for the nurses [7, 8]. However, as the years go by, loss of grip strength in the elderly means loss of independence. This results in the elderly dialysis patient taking less and less active part in the dialysis treatment, which increases the time spent in care [7].

Dietary interventions and nutritional support appeared to be effective in reducing or correcting PEW and improving outcomes in patients with CKD [26]. All patients with CKD should be periodically assessed for the presence of PEW and receive oral nutritional support if necessary [21, 26]. Providing meals or oral food supplements and other nutritional interventions to patients with CKD is the most promising way to increase serum albumin concentration and improve longevity and quality of life in this patient population.

Johansson et al. [47]: PEW can be addressed through dietary guidelines. However, information on dietary guidelines in elderly dialysis patients is limited. Further research and collaboration with geriatricians could improve the quality of life of elderly dialysis patients [47].

The Japanese Society of Renal Rehabitation has developed a guideline to increase exercise both at home and during dialysis [48]. The message is to set up an individual exercise and nutrition programme for each patient which will reduce malnutrition and increase the patient's conditions. Recently, Hatef et al. [49] studied the effect of a training programme on self-efficacy in haemodialysis patients in Iran. The results showed that there was a significant difference between the patient group that followed the training programme and the group that did not. The self-efficacy and physical performance of the first group were clearly improved. Although the patients' self-efficacy increased, the study unfortunately did not examine the impact on nursing care time.

Omar et al. [50] concluded in their study that high MICS score results indicated that malnutrition is common in dialysis patients. Their recommendation was to perform a nutritional assessment at the start of the first dialysis and to start nutritional interventions as soon as possible, if necessary, to prevent deterioration of the condition of the patient.

Recommendations

At the moment, not all dialysis centres include determination of nutritional status (e.g., by Social Global assessment or MCIS) and hand grip strength in the care plan of dialysis patients. In addition, many dialysis patients have impaired appetite. Thus, their protein requirement is not met. It is likely that improving nutritional status may limit the loss of muscle mass and thus improve the life expectancy of dialysis patients. A nutritional intervention organised with, for example, recipes would be ideal for this target group. A second important treatment strategy is exercise therapy. This would improve the patient's condition as well.

Dialysis patients who have a good nutritional status, a high hand grip strength and follow a training programme may participate in their treatment more and for a longer period. As a result, not only the quality of life and patient survival may improve, but the ultimate nursing care time may be manageable although the dialysis population grows older.

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Chapter 7

Summary and general discussion

Summary

The background to this thesis is the demand for a classification model to be able to determine the level of care of dialysis patients in the various dialysis centres in the Netherlands. To that end, level of care is further defined as the time a nurse actually spends on caring for a patient during the haemodialysis session [1, 2]. Understanding how much time a nurse actually spends on a patient is important because staff costs make up the majority of costs in a dialysis centre.

The need for healthcare is growing because we are ageing, we can and want to do more, with technological developments that make it possible for us to live longer while the desired quality of care is increasing. These developments have led to an increase in healthcare costs over the decades, and they are still rising.
In addition to the increasing demand for care due to the ageing population, dialysis centres in the Netherlands are experiencing a "double ageing" due to an active kidney transplantation programme for patients up to the age of 65. As a result, the proportion of elderly patients with (multiple) comorbidities is increasing as patients are growing older, and, consequently, the burden of care in these dialysis centres is growing as well. The result is an increasing demand on the available human and budgetary resources.

Since 1983, hospitals in the Netherlands have had to deal with a budgeting system, whereby only the actual work delivered, is paid for [3]. Given the relatively high cost of nursing staff in dialysis departments, it is important to be able to regulate and control these expenditures. The proper use of resources for the quality of patient care is an important responsibility of the managers of the department. Appropriate staffing of nurses is also relevant for maintaining and improving the quality and safety of care [2]. Not only financial resources are limited, also the (local) shortage of nursing staff forces managers of dialysis centres to strive for efficient staffing. Knowledge of the level of care of the patient and the time needed to provide the patient with the appropriate care, are preconditions for coordinating the accurate (daily) staffing of the department and staffing needs of the patients. A good classification model should offer that possibility, enabling the managers of the dialysis department to control costs and optimize patient care.

Critical considerations and key questions of a patient classification system relate to the validity and reliability of the (measuring) instrument to be developed [4]. Validity

can be defined as "does the result of the measurements actually reflect what we want to measure know”? Reliability refers to the results when the instrument is used by different persons as well as to the results of repeated measurements (under equal conditions).
In order to standardize the research (validation), a "classification list" was conducted with relevant actions that can be measured in time and that have to be performed by nurses during dialysis treatment, supplemented by a number of patient characteristics [2]. To guarantee an objective interpretation, the nurses used clear instructions **(Chapter 2)**.
The time measurements (with a stopwatch) were performed by observers, who were also provided with clear instructions about how and what to measure.
During the years of this longitudinal study, stopwatch time measurements were repeated and the results turned out not to be significantly different from the first measurements [5].

In the Netherlands dialyses centres can be categorized in 4 main categories: 1) dialysis centres in university hospitals, 2) dialysis centres in general hospitals, 3) independent centres with a nephrologist present, 4) independent centres where a nephrologist visits weekly or is present on demand. In our study, dialysis centres of all categories participated.
The classification model proved satisfactory for both initial and follow-up measurements for three of the four categories of dialysis centre. In the dialysis centres in the university hospitals, however, the actual stopwatch-measured time exceeded the estimated time by the questionnaire. It turned out that the nurses in the university hospitals needed 10 minutes more time than the estimated time **(Chapter 3)**. As in the university hospitals in general the most complex patients are treated, we did expect more time to be necessary in these centres but we could not clarify why on the basis of the classification model.
Dialysis centres in university hospitals provide more complex care than other dialysis centres. Patients in university centres generally can be divided into three categories: 1) patients with acute kidney failure and those without recovery of renal function after acute kidney disease, 2) patients with significant comorbidities, such as difficulties in treating systemic diseases and complicated infections, 3) patients after kidney transplantation that were on chronic intermittent haemodialysis treatment. As a result, dialysis nurses in university centres are confronted with a higher turnover of patients. Patients who start dialysis require more time **(Chapter 4)**. One of the reasons is that these patients do not yet contribute to their own treatment and the

(admitted) patients in the university centres are often too ill to actively participate in their own treatment.

