MEDICAL UNIVERSITY - PLEVEN

FACULTY OF PUBLIC HEALTH

DEPARTMENT OF SOCIAL MEDICINE AND HEALTH MANAGEMENT

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HEALTH CARE OF HEMODIALYSIS PATIENTS WITH TUNNELED CATHETER - MEDICAL, SOCIAL AND ECONOMIC ASPECTS

Abstract

of dissertation for award of educational and scientific degree "Doctor"

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The dissertation contains 201 pages, 48 figures, 6 photos, 11 tables, 6 annexes. The bibliography contains 218 sources, of which 77 are in Cyrillic, 141 in Latin.

In connection with the dissertation work, 3 full-text publications and 3 scientific notices in national forums have been made.

The dissertation has been approved and forwarded for public defense by the extended departmental council of the Department of "Social Medicine and Health Management" at the Faculty of "Public Health" of the Medical University - Pleven.

The official defense will take place on 07.03.2025 at 12:00 in the "Ambroise Pare" hall of the Telecommunications Center (TELEC) of the Medical University - Pleven.

Contents

Abbreviations used

HMI	Higher Medical Institute
LMI	Law on Medical Institutions
CP	Clinical pathway
WHO	World Health Organization
CRF	Chronic renal failure
HD	Hemodialysis
PD	Peritoneal dialysis
AVA	Arteriovenous anastomosis
AVP	Arteriovenous prosthesis
CAS	Catheter-associated sepsis
CD	Catheter dysfunction
MF	Medical facility
CVC	Central venous catheters
CDC	Center for Disease Control and Prevention
CAB	Catheter-associated bacteremia
CVC	Central venous catheter
DALYs	Disability-adjusted life years
DOPPS	Dialysis Outcomes and Practice Patterns Study
EDTA	European Dialysis and Transplant Association
ERA	European Renal Association
ERCA	European Renal Care Association
ESKD	End-stage renal disease
ESRF	End-stage chronic renal failure
IFKF	International Federation of Kidney Foundations
ISN	International Society of Nephrology
KDOQI	Kidney Disease Outcomes Quality Initiative
NKF	National Kidney Foundation

Introduction

With the onset of the epidemiological transition in the mid-twentieth century and the decline in morbidity and mortality from infectious diseases, chronic non-infectious diseases are becoming an epidemic globally.

Alongside the undisputed leadership of cardiovascular diseases, malignant neoplasms, chronic lung diseases, and diabetes in prevalence and mortality, there is growing evidence of the increasing social importance of chronic kidney disease.

According to the World Health Organization and the European Association of Nephrology, as of 2018, 9.1% (697.5 million people) of the world's population suffers from chronic kidney disease (CKD), and Bulgaria is one of the most affected countries in Europe. After screening in some areas of the country and analysis of registered diseases, the Bulgarian Society of Nephrology estimates that it affects 12.8% of the Bulgarian population. A large part of them are on renal replacement therapy, about 3,800 patients are on hemodialysis in 84 dialysis centers in Bulgaria.

In the last two decades, CKD has been on the rise. This trend can be associated with the following reasons:

- increase in morbidity due to the prevalence of behavioral risk factors (smoking, unhealthy diet), the prevalence of diseases that act as secondary risk factors for kidney damage (circulatory diseases, diabetes), aging population
- improvement of laboratory diagnostics
- prolonged survival of ill persons through the hemodialysis method

The mortality from CKD is also on an upward trend. The number of deaths rose from 813,000 in 2000 to 1.3 million in 2019, and kidney disease has moved from 13th to 10th place when ranking causes of death worldwide.

The frequently used DALYs (Disability-adjusted life years) indicator, which takes into account years of life lost due to premature death and disability, also shows unfavorable dynamics. DALYs show that, in addition to mortality, the public health significance of a disease is determined by its impact on the working capacity and social activity of individuals. Despite the prolonged survival of affected individuals, CKD has a negative effect on their social and occupational roles.

Chronic kidney disease to become the fifth most common cause of global disease burden is expected by 2040.

The social and economic consequences of CKD for society are substantial. Significant public funds are spent on the treatment of patients.

The quality of life of patients with CKD is largely determined by the quality of hemodialysis treatment. One of the major contributing factors is the vascular access used. There has been an increase in the use of central venous catheters (CVCs) worldwide.

In the world literature, tunneled catheters are increasingly regarded as permanent vascular access, given their use for prolonged periods of time in patients, especially those with "exhausted" other types of permanent vascular access.

Problems related to vascular access and its complications are the cause of additional patient suffering, repeated hospitalizations, and significant financial costs. There is a need to optimize the pre- and ongoing assessment, monitoring, and also the procedure of vascular access.

I. Aim, objectives, and methodology of the study

Objective

The aim of this research paper is to investigate and analyze the importance of quality of care in hemodialysis patients with a tunnelled catheter on complication rates, the clinical prognosis of the disease, and its social and economic impact on patients, their families, and public health costs.

Tasks

To achieve the goal, the following tasks are set:

1. To explore patients' views on the quality of health care in the dialysis unit.
2. To explore patients' views on their own competencies to carry out disease control activities.
3. To monitor the behavior of patients in the event of negative effects of the disease and complications during their dialysis treatment.
4. To explore nurses' and physicians' views on nursing competencies to provide quality health care to tunneled catheter patients**.**
5. To investigate the average "survival" of tunneled catheters, complication rates, and the cost of their treatment.
6. To develop a guide (practical guidelines) for patients and their relatives to monitor their general condition and the condition of the catheter

Subject of the study

The subjects of this study are the competencies of nurses working in dialysis centers to provide quality health care to hemodialysis patients, the competencies of patients to monitor and control their condition, and the impact of infectious complications on the cost of treatment.

Object of the study

The subject of this study is a sample of the hemodialysis centers operating as of April 2021, which serve patients with a tunneled catheter in the hemodialysis department of the

University Hospital - Pleven. At the start of the study, there were 84 hemodialysis treatment centers in Bulgaria. Seven centers were included in the study, representing 8% of the functioning ones at that time. The representativeness of the sample is supported by the random inclusion of dialysis centers of different categories (level of competence) and different regions of the country.

Technical units of observation

The following dialysis centers were included in the study:

- Pleven
- Lovech
- Cherven Bryag
- Sevlievo
- Silistra
- Veliko Tarnovo
- Vidin

Logical units of observation:

1. Hemodialysis patients with tunneled catheter
2. Doctors
3. Nurses

Working hypotheses

The study was conducted based on the following working hypotheses:

1. The quality of health care and care of vascular access by patients reduce the occurrences of infectious complications.
2. Patients are well informed about the disease and the appropriate hygiene and dietary recommendations.
3. The complication rate is directly related to the cost of treatment.

Setting of the study

A comprehensive medico-social study is underway, starting in 2021, with a horizon

for completion in 2025. In the process of scientific research, the following stages can be differentiated:

First stage (study preparation) - June 2021 - June 2022.

- breakdown of the scientific literature on the problem, preparation of a literature review, and formulation of its conclusions.
- formulation of the aim and objectives of the study
- preparation of tools - questionnaires, interview questions, self-monitoring diary, documentary survey questionnaire

Second stage (collection of empirical sociological information) - July 2022 - May 2023.

- Analysis of medical records
- Conducted surveys among 43 nurses and 22 doctors
- Semi-structured interviews with 84 patients
- Patient training on self-monitoring conducted

Third stage (data processing and analysis) - July 2022 - March 2024.

- Entering the collected data into the SPSS v. 26 statistical software, displaying the primary data, and organizing them into tables and graphs
- Analysis of the obtained data, summarizing the results, and drawing conclusions
- Formulation of conclusions, recommendations, and contributions of the dissertation

Characteristics of the persons studied

The following groups of individuals were included in the study:

- Patients on hemodialysis treatment with a tunneled catheter
- Nurses and physicians providing health care for hemodialysis patients with a tunneled catheter

Methods of the study

Sociological methods

– Survey method

A questionnaire was developed to conduct a direct individual survey with doctors and nurses.

– Interview

A questionnaire was developed to conduct a semi-structured interview with the patients containing 26 questions.

– Observation

A patient self-monitoring diary with 5 self-monitoring indicators was developed.

– Documentary method

A questionnaire has been developed to extract and systematize primary sociological information from official and normative documents.

Statistical methods

Descriptive statistics - we used the methods of descriptive statistics to describe the demographic and clinical characteristics of the patients.

A. **Analysis of variance of quantitative variables -** we presented the results by mean and standard deviation (Mean±SD), median and interquartile range (Me, IQR), minimum and maximum values (Min, Max).

B. **Frequency analysis of qualitative variables** - we presented the results by absolute and relative frequencies (number and %).

Methods for testing hypotheses

A. **Parametric methods -** Student t-test for comparison of groups of independent variables.

B. **Non-parametric methods**

a. **Kolmogorov-Smirnov and Shapiro-Wilk methods -** checking for normality of the distribution of a quantitative variable;

b. **Mann-Whitney U method -** comparing means of two groups of independent variables of a quantitative variable when the distribution is not normal;

c. **Kruskal-Wallis H method -** comparing means of three or more groups of independent variables of a quantitative variable when the distribution is not normal;

d. **Chi-square test and Fisher`s exact test -** search for a relationship between two qualitative variables.

Survival analysis

A. Kaplan-Meier method

B. Life-tables method

Survival was determined by Kaplan-Meier curve fitting, analyzed by long-rank test.

Statistical processing of the results was performed with the IBM SPSS Statistics Version 26 statistical package. The critical level of significance we used was $\alpha = 0.05$. The corresponding null hypothesis is rejected when the P value (P-value) is less than α.

II. Results and discussion

A survey of patients' views on the quality of health care in the Dialysis Unit

An interview questionnaire containing 26 questions was used to investigate patients' views on the quality of health care in the dialysis unit. After obtaining written informed consent, 104 patients were invited for an interview. 84 patients responded to the invitation, bringing the response rate to 80.8%. The mean age of the patients was 60.2±11.678 years and the sex distribution was 48 (57.1%) : 36 (42.9%) in favor of men.

Tab. 1 Sex, age, education, underlying kidney disease, and time since diagnosis with CKD

Feature	N=84
Gender (number, %)	
male	48 (57.1%)
female	36 (42.9%)
Age, *years* **(Mean±SD)**	60.2±11.678
Education (number, %)	
primary	5 (6.0%)
secondary	68 (81.0%)
tertiary	11 (13.1%)
Major kidney disease (number, %)	
Hypert. nephropathy	13 (15.5%)
ADPKD	6 (7.1%)
DN	19 (22.6%)
CGN	26 (31.0%)
CP	10 (11.9%)
CIN	9 (10.7%)
Other	1 (1.2%)
Time since diagnosis of CKD (number, %)	
1-2 years	6 (7.1%)
3-5 years	30 (35.7%)
over 5 years	48 (57.1%)

By educational level, 68 (81.0%) of the patients had secondary education, followed by 11 (13.1%) with tertiary education and 5 (6.0%) with primary education (Table 1).