Further investigation showed that not only the above factors play a role in dialysis patients in university hospitals. The blood values of this patient group demonstrated that the albumin level is lower and the CRP values are higher **(Chapter 5)**. In addition, we showed that hand grip strength of patients in university hospitals was also less. Altogether, these observations indicate that patients treated in university hospitals suffer from additional problems or illnesses than patients in the other hospital categories, that are not adequately captured by the classification list. Additional tests, such as the malnutrition inflammation score [6], may be used to further investigate this hypothesis.
A reduced nutritional status may make people more susceptible to other diseases. It can adversely affect the dialysis treatment and people feel less comfortable. This is especially true for elderly dialysis patients who are often already more vulnerable due to multiple disorders and functional limitations. These functional limitations require nurses to spend more time caring for the elderly **(Chapter 6)**. With all the dietary restrictions, it can be difficult for dialysis patients to remain in a good nutritional state. This is why the deployment of multidisciplinary care teams on dialysis wards is important. In addition to dialysis, these teams also deploy other interventions, such as lifestyle advice and exercise programmes, in order to remain mobile as long as possible. Above all, exercise to promote the dialysis patient's mobility ensures that patients can actively participate in their own treatment, thus reducing needed nursing care time [7].

In conclusion, we have succeeded in developing a classification model that can be used in three of the four categories of dialysis centres: dialysis centres in general hospitals, independent centres with a nephrologist present, and independent centres where a nephrologist visits weekly or is present on demand. For use in dialysis centres in university hospitals, the model must be further perfected.

Discussion

A growing global public health challenge is the fact that the population has aged significantly in recent decades. This process is expected to continue. In 2020, 727 million people worldwide were 65 years of age or older. This is expected to reach 1.5 billion by the year 2050 [8]. At the same time, we will see an increase in the number of chronically ill people because chronic diseases are more common in the elderly [9]. In this light, cardiovascular diseases, diabetes and kidney diseases are of increasing concern. Likewise, at present, the majority of the dialysis patient population consists of elderly people [10, 11].
This rise in elderly people that also most likely will have a higher burden of disease, does result in substantial increases in necessary healthcare costs which will be a global problem.
It is known that in the USA healthcare expenditure currently constitutes 17% of gross domestic product (GDP). In Europe it is on average 10% of GDP [12], making healthcare spending one of the highest and fastest growing government expenditures [13].
In the Netherlands, healthcare costs are expected to increase to €96 billion in 2060. Currently, this is €88 billion. The main reason for this increase is the ageing of the population. In particular, spending on dementia, cancer and cardiovascular diseases will increase [14].
Consequently, there are widespread calls to cut healthcare costs. If healthcare is to remain affordable for everyone in the long term, it is necessary to strive for greater efficiency and ensure that the available resources are spent as effectively as possible [15]. This also applies to dialysis care. Nurses are the largest economic investment in a dialysis department.
Managers and nurses of dialysis centres are expected to provide excellent dialysis care to dialysis patients, while care must also be organized efficiently. A classification system can help to match staff and patients so that costs are manageable [16, 17].

Thomas-Hawkins [18, 19] has been researching for years the proposition that sufficient nurse presence on dialysis units is crucial. Her studies provide evidence that having enough nurses on the unit improves the safety of dialysis patients.

The classification model described by Kleijn et al [2, 20] is a tool for matching the number of patients and nurses based on the patient's need for care, which is the total time spent by a nurse on the patient during dialysis treatment.
Two terms that are quite often used by nurses to indicate the level of care needed for patient care are 'Low Care' and 'High Care'. For dialysis patients, Low Care would then mean 'uncomplicated dialysis in a stable patient who actively participates in the treatment'. High Care refers to dialysis patients who require intense medical follow-up [21], usually with multiple comorbidities, poor health status, increased CRP, malnutrition, and little to no hand grip strength.
However, it is questionable whether only the necessary care time (care intensity in the classification model) can determine the criterion of Low Care or High Care. Both 'classifications' Low Care and High Care cannot be traced back one-to-one to the classification model. If a large part of the care time is due to the immobility of the patient, or the fact that the patient does not actively participate in his treatment, this does not "automatically" mean that the patient is in High Care. This patient does require a lot of care time, but is often a "Low Care patient" because the treatment is well tolerated and there are hardly any or no complications. In summary, the terms Low Care and High Care, without further definition/ specification, do not offer the possibility of mapping out the degree of care with sufficient accuracy as a basis for the right staffing in the dialysis department. Thus, classification models like the one we developed, will be relevant, since they can map out the workload of the nursing activities helping the managers of the dialysis units to plan for the right staffing.
Finally, the difficulty of the dialysis characteristics of "opening and closing the access" also plays a role. This holds especially true, in a new group of "High Care" patients entering the dialyses unit. Namely the 80-year-old starting dialysis [22]. These older patients also have older blood vessels, and it is a challenge for vascular surgeons to construct a good fistula or shunt in an older blood vessel. The degree of difficulty in puncturing the shunt also plays a role. Nevertheless, the question is whether age alone justifies the designation High Care.

However, a number of aspects require further attention.
The question can be asked whether mobility should be left out of the classification model and registered in a different way. The idea behind this is that, where necessary, helping the patient into the dialysis chair is not a nursing action and can be done by others (assistants).
Another question relates to the time difference found in the university setting: should 10 minutes be added to the total time as standard for patients in university hospitals

or should there be a separate classification model for dialysis patients in university hospitals? Additional research is needed to resolve this question.
Another topic that has not been addressed in our classification model is the architectural impact of the departments. How big are the wards, how many patients are there? The latter need not affect the time measurement, but it is imaginable that it may affect the ratio of the number of patients per nurse.

Future perspectives

Matching the care of dialysis patients to the number of nurses required for it remains a complex matter. However, under increasing financial pressure in healthcare, it is a must. This requires managers to think in new patterns: can care be organized differently? Various cost analyses of renal function replacement therapies [23, 24, 25] show that once a kidney transplant has been performed, the annual costs drop significantly. Compared to haemodialysis, CAPD and home haemodialysis are also cheaper. There are currently 4,990 dialysis [30] patients in Dutch dialysis centres. This number has remained stable for a number of years. In contrast, only 142 haemodialysis patients undergo home dialysis. This number has even decreased slightly in recent years. Of this last group, 52% is older than 65 years. [30]. It would be interesting to investigate possibilities to enhance the number of patients being dialyzed in the home setting. Does this low number have to do with living arrangements, not having a partner or informal caretaker, old age, or other factors that prevent people from carrying out their dialysis at home? In France and Belgium, we see "Autodialysis" or Collective Autodialysis Centres (CAD) emerging [26]. Auto here means autonomous. These departments are specially intended for dialysis patients who can carry out their treatment themselves and have little or no medical problems. These patients manage their dialysis process themselves. In other words, these are patients who are suitable for home haemodialysis, but for whom the home situation is an obstacle.
In these centres, one nurse for six patients (1:6) is present in the background to provide assistance. The nephrologist sees the patient once a week. In the Netherlands, we do have independent dialysis centres and satellites of general hospitals where patients undergo dialysis and the nephrologist visits once a week, but they still work with a 1:3 or 1:4 nurse-patient ratio, sometimes with help of a dialysis assistant. During the second part of our study, in which we investigated whether the classification model is suitable for application to the various dialysis centres [20], we observed that in these independent centres and satellites, many Low Care patients were dialyzed. That is, the patients were mobile, could actively participate in their treatment themselves and had few or no medical problems.

With the financial pressures in mind and the shortage of dialysis nurses, it would certainly be worth investigating whether the CAD (with a staffing ratio of 1:6) is a good solution in the Netherlands also to deal with these problems. The next question to study is whether a well-trained dialysis assistant could suffice to be the only person working in this CAD?

With the outflow of dialysis nurses and the increase in relatively elderly patients, there is an urgent need for a second job level. Dialysis assistant training has existed in the Netherlands for more than 15 years, but nationally there were major differences between training, task performance and competencies. The need for an unequivocal course in which educational requirements, area of expertise and final attainment levels are laid down, has been met and the Netherlands has had a recognized dialysis assistant course since the mid-2020 (6). The dialysis assistant is trained to independently perform an uncomplicated haemodialysis treatment in a stable patient.

We think that adequate deployment of dialysis nurses and dialysis assistants, using a classification model, is the key to improving the quality of patient care in dialysis patients, reducing complaints about the burden of care by nurses [27, 28, 29]. And finally, it will contribute to decreasing the problem of retaining sufficient numbers of nurses in the dialysis units.

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Samenvatting (Dutch summary)

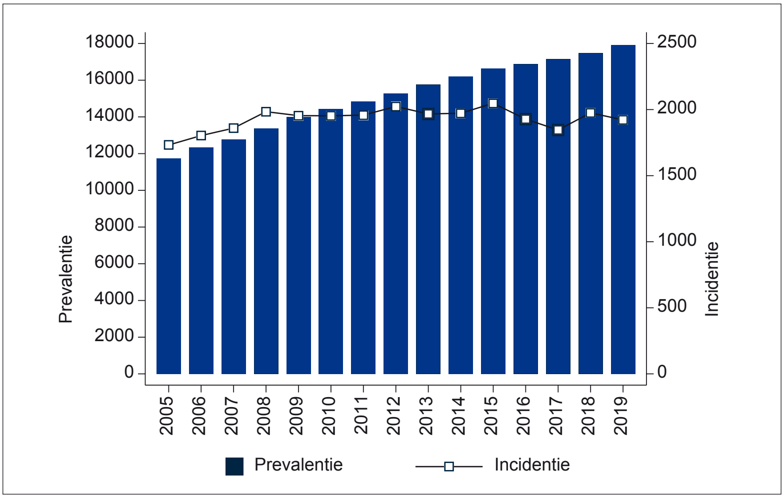
Nederlandse samenvatting

De voortdurende verbeteringen in de gezondheidszorg dragen eraan bij dat de wereldbevolking steeds ouder wordt. In Nederland bijvoorbeeld, met 17,4 miljoen inwoners, bedraagt het aandeel 65-plussers inmiddels 19,5% van de bevolking, waarbij 4,7% van de totale bevolking ouder is dan 80 jaar. De combinatie van een hoger aandeel ouderen en de hogere leeftijd die zij bereiken wordt wel dubbele vergrijzing genoemd [1].

Als gevolg van de vergrijzing van de bevolking en de vergaande nieuwe behandelingsmogelijkheden en technologische ontwikkelingen neemt ook het aantal patiënten met een chronische ziekte toe, waarbij veel oudere patiënten meerdere ziektes of comorbiditeiten hebben.

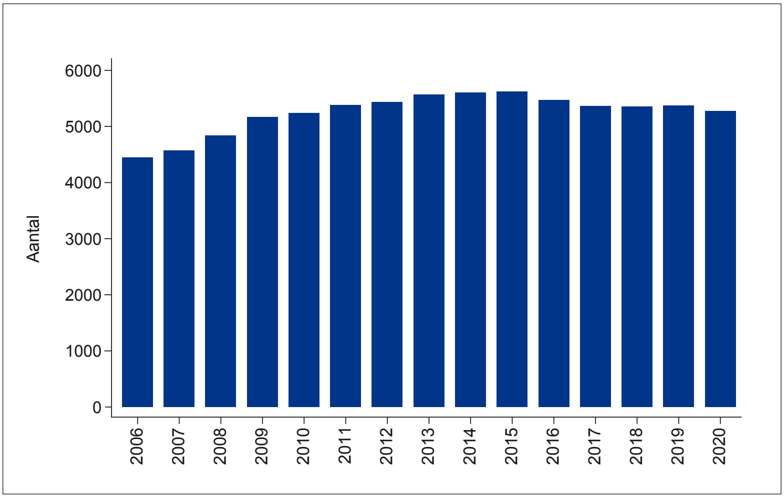
Veel voorkomende chronische aandoeningen bij ouderen zijn hart- en vaatziekten [2] en diabetes. Nederland telde in 2019 1,5 miljoen mensen met een vorm van hart- en vaatziekten en 1,2 miljoen diabetespatiënten [3]. Deze ziekten, maar ook hypertensie en obesitas zijn risicofactoren voor schade aan de nieren, hersenen en andere organen [4]. Chronische nierschade is een veelvoorkomend gezondheidsprobleem met een prevalentie van ongeveer 10% in verschillende landen over de hele wereld, en is geassocieerd met verhoogde cardiovasculaire morbiditeit en mortaliteit, en met een lagere levensverwachting [2]. Chronische nierschade leidt vaak tot de noodzaak van nierfunctie vervangende therapie, hetzij niertransplantatie, peritoneale dialyse of chronische intermitterende hemodialyse [5]. In het algemeen wordt chronische intermitterende hemodialyse uitgevoerd op een dialyse-afdeling, in een kleine minderheid als thuisdialyse.

Het aantal personen in Nederland dat afhankelijk is van nierfunctie vervangende behandeling neemt gestaag toe (figuur 1). Op 31 december 2019 betrof het ongeveer 18.000 patiënten [6].