The distribution of the underlying renal disease leading to chronic renal failure was as follows: chronic glomerulonephritis (CGN) 26 (31.0%), diabetic nephropathy (DN) 19 (22.6%), hypertensive nephropathy 13 (15.5%), chronic interstitial nephritis (CIN) - 9 (10.7%), chronic pyelonephritis (CP) - 10 (11.9%), autosomal dominant polycystic kidney disease - 6 (7.1%) and 1.2% - other nephropathies (Fig. 1).

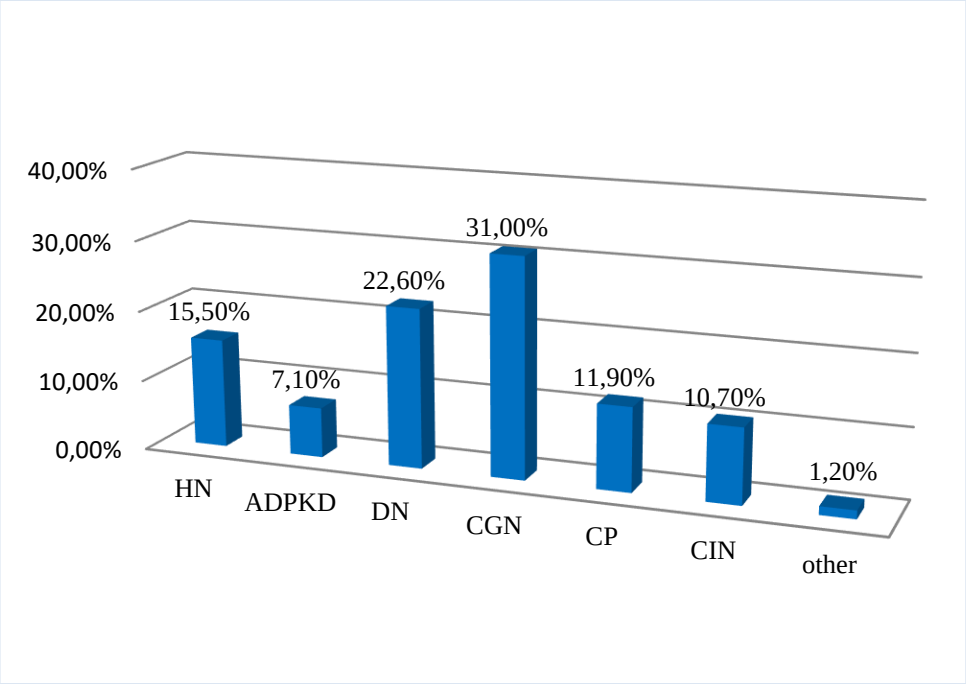


Fig. 1 Distribution of main renal disease leading to chronic kidney failure

(CGN - chronic glomerulonephritis, DN - diabetic nephropathy, HN - hypertensive nephropathy, CIN - chronic interstitial nephritis, CP - chronic pyelonephritis, ADPKD - autosomal dominant polycystic kidney disease)

Most of the 48 patients (57.2%) were diagnosed with chronic renal failure more than 5 years ago, 30 patients (35.7%) had a history of 3-5 years and 6 patients (7.1%) had a history of chronic renal failure for 1-2 years.

The presence of dialysis catheters is a prerequisite for the occurrence of complications, especially if there are lapses in compliance with the rules of service of vascular access. This becomes a reason for hospitalization of patients until the infection is controlled. During the study period, 25 (29.8%) persons were hospitalized once a year to control vascular access infection, 8 persons (9.5%) - 2 or more times and less than once a year 51 (60.7%) of the interviewed persons (Fig. 2).

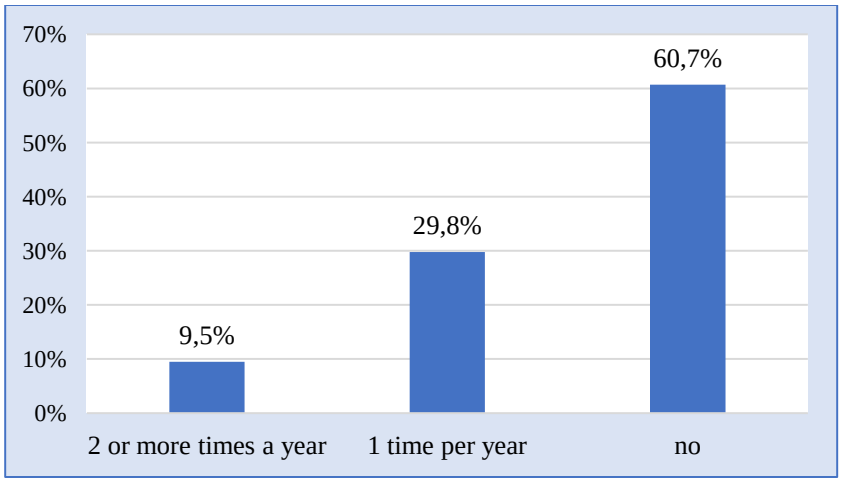


Fig. 2 Frequency of admission to hospital for treatment for complication or infection (n=84)

There is a close correlation between the incidence of vascular access complications and patients' ability to care for it.

Of those trained in learning activities of daily living during their stay in the hospital, 68 (81.0%) responded positively that they were trained by a nurse, 12 (14.3%) that their relatives were trained, 2 patients that they had partial knowledge or 2.4%, 2 patients also that no one trained them or 2.4% (Fig. 3).

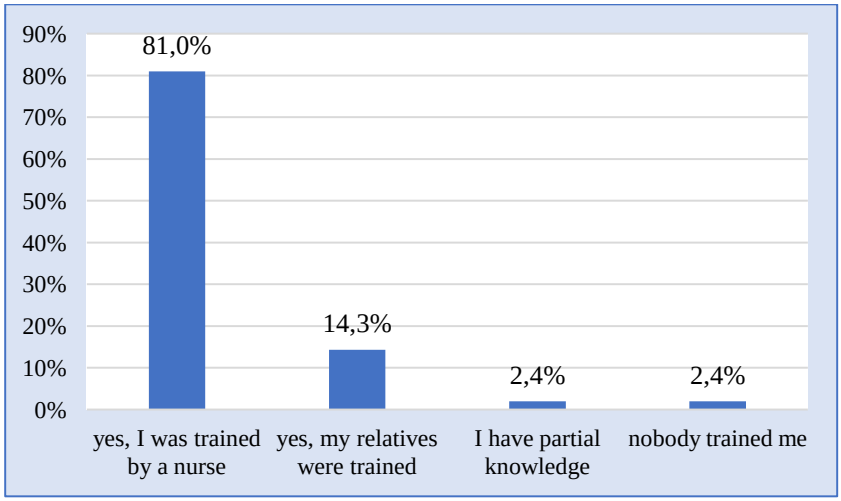


Fig. 3 Patients' opinion on training during the stay in the MF in learning activities of daily living (n=84)

The high percentage of patients trained by a nurse in learning activities of daily living is an indication of the active participation of dialysis nurses in the adjustment period

of patients in dialysis treatment. Their activities improve their motivation and thus reduce their dependence on family or hired attendants.

The goal of the established medical-patient relationship is to get the patient to behave in a way that enhances their quality of life and promotes treatment. The so-called 'therapeutic and interpersonal relationship' is built, which is extremely important for patients with end-stage renal failure. Patients need psychological support to adapt to their current condition. Nurses' awareness, their continuous improvement is related to the quality of care provided and to increasing patients' satisfaction.

The relatively small percentage of patients who are untrained or have only partial knowledge is probably due to the workload and shortage of medical staff to fulfill this role in health care delivery as well.

Hygiene, diet, and exercise are also closely related to maintaining good health in patients with CKD. This warrants exploring whether such information is provided to patients by healthcare professionals.

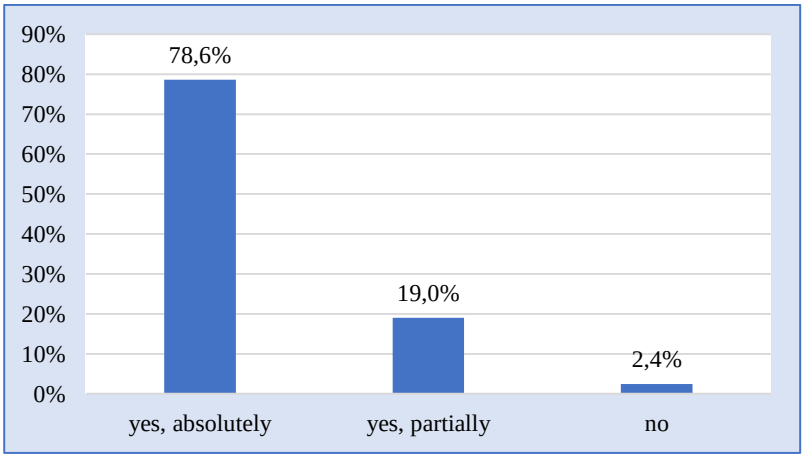


Fig. 4 Obtaining the necessary information on hygiene, diet, exercise, and health care (n=84)

78.6% of the patients confidently confirmed that they had received advice and explanations about diet and exercise adequate to their condition, (19.0%) felt that they had received some information, and two patients, or 2.4% had not received any information (Fig. 4)

Patient satisfaction indicates that health services are meeting their needs and

expectations as consumers as they are more knowledgeable and critical contemporarily. It is through satisfaction that the effectiveness of care can be measured.

Satisfaction surveys provide information on problem areas in health care delivery and can be used to make adjustments leading to improved quality of care and therefore quality of life for patients.