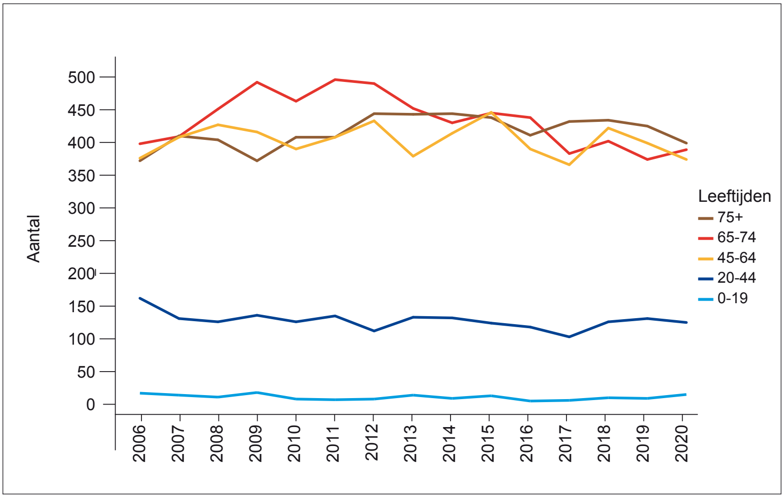
Figuur 1. Het aantal patiënten in Nederland dat afhankelijk is (prevalentie) en wordt (incidentie) van nierfunctie vervangende therapie per jaar.
Bron: https://www.nefrovisie.nl/nefrodata

Deze stijging is vooral te danken aan de toename van het aantal patiënten met een functionerend niertransplantaat. Het aantal patiënten met intermitterende hemodialyse was de afgelopen 10 jaar namelijk vrijwel stabiel (figuur 2).



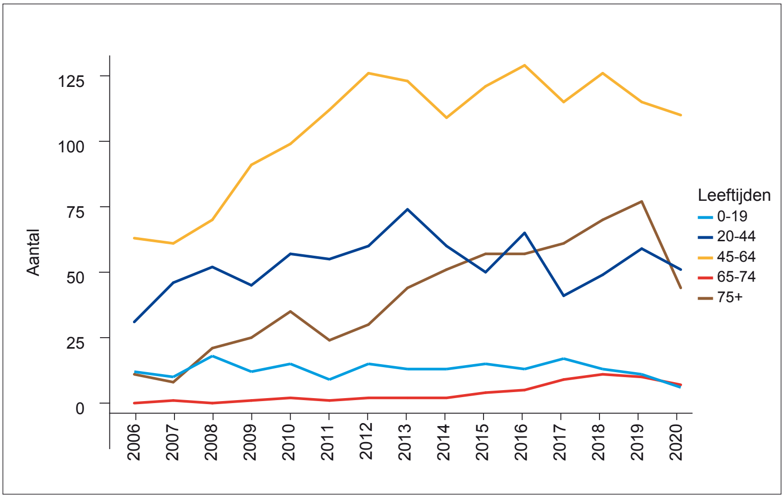
Figuur 2. Het aantal patiënten in Nederland dat afhankelijk is van intermitteende haemodialysebehandeling per jaar.
Bron: https://www.nefrovisie.nl/nefrodata

Terwijl er tot 2009 een aanzienlijke toename was van incidente hemodialyse-patiënten in de leeftijd van 75+, is de incidentie in deze leeftijdsgroep sindsdien gestabiliseerd en neemt zij vanaf 2012 gestaag af (figuur 3). Deze figuur laat ook zien dat de incidentie van hemodialyse in de andere leeftijdsgroepen de afgelopen 15 jaar niet wezenlijk is veranderd.



Figuur 3. Leeftijdsverdeling van incidente patiënten bij aanvang van intermitterende hemodialysebehandeling.
Bron: https://www.nefrovisie.nl/nefrodata.

Voor een deel kan de daling van het aantal oudere hemodialysepatiënten worden verklaard door de stijging van het aantal niertransplantaties in deze patiënten-groep (figuur 4) via het levende-verwanten-niertransplantatieprogramma en door initiatieven zoals het old-for old postmortale transplantatieprogramma van Eurotransplant. Vanaf 2011 was er namelijk een aanzienlijke stijging van het aantal patiënten >65 jaar dat werd getransplanteerd. Deze stijging was al eerder begonnen in de leeftijdsgroep 45-64 jaar. Cijfers laten zien dat in 2020 het aantal transplantaties afneemt, voornamelijk als gevolg van de covid-19-pandemie.



Figuur 4. Leeftijdsverdeling van incidente transplantatiepatiënten
Bron: https://www.nefrovisie.nl/nefrodata.

Met de toename van het aantal oudere patiënten (met veelal meerdere comorbiditeiten) nemen ook de kosten in de gezondheidszorg toe. Deze toename van de zorgkosten is volgens het Rijksinstituut voor Volksgezondheid en Milieu (RIVM) voor een deel te wijten aan de vergrijzing en de bevolkingsgroei, voor een ander deel aan overige factoren zoals technologische ontwikkelingen [7].

Door de toename in zorgkosten en de introductie van financieringsstructuren komt de bekostiging van de zorg in Nederland onder druk te staan. Dit betekent dat ziekenhuizen worden gedwongen tot het organiseren van efficiëntere patiëntenzorg met behoud of zo mogelijk verbetering van kwaliteit. De schaarse middelen moeten doelmatig worden ingezet. Hierbij komt dat we in Nederland ook worden geconfronteerd met een tekort aan verpleegkundigen.
Doelmatige inzet van middelen dwingt tot een efficiënte inzet van verpleegkundigen, zij zijn immers de grootste kostenpost. Steeds vaker wordt getracht om met minder personeel dezelfde zorg te leveren. Vacatures worden door bezuinigingen vaak niet opgevuld. Vanuit de verpleging worden klachten geuit over de toegenomen werkdruk. Uitkomsten van onderzoeken geven aan dat de werkdruk flink teruggedrongen zou kunnen worden wanneer zorgvraag en zorgaanbod beter op elkaar worden afgestemd. Een groot gedeelte van de gestegen werkdruk zou een doelmatigheidsprobleem zijn. Met meer inzicht in de zorgvraag en het benodigde zorgaanbod zou de werklast beheersbaar moeten zijn [8].

Een eerste vorm van patiëntenclassificatie werd reeds toegepast door Florence Nightingale gedurende de Krimoorlog in 1853–1856 [9, 10]. Zij groepeerde de patiënten die de meeste zorg behoefden vooraan in de zaal, zodat ze direct in het zicht van de verzorgenden lagen.
In de jaren zestig werd in de Verenigde Staten een classificatiesysteem ontworpen om zorgbehoeften van individuele patiënten vast te stellen en te groeperen in categorieën. Op deze wijze kon de werklast van de verpleegkundigen worden bepaald en de toewijzing van de patiënten worden verbeterd [11].
Rond dezelfde tijd werden in acht staten van de VS specifieke personeelsratio's in dialysecentra ingevoerd [12]. Gemiddeld was de aanvankelijke verhouding in de VS 1:8 voor verpleegkundigen en 1:3 voor assistenten.
Dialyse werd in het begin van de jaren zeventig in Saoedi-Arabië ingevoerd. Dertig jaar later werd een studie opgezet [13] met het doel inzicht te verkrijgen in de spreiding van de dialysecentra in Saoedi-Arabië, hun capaciteit, beschikbare apparatuur, aantal personeelsleden en aantal patiënten. Uit de resultaten bleek dat in Saoedi-Arabië een verhouding van 1:32 voor nefrologen en van 1:5 voor verpleegkundigen werd gehanteerd.
In België onderzocht Versweijveld de werkdruk op zes Vlaamse hemodialyseafdelingen. Dit werd gedaan naar aanleiding van de vergrijzing van de bevolking, een tekort aan verpleegkundigen en een toename van de werkdruk op de dialyseafdelingen. Het doel van deze studie was te achterhalen welke items van belang zijn om op te nemen in een specifiek meetinstrument voor de zorgzwaarte bij hemodialyse. Eén van de onderzoeksvragen was: "hebben de complicaties en de zorgzwaarte van de patient invloed op de werklast van de verpleegkundigen?" De studie werd uitgevoerd bij chronische hemodialysepatiënten. Er werd geen onderscheid gemaakt tussen categorieën van dialyseafdelingen. Uitkomst van het onderzoek was: "naarmate de zorgzwaarte van de patiënt toenam werd, nam ook de tijd van patiëntgebonden handelingen toe". Er werd een groot verschil tussen de afdelingen geconstateerd. Bij patiënten met veel complicaties nam de zorgtijd met 9 minuten toe. [14].

Ondanks een aantal knelpunten in de dialysezorg: het dreigend tekort aan verpleegkundigen, veranderingen in het profiel van dialysepatiënten (steeds meer oudere patiënten), en de stijging van de kosten, kennen we in Nederland nog geen gouden standaard om een dienstrooster voor dialyseafdelingen te maken waarbij het aantal verpleegkundigen optimaal is afgestemd op de actuele zorgbehoefte.

Reeds in de jaren tachtig werd ik als leidinggevende in een algemeen ziekenhuis met onder andere een dialysecentrum in mijn zorgeenheid geconfronteerd met stijgende kosten en dus bezuinigingsmaatregelingen. Verdere bezuiniging op personeel op de dialyseafdeling kon volgens mij niet. Immers, voor elke dialysebehandeling zijn handen nodig.
Om aan alle dialysepatiënten die zorg te verlenen die zij nodig hebben, is het van belang om zorgvraag en zorgaanbod op elkaar af te stemmen.
Navraag bij de dialysecentra in Nederland naar de inzet van verpleegkundigen in relatie tot het aantal patiënten leerde dat verschillende normen worden gebruikt. Sommige centra hanteren een ratio van 1:5 (d.w.z. één verpleegkundige per vijf dialysepatiënten), andere centra 1:4, terwijl de meerderheid van de centra een verhouding van 1:3 hanteerde. In universitaire dialysecentra was deze verhouding meestal nog hoger, 1:2.
Een dialyseverpleegkundige krijgt tijdens elke shift een aantal patiënten toegewezen volgens de norm van de afdeling. Hierbij wordt er van uit gegaan dat iedere patiënt evenveel zorg nodig heeft, dezelfde zorgzwaarte heeft. De praktijk leert echter dat bij de hemodialysebehandeling per patiënt verschillen bestaan qua zorgzwaarte.
Om afgestemd op de zorgzwaarte van patiënten een toewijzing van verpleegkundigen te kunnen hanteren, is onderzoek gedaan naar relevante patiëntkarakteristieken welke bepalend zijn voor de zorgzwaarte, met de bedoeling een classificatiemodel te ontwikkelen dat de zorgzwaarte van chronische hemodialysepatiënten kan voorspellen.
In dit onderzoek wordt de basisdefinitie van zorgzwaarte gehanteerd zoals beschreven door Diericks & Sermeus [9]: "Zorgzwaarte is de tijd die de verpleegkundige daadwerkelijk aan de patiënt besteedt".

Wanneer met behulp van een adequaat patiëntenclassificatiemodel de zorgzwaarte is vastgesteld, kan een dienstrooster (verpleegkundige bezetting) worden gemaakt waarin de zorgvraag van patiënten en de inzet van verpleegkundigen op elkaar zijn afgestemd. Een goed dienstrooster ondersteunt de kwaliteit van zorgverlening en maakt daarmee de zorg veiliger. Een goed dienstrooster bepaalt mede de medewerkerstevredenheid [15]. Omgekeerd geldt ook dat de aanwezigheid van voldoende verpleegkundigen de patiënttevredenheid verhoogt [16, 17].

Doel van het onderzoek

Het ontwikkelen van een classificatiemodel dat de zorgzwaarte van chronische hemodialysepatiënten kan voorspellen.
Daarbij moest het model in staat zijn het aantal verpleegkundigen te voorspellen dat nodig is voor de dagelijkse zorgverlening en toepasbaar zijn in alle categorieën dialysecentra:

categorie 1: dialysecentra in universitaire ziekenhuizen;
categorie 2: dialysecentra in algemene ziekenhuizen;
categorie 3: zelfstandige dialysecentra, buiten een ziekenhuis, waar een nefroloog aanwezig is;
categorie 4: zelfstandige satellietdialysecentra, waar een nefroloog alleen op afroep of tijdens wekelijkse rondes beschikbaar is.

Additionele doelen:

- onderzoeken of de zorgzwaarte voor dialysepatiënten werd beïnvloed door bepaalde patiëntkenmerken, en verschilde per categorie dialysecentrum.
- onderzoeken of de klinische conditie van dialysepatiënten van invloed was op de zorgzwaarte.
- Wanneer patiënten lijden aan ondervoeding en een geringe handknijpkracht hebben, hebben zij dan ook meer verpleegkundige zorgtijd nodig? (Patiënten die hemodialyse ondergaan hebben vaak weinig eetlust en last van spierzwakte).