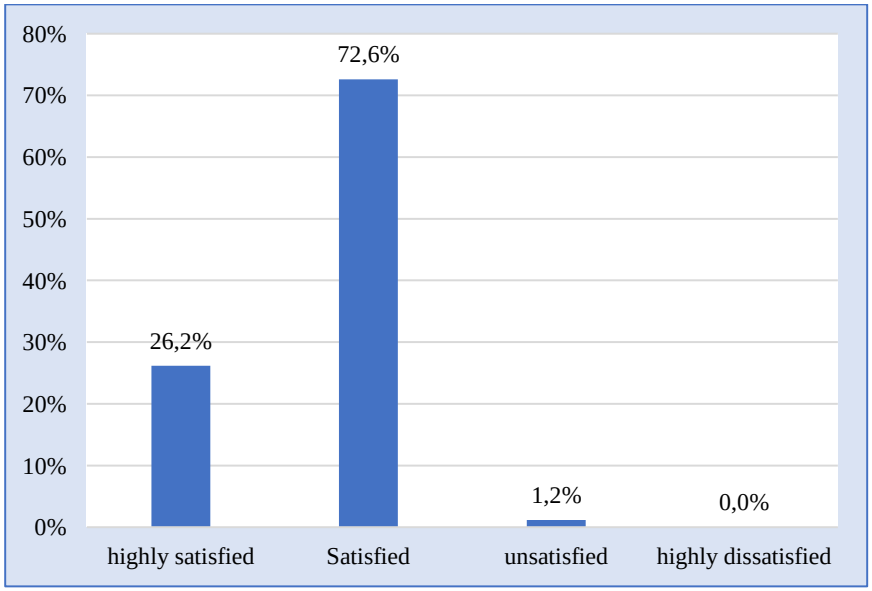


Fig.5 Satisfaction with health care provided in the dialysis unit (n=84)

In our study, the percentage of highly satisfied (26.2%) and satisfied patients (72.6%), 1.2% were dissatisfied and no patients expressed dissatisfaction with care (Fig. 5). The degree of satisfaction is directly related to the age of the patients (r_s = 0.256, 84, p = 0.019). Older patients expressed a higher level of satisfaction.

Despite the reduced number of nurses in dialysis units and in the health care system in general in Bulgaria, the dialysis nurse has a crucial role in providing health care, both during the dialysis procedure and in providing a supportive role to patients.

The patient has a choice - to conduct the treatment and to entrust their health to staff they trust. Trust and mutual respect between the patient and medical professionals is inseparable from the treatment provided. Hemodialysis is a supportive treatment and the

time that patients spend during dialysis sessions, which are at least 4 hours long, are prerequisites for building trust, a new type of relationship, and an understanding of the activities carried out by medical staff in dialysis units.

Could they fully trust doctors and nurses and share their health problems, 79 (94.0%) of the patients responded positively, 5 (6.0%) had preferences for certain doctors and nurses, and there were no patients who could not trust the medical staff at all (Figure 6). Patients who could trust certain doctors and nurses had a mean age of 68 years.

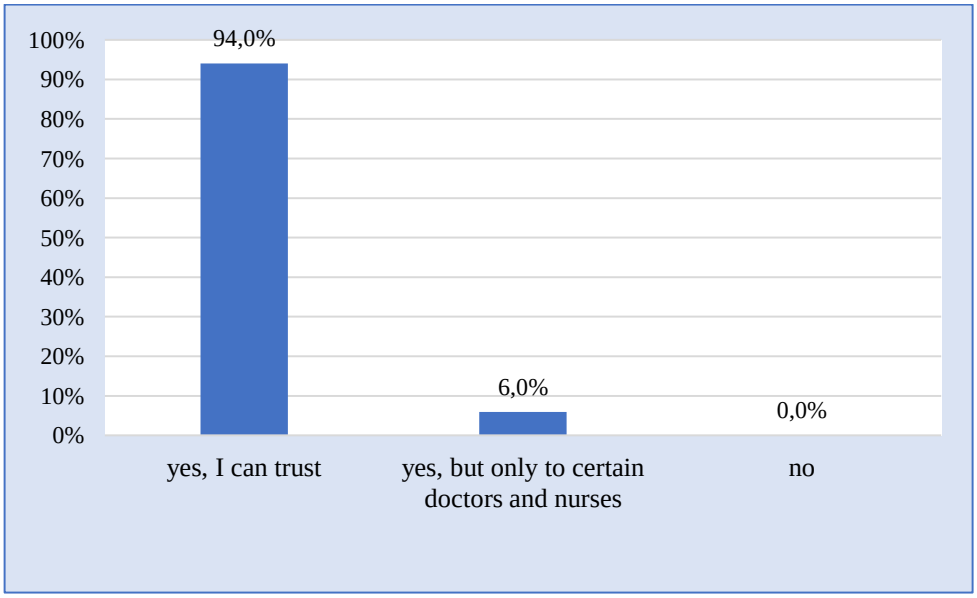


Fig.6 Trust in doctors and nurses (n=84)

Do they have knowledge and skills in taking care to improve their health status 54 (64.3%) definitively answered “yes, completely,” with some hesitation 27 (32.1%) answered “yes, partially,” 3 (3.6%) answered negatively - they do not have any knowledge to take care of their health (Fig. 7). This is rather a result of low health culture, carelessness and disinterest of those who responded to the interview.

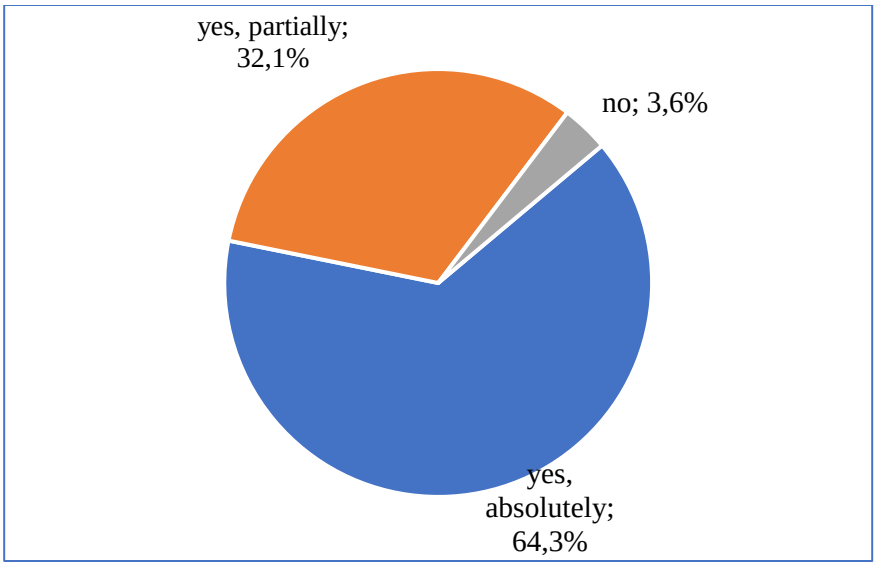


Fig. 7 Self-reported knowledge and skills in caring for one's health (n=84)

Patients with CKD on hemodialysis need to have the skills to control their disease by taking prescription medication, following a special diet, and exercising.

Per the standard for dialysis treatment, hemoglobin, serum iron, calcium, and phosphorus are monitored monthly through blood tests.

The study found that more than 85.7% of the patients regularly took medication related to their disease, 10.7% only when necessary and 3.6% did not take medication. All of them were of the opinion that they were capable of following the instructions of the healthcare professionals regarding taking medication. The reasons why patients do not take medications are on the one hand - indiscipline and disinterest in health, on the other hand, according to laboratory indicators, some patients do not need to take additional medications (Fig. 8).

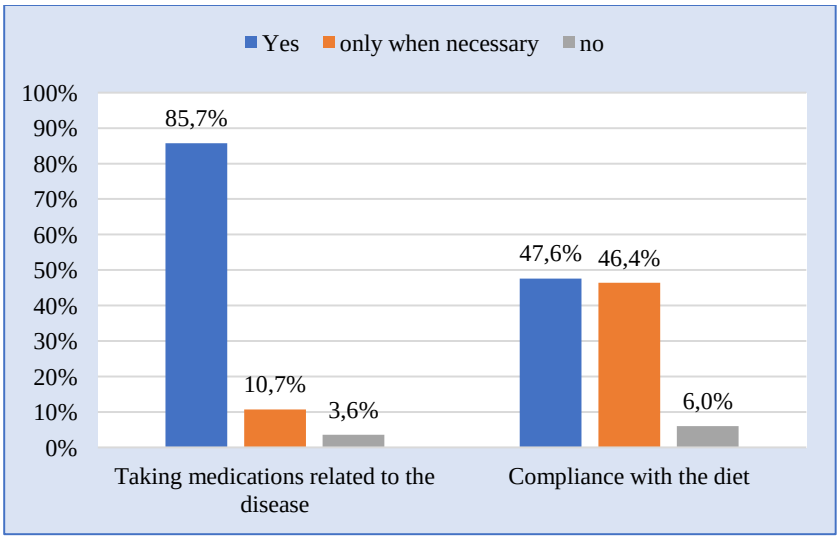


Fig. 8 Medication intake and dietary compliance (n=84)

The patients' attitude to dietary compliance showed that in 40 (47.6%) patients it was positive, the patients who "only when necessary" complied with the diet were 39 (46.4%), and 5 (6.0%) did not comply with the diet.

Physically active were 73 (86.9%) of the interviewees, while 11 (13.1%) were not mobile and needed help (Fig. 9). Here we can take into account the fact that after the procedure some patients are not as vigorous as they were before it, due to hypotension, higher ultrafiltration, presence of muscle cramps and other manifestations of discomfort.

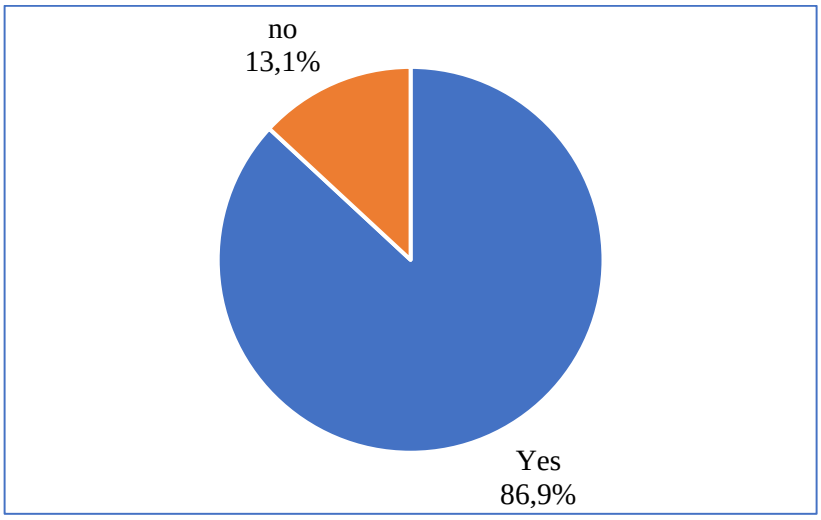


Fig. 9 Patients' motor activity (n=84)

This can have an impact on physical activity, which in turn is important for patients' general well-being, quality of life, and maintaining their sense of fulfillment.

Hemodialysis treatment also resulted in lifestyle changes - 77 (91.7%) answered yes, 4 (4.8%) answered no, and 3 (3.6%) answered partially (Fig. 10).