Hoofdstuk 2 beschrijft de ontwikkeling van het classificatiemodel. Verpleegkundigen en nefrologen van diverse dialysecentra (universitaire en algemene ziekenhuizen, zelfstandige centra en zelfstandige satellietcentra) werden benaderd en gevraagd om hun medewerking te verlenen. Omdat bekend is dat de populatie in de verschillende provincies verschillend is, liggen de centra die meedoen dan ook in de verschillende provincies. In het westen van Nederland wonen bijvoorbeeld meer patiënten met een niet-westerse achtergrond dan in het noorden en oosten.
Op een oproep aan alle hoofden van dialysecentra in Nederland om aan te geven of zij beschikten over een middel om patiënten in te delen naar zorgzwaarte, reageerden er 39, waarvan er acht de beschikking bleken te hebben over een “instrument” om diverse patiëntgebonden elementen bij de dialysebehandeling in “punten” uit te drukken. Het aantal te meten aspecten liep uiteen van 17 tot 67. Tenslotte varieerde per dialyseafdeling het aantal toe te kennen punten. Na literatuurstudie en analyse van het toegezonden materiaal werd een eerste model gemaakt. Dit model werd als

pilot toegezonden aan vijf dialysecentra met het verzoek dit in te vullen. Een tweede pilot werd toegezonden aan twaalf dialysecentra. Na verwerken van ontvangen respons werd de definitieve lijst aan dezelfde centra toegezonden, met instructies voor het hanteren van de lijst.
Per patiënt vulden verpleegkundigen de classificatielijst in, en een formulier met patiëntkenmerken.
Onafhankelijke waarnemers gebruikten stopwatches en klokten de tijd die verpleegkundigen besteedden aan afzonderlijke stappen van de dialysebehandeling bij iedere patiënt. Daarnaast vulden nefrologen voor dezelfde patiënten de Charlson Comorbidity Index in.

In elk centrum werkten ook dialyseassistenten. Hun werkzaamheden verschilden per centrum. Waar zij in het ene centrum de voeding en de materialen in het magazijn verzorgden, deden zij in een ander centrum ook patiëntgebonden handelingen bij laag complexe dialysepatiënten, hiervoor hadden zij dan wel een éénjarige opleiding gevolgd.
Bij de verwerking van gegevens hebben we in het onderzoek er voor gekozen om geen onderscheid te maken tussen verpleegkundigen en assistenten. Het aantal van deze laatsten was namelijk miniem. Nu er steeds meer dialyseassistenten komen zou in een vervolgonderzoek onderzocht kunnen worden of het in zorgtijd verschil maakt wanneer dialyseassistenten worden ingezet in plaats van dialyseverpleegkundigen.

In **hoofdstuk 3** wordt aandacht besteed aan de vraag of patiëntkenmerken en de verschillende categorieën dialysecentra ook van invloed kunnen zijn op de hoeveelheid benodigde zorgtijd. Hiertoe werden de dialysecentra onderverdeeld in vier typen: Categorie 1: dialysecentra in universitaire ziekenhuizen; Categorie 2: dialysecentra in algemene ziekenhuizen; Categorie 3: zelfstandige dialysecentra buiten het ziekenhuis, waar een nefroloog aanwezig is; Categorie 4: zelfstandige satelliet dialysecentra waar een nefroloog op afroep beschikbaar is en een keer per week visite komt lopen. De benodigde data waren reeds verzameld bij de ontwikkeling van het classificatiemodel.
Er werd een verschil in zorgtijd gevonden tussen universitaire en niet-universitaire dialysecentra, waarbij significant meer tijd nodig was voor dialysebehandeling in de eerstgenoemde centra. Dit verschil kon niet worden verklaard uit de patiënten karakteristieken. Verondersteld werd dat patiënten in de universitaire centra zieker zijn dan patiënten in de andere centra.

In **hoofdstuk 4** wordt ingegaan op het feit dat de wereldbevolking vergrijst en dat deze trend is geassocieerd met een toename van dialysepatienten die steeds meer comorbiditeiten hebben [18]).
In Nederland is 65% van de hemodialysedialysepatienten ouder dan 65 jaar, 38% is ouder dan 75 jaar [19]. Kennis van geriatrische problemen en dus de specifieke behoeften van ouderen is voor verpleegkundigen steeds belangrijker geworden [20, 21].
Hebben deze veranderingen invloed op de verpleegkundige zorgtijd? Om dit na te gaan werd gebruik gemaakt van de initieel ingevulde formulieren (baseline), de formulieren welke na 1 jaar (baseline +1), respectievelijk na 4 jaar (baseline +4) door de 12 deelnemende dialysecentra waren ingevuld.
Het bleek dat de gemiddelde tijd die verpleegkundigen nodig hadden voor de dialysehandelingen niet of nauwelijks veranderde in 4 jaar tijd. Met de instroom van meer oudere patiënten zien we wel dat verpleegkundigen bij de start van de dialysebehandelingen voor deze groep patiënten meer tijd nodig hebben.
Ook de groep ouderen die gedurende 4 jaar meededen met het onderzoek vroegen meer tijd. Dit had vooral te maken met afnemende mobiliteit. In de groep jongere patiënten constateerden we een afname van zorgtijd. Dit had te maken dat in toenemende mate patiënten actief deelnamen aan hun behandeling. Daardoor bleef de gemiddelde zorgtijd die nodig was voor de gehele groep nagenoeg gelijk.
De vraag die voor een vervolgonderzoek kan worden gesteld is: blijft dit zo. Hoe lang hebben we nog te maken met deze mix van dialysepatiënten. De focus ligt immers op niertransplantaties met levende donoren bij jongeren. De instroom van oudere dialysepatiënten met meer comorbiditeiten zal toenemen en daarmee wellicht ook de zorgtijd die verpleegkundigen nodig hebben.

Eerder onderzoek heeft aangetoond dat de tijd die nodig is voor de behandeling van dialysepatiënten hoger is in universitaire dialysecentra dan in niet-universitaire dialysecentra. Die verschillen kwamen niet voort uit verschillen in dialysekenmerken of in persoonskenmerken. In **hoofdstuk 5** wordt nagegaan of de klinische toestand van patiënten invloed heeft op de verpleegkundige zorgtijd bij dialysepatiënten in de verschillende categorieën dialysecentra.
De verpleegkundige zorgtijd werd opnieuw met gebruik van stopwatches gemeten door tijdwaarnemers. Verpleegkundigen vulden niet alleen het classificatiemodel in maar ook een formulier met klinische gegevens van de patiënt: bloedwaarden, aantal klinische opnames, de Subjective Global Assessment meting en de handknijpkracht.
Opnieuw bleek dat dialysepatiënten in universitaire ziekenhuizen meer verpleegkundige zorgtijd vroegen. Deze patiënten hadden een lagere serumalbumine waarde, de

handknijpkracht was minder en de Subjective Global Assessment-waarde was lager. Patiënten in universitaire centra waren zieker dan de patiënten in niet-universitaire centra en hadden een slechtere voedingsstatus. Dit heeft implicaties voor de behandeling van patiënten, wat relevant is gezien het (dreigend) tekort aan verplegend personeel.
De vraag die voor vervolgonderzoek kan worden gesteld is: zou een betere voedingstoestand van de dialysepatiënten de verpleegkundige zorgtijd doen afnemen.