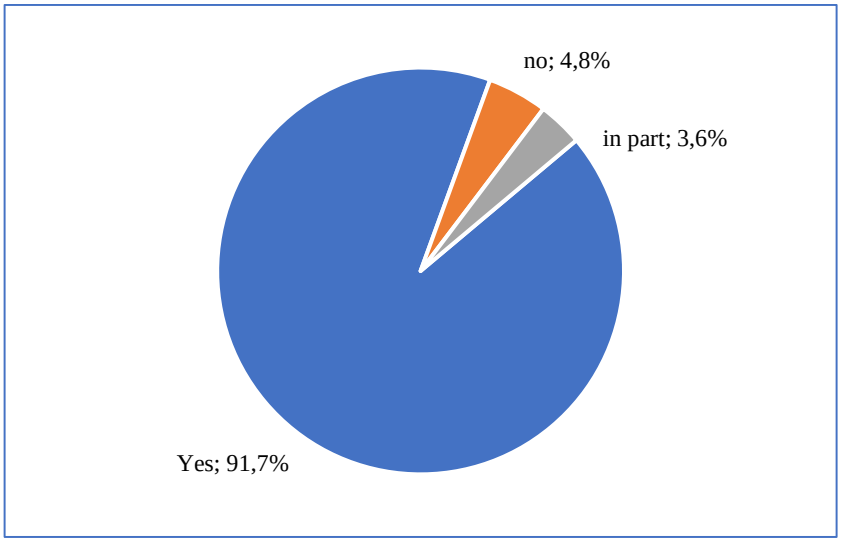


Fig. 10 Presence of lifestyle change in patients on dialysis treatment (n=84)

The majority of the interviewed patients have changed their stereotype of life - the way of eating, related to dietary restrictions (composition and quantity of food), reduction of the amount of liquids and salt intake, exercise and rest, social contacts, home, and work commitments.

Do they take care of their vascular access 59 (70.2%) responded positively, “yes, sometimes” - 20 (23.8%), no care 5 (6.0%).

A significant percentage of patients (70.2%) cared for their vascular access by keeping the catheter dressing placed by the nurse at the end of the procedure clean and dry (when showering), so as not to compromise its integrity until they presented to the center for their next hemodialysis session (Fig. 11).

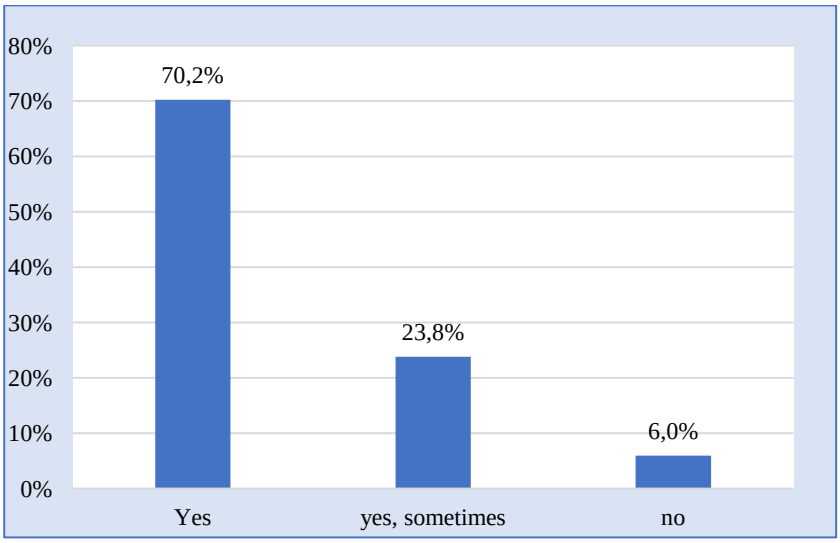


Fig . 11 Caring for your vascular access (n=84)

Able to allocate funds from their budget to provide supplies for vascular access care, 58 (69.0%) responded affirmatively, while unable to allocate funds were 26 (31.0%) (Fig. 12).

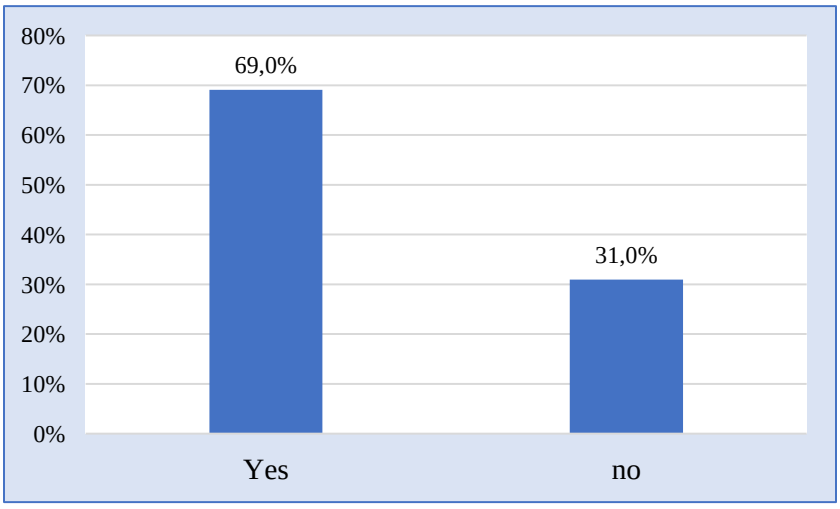


Fig. 12 Patient's ability to allocate money from their budget for supplies for their vascular access. (n=84)

Here, we found a statistically significant association between age and the ability of

the patient to allocate funds from their budget for supplies needed to care for their vascular access (r_{pb} =0.327, 84, p=0.002).

Patients at a younger age have more options depending on their health and education, they can provide additional funds to their budget.

The consumables are waterproof dressings, which can be purchased freely from the pharmacy network at an affordable price, and ointments which are placed on the outlet of the tunneled catheter as a prophylaxis for infection.

In many areas, funds are provided (depending on the financial situation of the municipality, monthly or annually) to help with travel costs, food, medicines, etc. to patients undergoing hemodialysis.

Did they receive information about their prescribed treatment, 79 (94.0%) of the patients responded affirmatively, 2 (2.4%) with no that they did not receive information, 3 (3.6%) could not answer (Fig. 13).

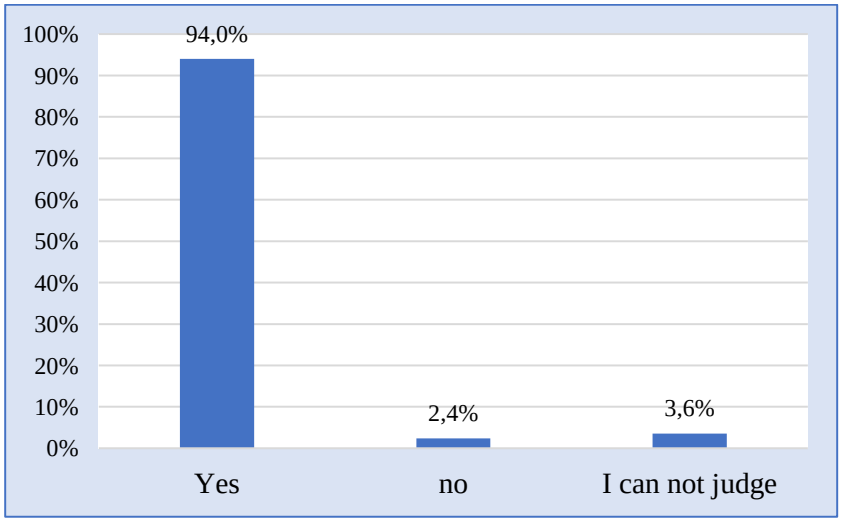


Fig. 13 Awareness of prescribed treatment (n=84)

Additional information about their treatment at home was needed by 52 (61.9%) of the patients, who responded positively, 21 (25.0%) indicated that their relatives were informed, 3 (3.6%) had no information, and none indicated that they needed help (Fig. 14).

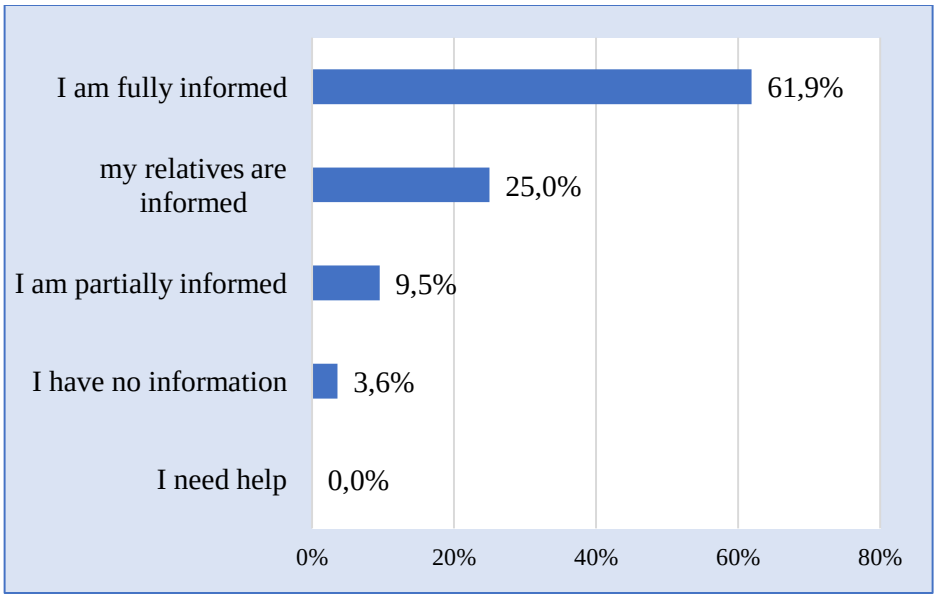


Fig. 14 Need for further information about their ongoing treatment at home? (n=84)

Upon dehospitalization, each patient or their relatives must be given instructions on the dietary and exercise regimen to be followed, as well as on the medication to be taken as ongoing and supportive therapy.

Almost 62% of the patients interviewed received further information if they were interested, but this was mostly related to whether they also had a health culture. In patients where their general condition did not allow, relatives were informed. Those who answered that they had no information were patients with low education, and a lack of self-discipline to follow any regimen regarding the maintenance of their health condition.

Survey of patients' views on their own competencies for disease control activities

In the self-monitoring questionnaire, we included the following indicators: blood pressure, observation of the integrity of the tunneled catheter dressing, chills, and body temperature elevation, and appropriate behavior when abnormalities were recorded.

Monitoring fluid intake and body weight on days when the patient was not on hemodialysis (inter-dialysis period) (Table 2).