Een verminderde voedingstoestand kan mensen vatbaarder maken voor andere ziekten. Bij dialysepatiënten kan het de dialysebehandeling nadelig beïnvloeden. Dit geldt vooral voor oudere dialysepatiënten die vaak al kwetsbaarder zijn door meerdere aandoeningen en functionele beperkingen. Deze functionele beperkingen maken dat verpleegkundigen meer tijd moeten besteden aan de verzorging van ouderen **(hoofdstuk 6)**. Met alle dieetrestricties kan het voor dialysepatiënten moeilijk zijn om in een goede voedingstoestand te blijven. De inzet van multidisciplinaire zorgteams op dialyseafdelingen is van groot belang. Deze teams zetten naast dialyse ook andere interventies in, zoals leefstijladviezen en beweegprogramma's, om patiënten zo lang mogelijk actief/mobiel te laten blijven. Vooral bewegen ter bevordering van de mobiliteit van de dialysepatiënt zorgt ervoor dat patiënten actief kunnen deelnemen aan hun eigen behandeling, waardoor de directe zorgtijd afneemt.

Toekomstperspectieven

Afstemmen van zorg aan dialysepatiënten en het aantal verpleegkundigen wat hiervoor nodig is, blijft een complexe materie. Zeker onder de toenemende financiële druk in de gezondheidszorg. Dit vraagt van managers om in nieuwe patronen te gaan denken: kan de zorg anders worden georganiseerd. Diverse kostenanalyses van nierfunctie vervangende therapieën [23, 24, 25] laten zien dat nadat de niertransplantatie eenmaal is uitgevoerd de jaarlijkse kosten aanzienlijk dalen. In vergelijking met haemodialyse zijn ook CAPD en thuishaemodialyse goedkoper. In de Nederlandse dialysecentra dialyseren momenteel 4.990 [19] patiënten. Dit aantal blijft al een aantal jaren stabiel. 142 patiënten dialyseren thuis. Dit aantal neemt de laatste jaren iets af. Van deze laatste groep is 52% ouder dan 65 jaar [19]. Het is interessant om onderzoek te doen waarom er niet meer mensen thuis dialyseren. Heeft dit met woonvormen te maken, wel of geen partner/mantelzorger hebben, ouderdom of andere zaken die

beletten om thuis te dialyseren. In Frankrijk en België zien we "Autodialyse" ofwel Collectief Autodialyse Centra (CAD) ontstaan [26]. Auto betekent hier autonoom. Deze afdelingen zijn speciaal bedoeld voor dialysepatiënten die hun behandeling zelf kunnen uitvoeren en medisch gezien weinig tot geen problemen hebben. Deze patiënten beheren zelf hun dialyseproces. Op de achtergrond is één (1:6) verpleegkundige aanwezig om hand- en spandiensten te verrichten. De nefroloog ziet de patiënt één keer per week. In Nederland hebben we wel centra waar patiënten dialyseren en de nefroloog één keer per week langskomt maar daar wordt nog met 1:4 verpleegkundigen gewerkt met daarnaast ook een assistent.
Tijdens ons onderzoek (hoofdstuk 3), waarin we onderzochten of het classificatiemodel geschikt is voor de verschillende dialysecentra [27] zagen we dat in deze centra veel low care patiënten dialyseren. Dat wil zeggen: de patiënten waren mobiel en konden zelf deelnemen aan hun behandeling. Met de financiële druk in het achterhoofd en het tekort aan dialyseverpleegkundigen zou het zeker de moeite waard zijn om te onderzoeken of in Nederland de CAD een goede oplossing is om deze problemen het hoofd te bieden.
De volgende vraag die kan worden gesteld is: kan in deze CAD een dialyse-assistent werken? Met de uitstroom van dialyseverpleegkundigen en de toename van relatief oudere patiënten is er een dringende behoefte ontstaan aan een tweede functieniveau.
De opleiding dialyse-assistent bestaat al meer dan 15 jaar in Nederland. Landelijk bestonden er echter grote verschillen tussen de opleidingen, taakuitvoering en bevoegdheden. Een éénduidige opleiding, waarbij opleidingseisen, deskundigheidsgebied en eindtermen zijn vastgelegd, is inmiddels gerealiseerd en Nederland kent vanaf medio 2020 een erkende opleiding tot dialyse-assistent [28]. De dialyse-assistent wordt opgeleid om zelfstandig een ongecompliceerde hemodialysebehandeling uit te voeren bij een stabiele chronische patiënt. Het classificatiemodel is een hulpmiddel om de juiste dialysepatiënten toe te delen aan de dialyse-assistent.

Conclusie

Adequate inzet van dialyseverpleegkundigen en dialyseassistenten, met behulp van een classificatiemodel is de sleutel tot het verbeteren van de kwaliteit van de patiëntenzorg bij dialysepatiënten, het verminderen van klachten over zorgzwaarte door verpleegkundigen [29, 30, 31]. En uiteindelijk zal het een bijdrage leveren aan het probleem van het vasthouden van verpleegkundigen op de dialyseafdelingen.
Het ontwikkelde classificatiemodel kan een goed hulpmiddel zijn om de inzet van het beschikbare personeel, verpleegkundigen en assistenten, af te stemmen op de aantallen en de zorgbehoeften van patiënten in drie van de vier categorieën dialysecentra. Het model zou voor de universitaire dialysecentra moeten worden geperfectioneerd.

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Dankwoord

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Curriculum vitae

Curriculum vitae

Ria (Hendrika, Catharina) de Kleijn werd geboren op 6 oktober 1950 in Amstelveen (gemeente Nieuwer–Amstel). Na het behalen van haar diploma MULO-B en vervolgens het MMS diploma, besloot zij verpleegkundige te worden. Zij behaalde het diploma "Ziekenverpleging A" in 1973. Vervolgens volgde zij nog diverse opleidingen en deed in verschillende ziekenhuizen werkervaring op.
In de laatste jaren voor haar pensionering startte zij met onderzoek. Dit onderzoek ronde zij na haar pensionering af.