Table 2 Self-monitoring questionnaire

Indicator	Result	Behavior
Blood pressure		**Behaviour at elevated blood pressure**
Low	7 (12.3%)	Tablets for blood pressure - 5 persons
Normal	40 (70.2%)	Did nothing - 2 persons
High	10 (17.5%)	
Dressing integrity and dryness		**Behavior in the absence of integrity and dryness of the dressing**
Yes	50 (87.7%)	Additional patch - 4 persons
No	7 (12.3%)	Did nothing - 3 persons
Chills, fever		**Behavior in chills, fever**
Yes	4 (7.0%)	Antipyretic - 1 person
No	53 (93.0%)	Did nothing - 3 persons
Intake of fluids		
500 ml.	18 (31.6%)	
1 liter	34 (59.6%)	
More than 2 l.	5 (8.8%)	
Body weight control between dialysis sessions		
2 kg.	22 (38.6%)	
Over 3 kg.	35 (61.4%)	

57 patients out of 104, or 54.8%, responded. The self-monitoring diary provided detailed instructions to patients about each indicator and its importance, regarding general condition and associated complications.

In our study, the patients recorded values where their blood pressure was normal in 40 (70.2%) of them, 7 (12.3%) had lower than usual, 10 or 17.5% of the patients recorded elevated than usual values. The two patients whose blood pressure was elevated than their usual blood pressure did not take any medication to lower it, unlike the 5 patients who took antihypertensive medication.

Hypertension is a major risk factor for cardiovascular disease, the leading cause of

death among hemodialysis patients. Despite guidelines that call for blood pressure control as a top priority in dialysis patients, hypertension is prevalent in a large proportion of patients and is often poorly controlled.

Regarding the integrity of the catheter dressing. In 50 (87.7%) of the patients, the dressing integrity was not compromised as placed in the dialysis unit. In 7 (12.3%) there was a breach of integrity. However, four of them tried to put on an additional dressing until the time of the next procedure, three patients did not take any action to avoid contamination of the catheter and the skin around it, which is a prerequisite for infection.

Chills and fever

Four (7.0%) of the self-monitored patients had symptoms, one of them took antipyretic, the remaining three did not take medication, 53 (93.0%) had no chills sensation and their fever was higher than normal. Elevated temperature may be a sign of infection, so it should be controlled and responded to suitably.

Deviations from body temperature, as well as the sensation of chills in patients with a tunneled catheter, can always be a sign of an infectious complication. The patient should notify the dialysis unit staff immediately at the next procedure so that the necessary investigations can be performed and adequate treatment initiated.

The most frequently cited chronic complications associated with the greatest risk to patients' lives and health are infectious complications of central venous catheter use. According to some authors, approximately 250,000 cases of catheter-related infections are identified each year in the United States, accounting for 12 to 25% of patient deaths.

Intake of fluids

18 (31.6%) patients took 500 ml of fluids daily, 34 (59.6%) patients took 1 liter daily, 5 (8.8%) patients took more than 2 liters.

Body weight control

22 (38.6%) of the patients were 2 kg. above their optimal body weight in the interdialysis period. 35 (61.4%) were 3 kg. above their optimal body weight. Optimal body

weight is that which is achieved at the end of haemodialysis, after maximum extraction of retained body water. It is determined by a physician and is individual for each patient, taking into account - the physique, there should be no edema, shortness of breath, blood pressure should be within normal limits or close to them Over 80-90% of patients with terminal renal failure have marked arterial hypertension.

Weight gain beyond optimal is actually overhydration, which can lead to the appearance of edema, worsening hypertension, and the appearance of pulmonary stasis. Excessive fluid use can lead to life-threatening complications. These are cerebral and pulmonary edema, in which it is imperative to perform hemodialysis procedures on an emergency basis.

A number of studies have shown that the overall level of self-control of patients is low, which may be due to negligence or low health culture. By improving patients' self-control, they can be encouraged to change their bad habits.

Their ability to self-monitor (measuring blood pressure, monitoring dressing and keeping it dry, clean, and whole, controlling fluid intake), adhering to dietary recommendations (eating potassium-poor foods or reducing those that contain potassium), reduces the occurrence of potential complications and improves their quality of life. Such patients adapt better to their disease and, consequently, to their changed lifestyle as required. Thus, they will increase the duration and quality of life with chronic renal failure by carrying out their hemodialysis treatment.

Survey of nurses' views on the quality of health care in dialysis units

Nurses responding to the survey were 43 (n=43).

Their basic medical education was respectively: the majority had higher education 53,5%, 39,5% had semi-university and 7,0% had secondary-special education. In terms of their work experience, the highest percentage among the nurses responding to the survey were

those with more than 20 years, both general and in the dialysis unit (Table 3).

Tab. 3 Socio-demographic characteristics of nurses (n=43)

Socio-demographic characteristics		**N=43**
Basic medical education (number, %)		
	Secondary (vocational)	3 (7.0%)
	Post-secondary non-tertiary	17 (39.5%)
	Tertiary	23 (53.5%)
Total work experience (number, %)		
	Up to 5 years	0 (0.0%)
	5 - 10 years	0 (0.0%)
	10 - 15 years	5 (11.6%)
	15 - 20 years	4 (9.3%)
	Over 20 years	34 (79.1%)
Work experience in a dialysis unit (number, %)		
	Up to 5 years	4 (9.3%)
	5 - 10 years	4 (9.3%)
	10 - 15 years	7 (16.3%)
	15 - 20 years	13 (30.2%)
	Over 20 years	15 (34.9%)
Dialysis unit category (number, %)		
	1st	10 (23.3%)
	2nd	23 (53.5%)
	3rd	10 (23.3%)

A high percentage of nurses 72.1% strongly felt that their numbers should increase. There is a shortage of nurses in our country and around the world. Regarding the answers of (20.9%) of respondents that their number is sufficient, it can be interpreted with the existence of unequal distribution of specialists in health facilities in the areas (Fig. 15).

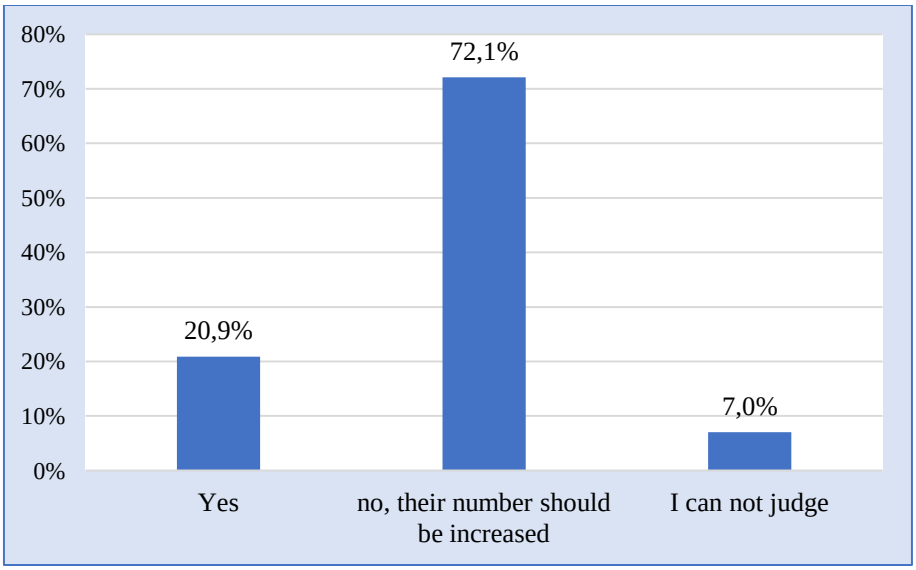


Fig. 15 Opinion of the nurses in the dialysis unit whether they are sufficient in number to provide quality health care to patients (n=43)

The reasons are related both to the availability of more financial resources and to ensuring better working conditions. For the nurses (20.9%) who believe that there are enough nurses, their answer may be related to the free choice of patients to have their treatment wherever they want, given the existence of private dialysis centers already, and also the opening of such centers in many hospitals. There is free movement of staff and patients from hospitals to private dialysis centers and vice versa, hence there may already be an incorrect staff/patient ratio. On the other hand, there may be more clustering of medical staff in cities where there are medical universities. A low percentage of nurses who responded to the survey were unable to estimate (7%) the number of them to provide quality health care.

Across the different levels of competence of the hemodialysis units included in the study and nurses' views on whether the number of nurses was sufficient to provide quality health care, statistically significant results were found ($x^2 = 27.424$, $df = 4$, $p = 0.000$, Phi $= 0.799$).

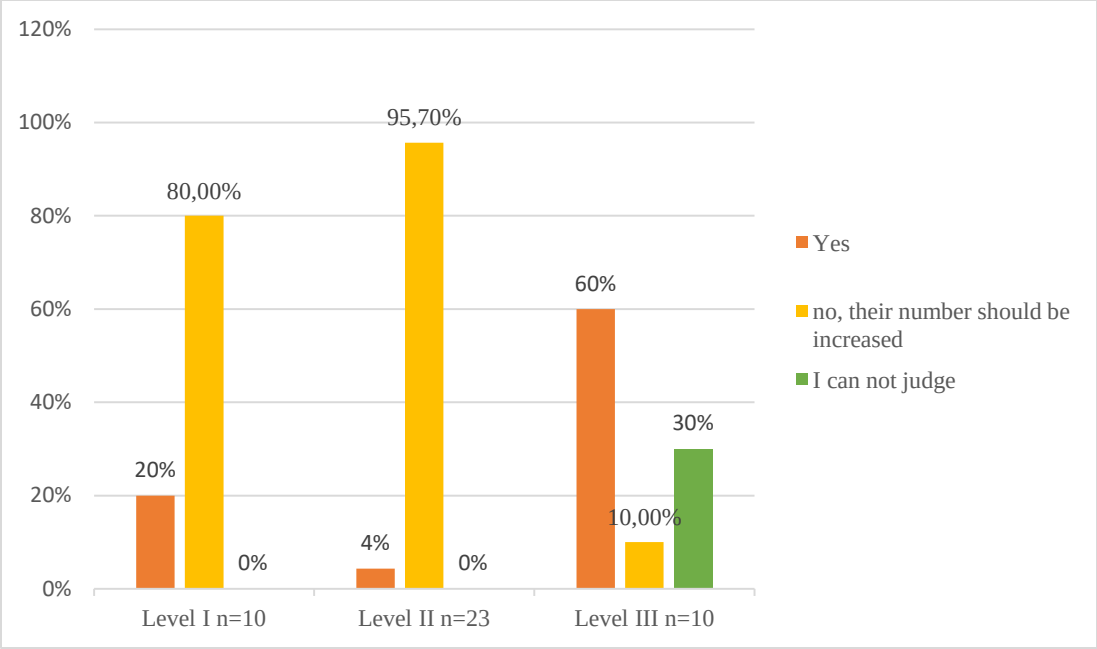


Fig. 16 Nurses' opinion on the sufficiency of the number of nurses in the wards according to the level of hemodialysis wards

Nurses at the first and second levels of competence are adamant that their numbers need to increase to provide quality health care (Figure 16). This is probably due to, the lack of medical training facilities in these localities to provide sufficient staff, the low pay which is not attractive to those starting their career.