Promoveren als (gepensioneerd) verpleegkundige is hetzelfde als wonen in Groningen. Je moet het voortdurend uitleggen.

Opleidingen

Kinderaantekening, diploma 1974
Neonatologie, theoriecertificaat 1977
Management voor Non Profit Organisaties, IBW, diploma 1990
Tweede graads lerarenopleiding verpleegkunde, diploma 1992
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Applicatiecursus voor de lerarenopleiding, getuigschrift 1999
Twee modulen van de Vervolgopleiding Verpleegkundig Specialist, verklaring 1999
Bijscholingsprogramma Juridische Aspecten en Organisatiekunde, verklaring 1999
Masterclass Opleiding Hoofden Dialyseafdeling, diploma 2002
MBA Bedrijfskundig Zorgmanagement, diploma 2006
Research Integrity Course, certificaat 2022

Werkervaring

1969 – 1973	Leerling Ziekenverpleging A, Juliana Ziekenhuis te Amsterdam
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1975 – 1977	Waarnemend Hoofd Kinderafdeling, Ziekenhuis Rijnoord te Alphen a/d Rijn
1976	Stage Neonatologie, Wilhelmina Gasthuis te Amsterdam
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1985 – 1992	Oproepverpleegkundige, Ziekenhuis De Lichtenberg te Amersfoort
1990 – 1992	Oproepverpleegkundige, Sinaï-kliniek te Amersfoort
1990 – 1992	Avond- en nachthoofd, St. Elisabeth Verpleeg- en Gasthuis te Amersfoort
1992 – 1998	Praktijkdocent afdelingen Pediatrie, Neonatologie en Verloskunde, Chr. Ziekenhuis Eemland te Amersfoort
1998 – 1999	Verpleegkundige Kwalificatieniveau 5, Zorgeenheid Gynaecologie/ Verloskunde, Chr. Ziekenhuis Eemland te Amersfoort
1999 – 2002	Zorgeenheidsmanager Interne Geneeskunde 3 (w.o. Dialysecentrum), Chr. Ziekenhuis Eemland te Amersfoort
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2004 – 2008	Zorgeenheidsmanager Interne Geneeskunde (w.o. Dialysecentrum) & Reumatologie, en Manager Diëtethiek, Meander Medisch Centrum te Amersfoort
2008 – 2011	Projectleider NIAZ-accreditatie Meander Medisch Centrum te Amersfoort
2009 – 2014	Manager Meander Dialysecentra (3 locaties) te Amersfoort, Harderwijk en Zeewolde
2014 – 2018	Projectmanager onderafdeling Nefrologie UMCG te Groningen
2018 – heden	Onbezoldigd medewerker onderafdeling Nefrologie UMCG te Groningen
2021 – heden	Projectleider Beatrix Kinderziekenhuis, UMCG te Groningen

Overige ervaring

1990 – 1999	Diaconaal medewerker, Oecumenische Geloofsgemeenschap, Wijkgemeente "Het Brandpunt" te Amersfoort
1993 – 1999	Voorzitter Medezeggenschapsraad Gabrie Mehen, Chr. School voor Basisonderwijs, Amersfoort
2003 – 2011	Lid Financiële commissie Immanuelkerk, wijkgemeente PKN Groningen
2008 – 2018	Lid Plenaire Visitatiecommissie DiaVisie
2009 – 2014	Secretaris Leo Fretz Stichting, (doel van de Stichting: ontwikkelen van nieuwe modaliteiten voor nierpatiënten in de regio Eemland)
2017 – 2020	Lid Cliëntenraad Verzorgingshuis Westerholm, Haren
2018 – 2019	Lid Commissie van Dam: Commissie Herziening Visitatiesystematiek Dialyse
2018 – heden	Lid werkgroep Welzijn, Hildegard parochie, Groningen
2020 – heden	Secretaris Cliëntenraad Verzorgingshuis Westerholm, Haren

Symposia

Organisatie & voorzitter

10-03-2004	Samen Klaren, Symposium met als onderwerp Communicatie
21-09-2005	Nachtelijke Centrum Dialyse
15-02-2007	Artrose beHANDelbaar, Symposium over Artrose
06-02-2008	De Dialysesatelliet gericht op de toekomst
10-03-2010	Lithiumnefropathie, Lithium en nierziekten
19-03-2014	Debat in de Zorg

Dagvoorzitter

01-11-2006	Baxtersymposium, De Chronische Dialysepatiënt

Publicaties

Kleijn HC de. Samen Klaren.
LVDT Magazine 2004, juni, nummer 2 (nominatie: "Roche Award")

Kleijn HC de. Eerste nachtelijke centrumdialyse in Nederland.
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Kleijn de R, Hagen C, Uyl-de Groot C, Diepenbroek A, Pasker-de Jong PCM, Wee ter PM. Differences in care burden of patients undergoing haemodialyses in different centres in the Netherlands.
Journal of Renal Care 2017; 43(2): 98-107

Kleijn de R, Uyl-de Groot C, Hagen C, Franssen C, Schraa J, Pasker-de Jong PCM, Wee ter PM.
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Presentaties

Kleijn HC de. Zorgzwaarte meten bij hemodialysepatiënten.
Presentatie Nederlandse Nefrologie dagen, maart 2012

Kleijn HC de. Unchanged nursing care time for patients undergoing haemodialysis despite changes in characteristics over four years.
Presentatie Nederlandse Nefrologie dagen, maart 2019

Kleijn HC de. Unchanged nursing care time for patients undergoing haemodialysis despite changes in characteristics over four years.
Presentatie EDTNA Praag, september 2019

Posters

Kleijn HC de. Zorgzwaarte meten bij hemodialysepatiënten.
Wetenschapsymposium Meander Medisch Centrum, maart 2012

Kleijn HC de. Unchanged nursing care time for patients undergoing haemodialysis despite changes in characteristics over four years.
ERA-EDTA Boedapest, juni 2019

Kwaliteit

2000	Auditorentraining Hans Mak Iinstituut
2008	Interne auditor training incompagny in Meander Medisch Centrum (NIAZ)
2008 – 2010	Meander Medisch Centrum voorbereid op NIAZ-audit, nulmeting, audits met als resultaat: het certificaat
2010	Workshop Intervisie bijeenkomst veiligheidscultuur Q-consult
2010	Tweedaagse Workshop HKZ Cliënt-/Patiëntveiligheid, stap naar implementatie
2014	Projectleider ontwikkeling van en voorbereiding ISO-certificering zorgtraject Niertransplantatie UMCG
2015	4 x 2 uur Workshop Prospectieve Risico-Inventarisatie

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