All nurses surveyed (n=43; 100.0%) strongly agreed that health care for hemodialysis patients with a tunneled catheter requires specific competencies.

Multiple studies have indicated that in the first six months to 1 year, patients have a 15-20% mortality rate. Because of this, patients need special care, which is provided by nurses with specific competencies in conducting the nursing process for hemodialysis patients.

For nurses, it is their ability to perform specialized health care in hemodialysis patients that includes establishing therapeutic and interpersonal relationships, managing symptoms of physical limitations, and mental health, and the education that is needed by patients.

The highest percentage of 90.7% (Fig. 17) indicated special care for vascular access

as a specific competency. Nurses play a key role in its assessment, maintenance, and monitoring. It is the foundation for conducting an effective hemodialysis procedure and increased quality of life for patients.

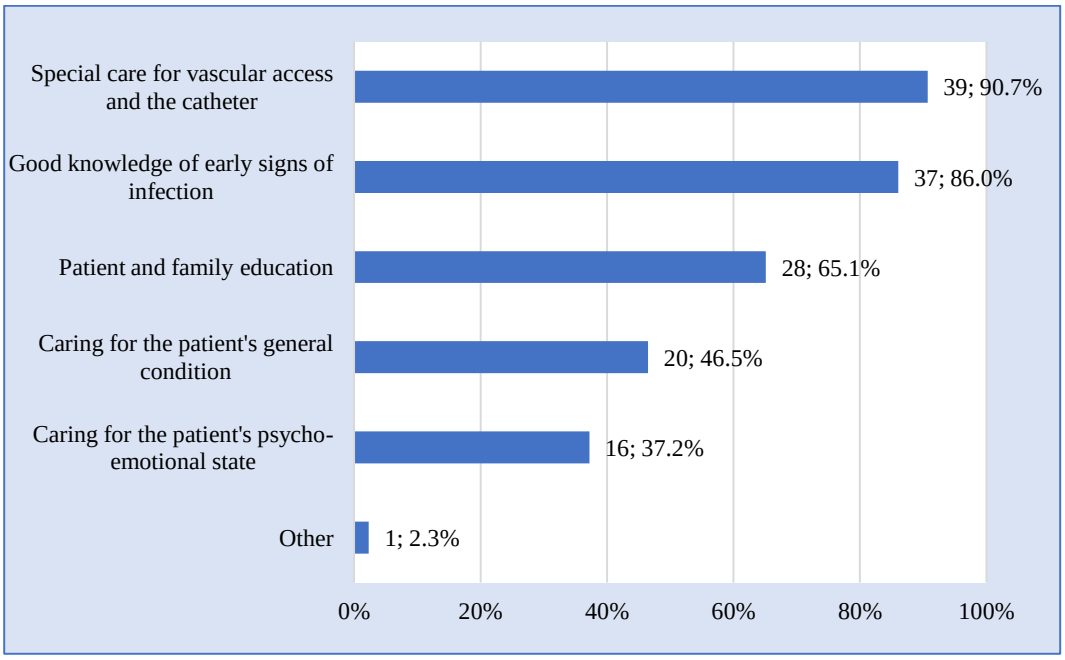


Fig. 17 Specific competencies, according to nurses

Specific competencies are also in the preparation of the catheter for the hemodialysis procedure. Meticulous disinfection is mandatory when connecting the haemolines from the device to the catheter while observing asepsis. Monitoring of the patient during the procedure for possible bleeding from the catheter outlet or the presence of a hematoma, basic vital signs, monitoring of the dialysis machine (blood hemolysate pressure values, dialysis solution concentration values), and keeping them within normal limits. All these activities performed by the nurses are absolutely necessary for conducting an effective and safe hemodialysis procedure.

Nurses who considered good knowledge of the signs of infection to be one of the mandatory competencies were 86%. Catheter-related infections are exit site, tunnel, and bloodstream infections, the latter being the second cause of hospitalization and mortality in hemodialysis patients after cardiovascular disease.

Another competency was patient education, which was indicated by 65.1% of respondents. The nurse provides education to the patients regarding the care of their vascular access, food, and fluid intake (their quantity and quality), exercise regimen, medication intake, etc.

Caring for the patient's general condition was mentioned by 46.5% of nurses as the next competence. These are respectively the care of monitoring the patient during the procedure, skin, visible mucous membranes, vital signs - blood pressure, pulse, respiration, and if necessary measuring body temperature. Monitoring of vascular access for complications (hematomas, bleeding, secretions) is done. All data are reflected in a dialysis protocol, which is validated in the standard for dialysis treatment.

Care for the psycho-emotional state was mentioned by 37.2%, and other competencies (communication skills, teamwork) were mentioned by 2.3% of the nurses who responded to the survey.

Do they have sufficient knowledge and skills to operate tunneled catheters, 79.1% of the nurses strongly felt that they did, while 20.9% expressed hesitation with "Yes, but somewhat" (Fig. 18).

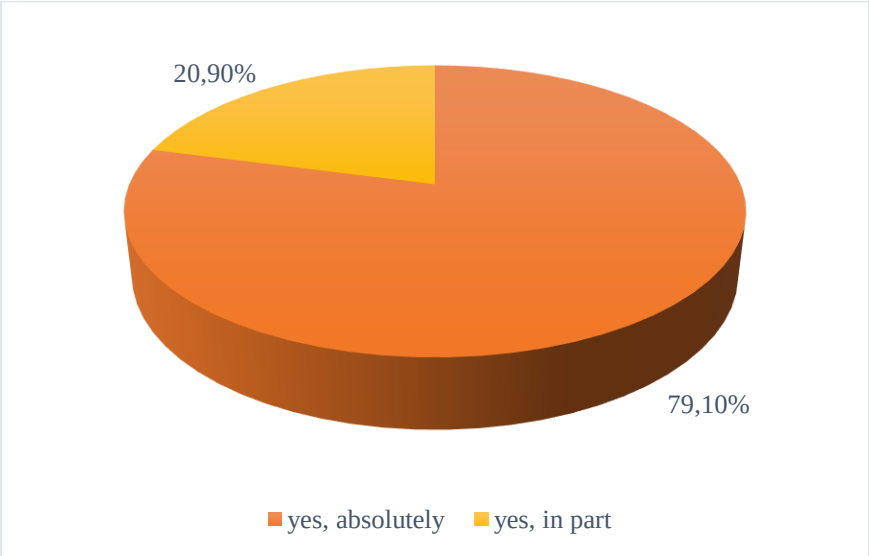


Fig. 18 Nurses' self-assessment of knowledge and skills in tunneled catheter use

In our survey, according to the respondents, the best way to improve their

competencies 37.2% thought that training was necessary before starting work in a dialysis unit, 32.6% had no answer. Enrolling in qualification courses outside working hours in the dialysis unit and working with a mentor during the working shift until competencies are mastered are the ways to improve them thought 14% of the nurses surveyed.

The skills development activities in which the nurses participated were as follows, shown in Figure 19.

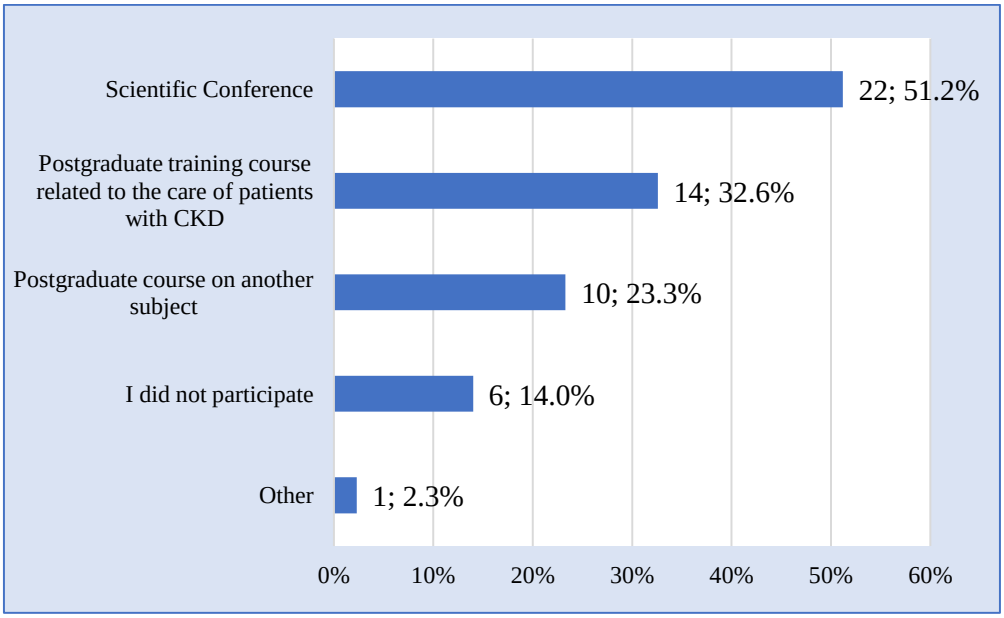


Fig. 19 Nurse upskilling activities

51,2% of the respondents mentioned the scientific conferences - forums organized by the BAHCP (Bulgarian Association of Health Care Professionals), by the Bulgarian Society of Nephrology with the participation of nurses in dialysis structures (the conferences are annual). 32,6% participated in postgraduate training courses related to the care of patients with CKD, 23,3% participated in a course on other topics, 2,3% mentioned other activities where they could improve their qualifications. 14,0% did not take any action to improve their skills. Possible reasons for this passivity are probably the financial resources associated with participation in such forums, the inability to take time off work due to staff shortages, the lack of additional financial incentives - pay rises relative to qualifications, provision of career progression. Last but not least is the lack of desire to

improve.

Nurses' opinion on the need to have specialty training for Dialysis Nurses, 86.0% strongly agreed that there should be such training. Interestingly, 35% of them responded that they have some knowledge and skills to operate the tunneled catheters, i.e. they are willing to be trained to increase their knowledge and skills to be useful to patients. 11.6% could not answer and 2.3% did not think that such specialisation should be introduced.

Do nurses follow the rules of operation of tunneled catheters, 69.8% in the survey self-assessed affirmatively, while 30.2% follow them but partially (Fig. 20).

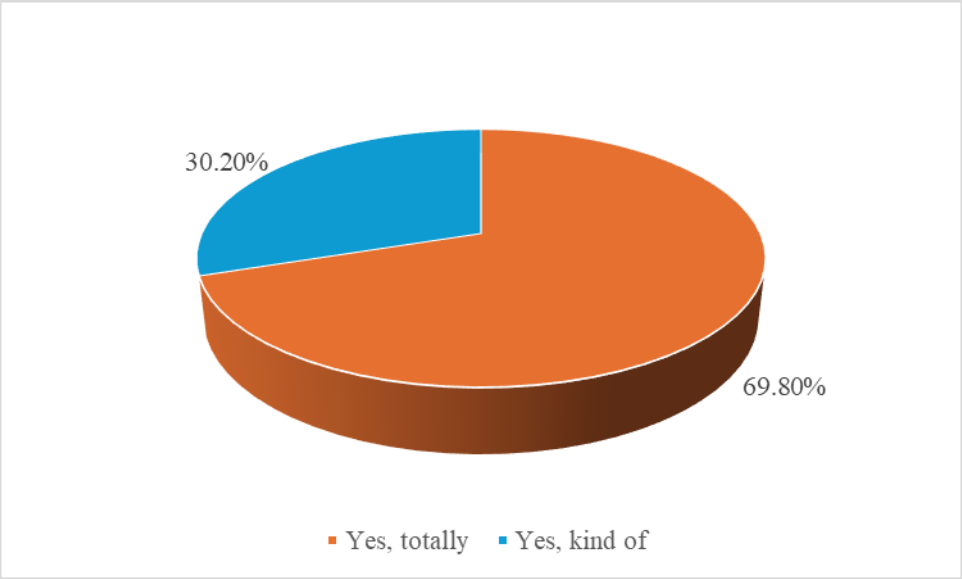


Fig. 20 Nurses' opinion on whether they follow the rules for the use of tunneled catheters.

It is characteristic of the respondents (who answered "Yes, partly") that they expressed a desire to have a specialization in Dialysis Nursing. This can be interpreted that they consider specialization as a way to improve themselves. Lack of motivation, carelessness in performing duties, and lack of necessary skills were indicated by an equal percentage of 31.6% of nurses. However, 89.5% expressed insufficient time to attend to the patient due to staff shortage (Figure 21).

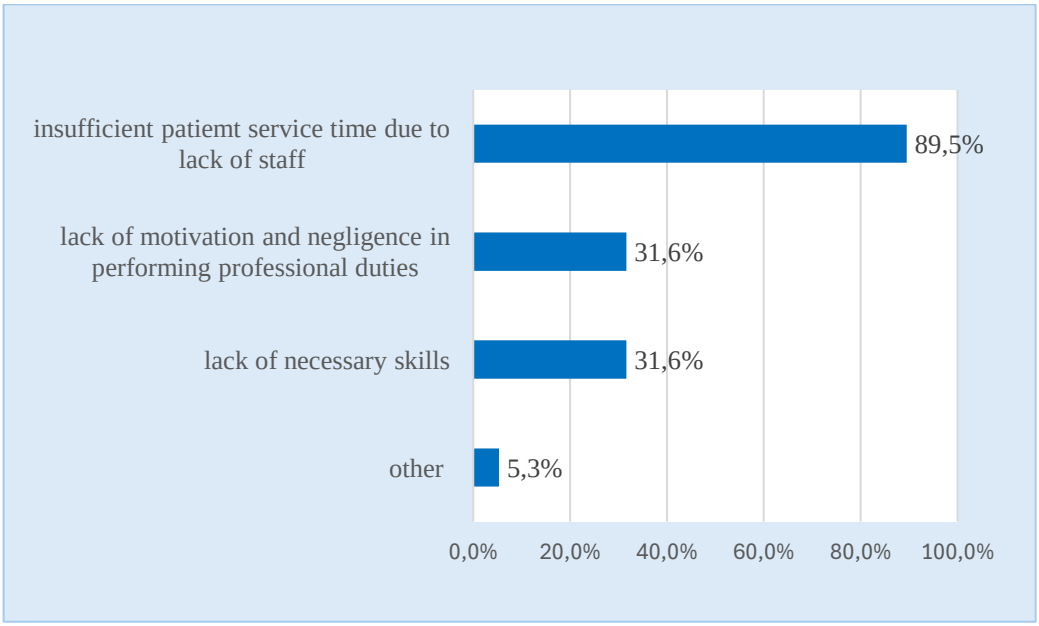


Fig. 21 Possible reasons for the answer "Yes, partly" for compliance with catheter operating rules.

This is of course directly related to the quality of work. The shortage of nurses is a worldwide problem.

Regarding compliance with the instructions given by the nurses to the patients regarding the care of the catheter, 9.3% of the nurses expressed the opinion that they were not followed, 7.0% gave a positive evaluation, while the majority 83.7% were hesitant towards the patients and answered: "No, completely".

The most common reason for patients not following the instructions, 77.4% of nurses considered low health culture and incompetence, 25.8% that patients have a passive attitude towards the problem, and 19.4% considered that there are poor living conditions (Fig. 22).

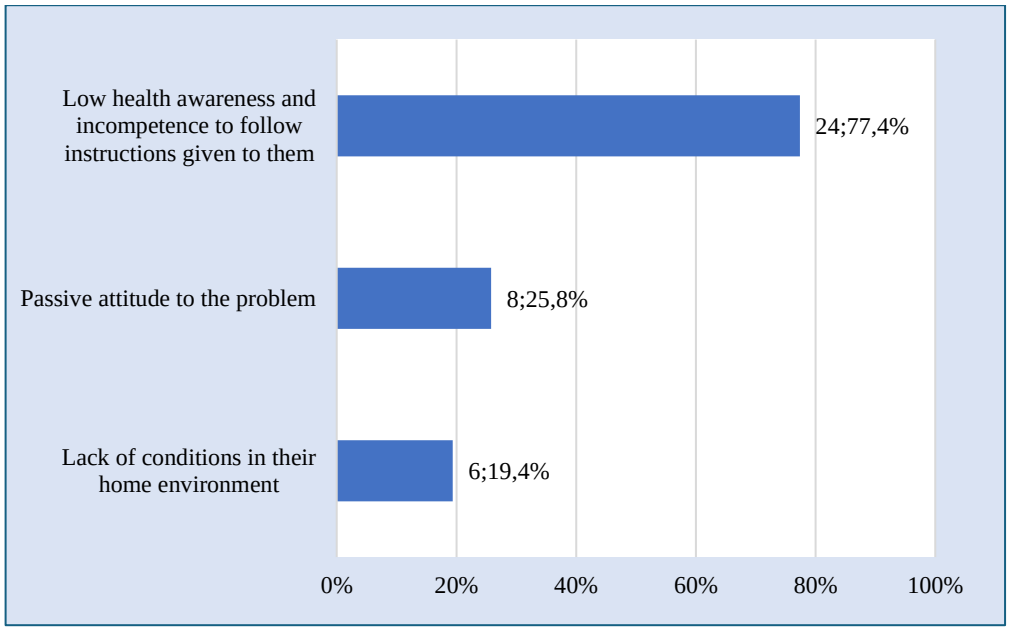


Fig.22 Reasons why patients do not follow the instructions given to them by nurses

Low patient health culture is associated with uncontrolled hypertension and diabetes, obesity, which are among the main risk factors for the development of chronic renal failure. Most of the patients are late in seeking help from their personal physician who accordingly, if there is a problem, refer them to a specialist nephrologist. They are not aware of the possible complications that can occur if the recommendations are not followed in terms of taking medications, neglecting dietary and exercise regimens, and taking care of vascular access. All this is directly related to the duration and quality of life of the patients.

Regarding the proposed ways to improve the quality of health care in patients with tunneled catheters to reduce catheter-related infections, 65.1% of nurses had no suggestions.

However, 34.9% of nurses indicated solutions with the majority of them relying on hygiene and patient awareness. The remainder was regarding the health care provided by nurses (compliance with tunneled catheter rules, knowledge of early signs of infection and possible complications) (Table 4).

Table 4 Suggested ways nurses can improve the quality of healthcare

Valid	unanswered	28	65,1
	discussion with a doctor	1	2,3
	good hygiene and full patient responsibility	1	2,3
	for staff - novelty training, for patient - hygiene instructions	1	2,3
	Information brochures, discussions	1	2,3
	patient awareness	1	2,3
	courses, training	1	2,3
	better patient hygiene	2	4,7
	more information about nutrition and hygiene	1	2,3
	improving patient hygiene	1	2,3
	attending lectures on the subject	1	2,3
	cleaning of the catheter and replacement of the dressing every xd	1	2,3
	regular cleaning of the catheter	1	2,3
	compliance with the rules of work and disinfection	1	2,3
	patient hygiene and knowledge of the risks of complications	1	2,3
	Total	**43**	**100,0**

When asked about occupational burnout, 39.5% of nurses responded positively. Respondents who could not judge and those who did not show signs of occupational burnout were equal at 30.2%.

In the survey, 51.2% of nurses, when asked if they themselves had signs of occupational burnout, did not think they showed signs of occupational burnout, while 39.5% confirmed that they did, and 9.3% expressed hesitation and could not judge (Fig. 23).

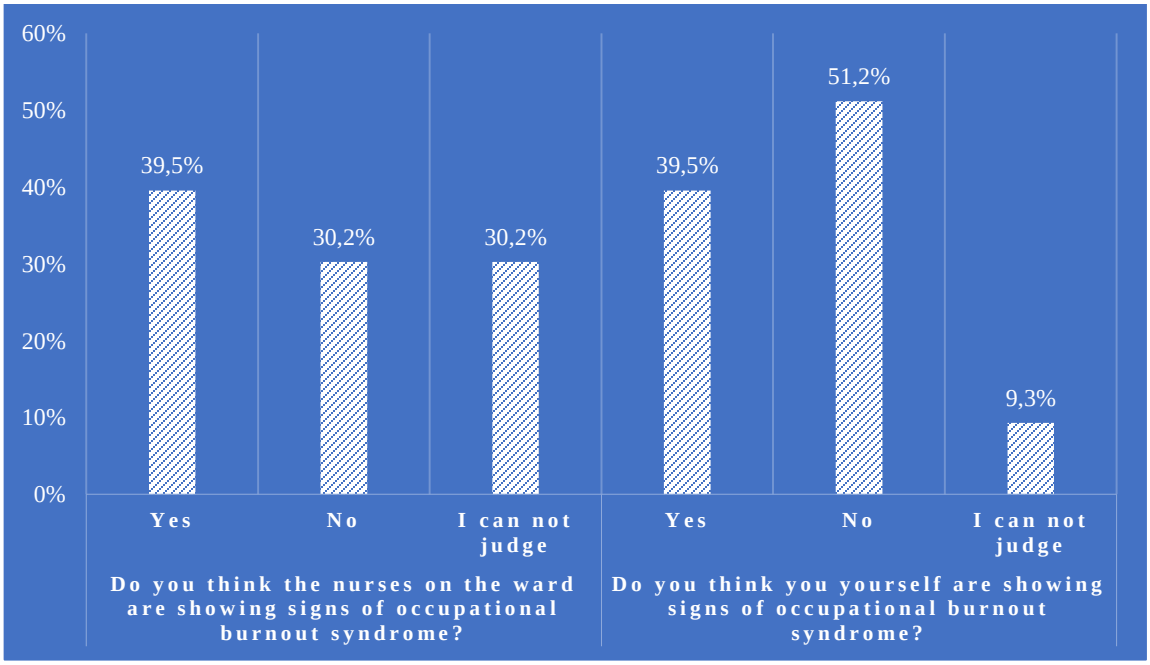


Fig. 23 Do the nurses consider themselves to be exhibiting occupational burnout syndrome and do each of them consider themselves to be exhibiting signs of occupational burnout

In modern times, especially in hemodialysis centers, nursing is considered a high-risk and stressful profession, given the constant need to deal with emergencies. Nurses often find themselves in stressful situations where they have to provide high-quality health care to the patients.

With nurses being the most numerous resource in the health care system, this is likely to have a negative impact on the quality of health care, absenteeism, increased turnover, and consequently reduced patient satisfaction.

Those responding to the survey who had signs of occupational burnout were 72.7%. Occupational burnout is characterized by easy fatigability and irritability. 31.8% of respondents have a loss of motivation and interest in work, another 9.1% (health problems), reluctance to professional improvement, and growth 4.5% (Fig. 24)

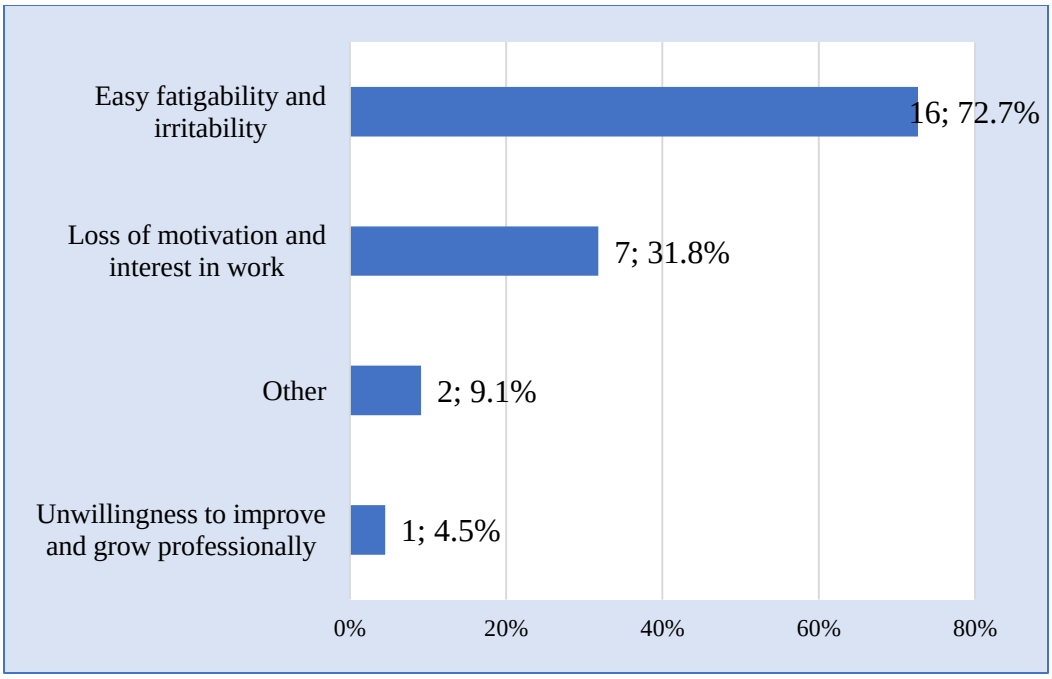


Fig. 24 Signs of occupational burnout when answering "Yes" to its presence in nurses.

Survey of physicians' opinions on the quality of health care in dialysis units

There were 22 physicians who responded to the survey. The majority of them (68.2%) had work experience of more than 20 years followed by those with 3 years (13.6%), doctors with work experience between 5-10 years and 15-20 years had an equal percentage (4.5%), 10-15 years work experience was prevalent in 9.1%. Here also the respondents with total and dialysis unit experience of more than 20 years were having the highest percentage as in the case of nurses responding to the survey (Table 5).

Table 5 Characteristics of doctors

Characteristics	N=22
Work experience, *years* (number, %)	
Up to 5 years	3 (13.6%)
5 - 10 years	1 (4.5%)
10 - 15 years	2 (9.1%)
15 - 20 years	1 (4.5%)
Over 20 years	15 (68.2%)
Work experience in a dialysis unit, *years* (number, %)	
Up to 5 years	4 (18.2%)
5 - 10 years	3 (13.6%)
10 - 15 years	1 (4.5%)
15 - 20 years	5 (22.7%)
Over 20 years	9 (40.9%)
Category of dialysis unit	
First	7 (31.8%)
Second	9 (40.9%)
Third	6 (27.3%)

Their work experience in hemodialysis units was distributed as follows: again, physicians with more than 20 years of experience had the highest percentage of 40.9%, followed by 15-20 years 22.7%, up to 5 years 18.2%, 5-10 years 13.6%, between 10-15 years 4.5% (Table 5).

The largest percentage (40.9%) were representatives from the second level of competence health facility, followed by the first level (31.8%), the smallest number were doctors from the third level of competence health facility (27.3%).

In terms of specialties held: doctors with a specialty in Internal Medicine and Nephrology had equal percentages of 27.3%, with two specialties each in Internal Medicine and Nephrology at 18.2% and Internal Medicine and Cardiology at 4.5%, and other (postgraduates) at 22.7% (Figure 25).

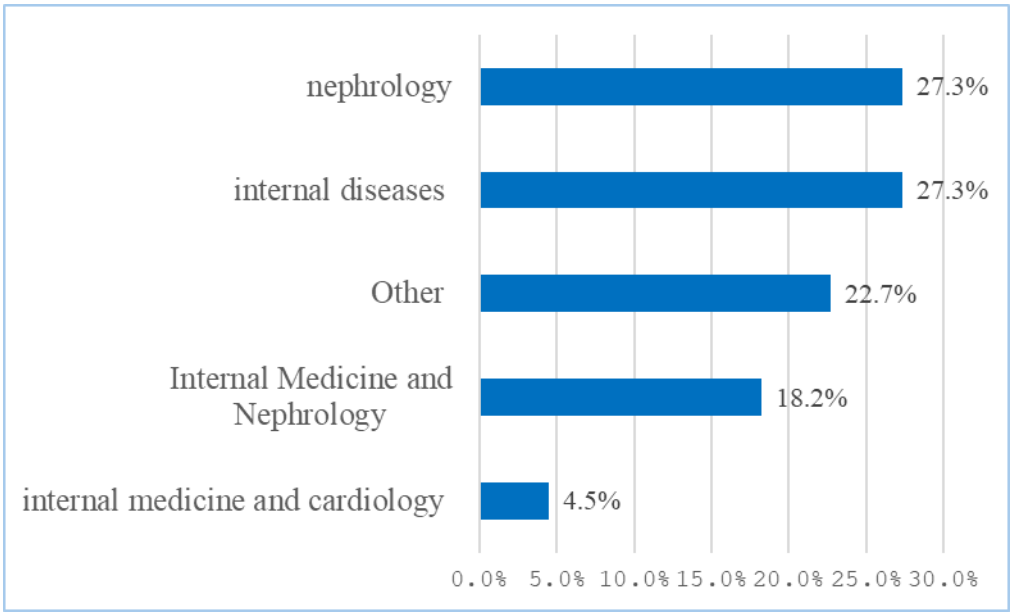


Fig. 25 Distribution of doctors by specialty

It is evident from Figure 25 that the wards included in the study are well-staffed with specialists to provide quality care to patients on hemodialysis treatment.

All physicians surveyed (n=22; 100.0%), regardless of their professional experience, believed that health care for hemodialysis patients with a tunneled catheter requires specific competencies from the nurse (Fig. 26).

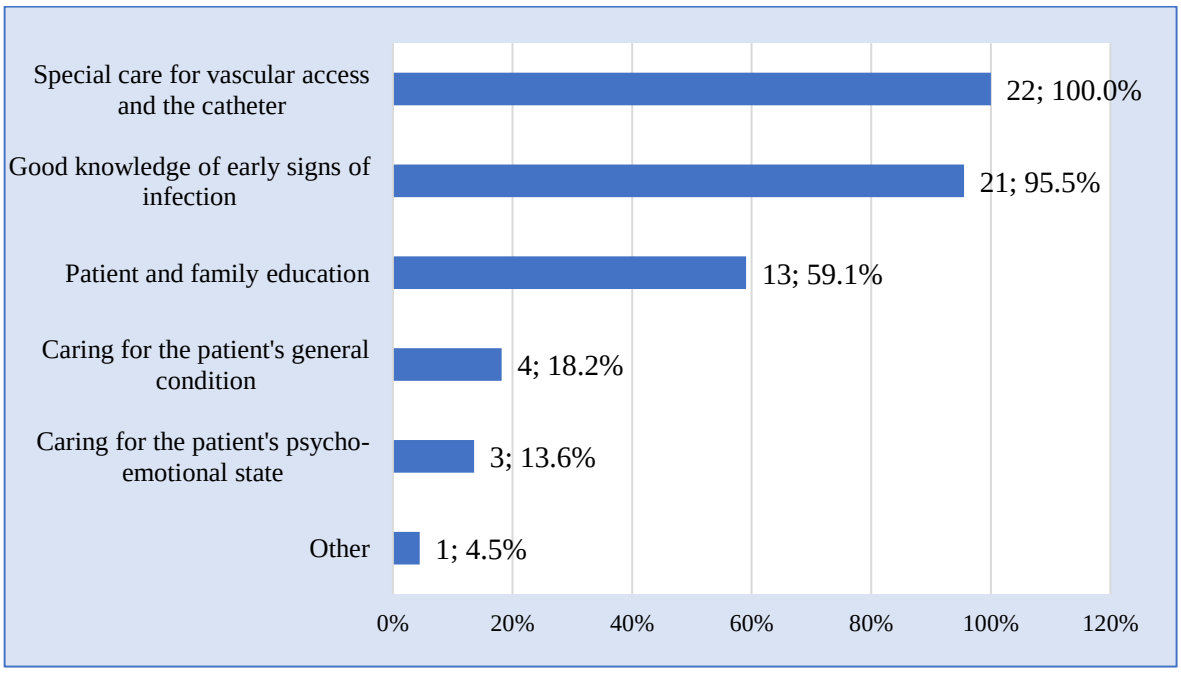


Fig. 26 Specific competencies of nurses, according to doctors

Physicians (n=22; 100%) felt that special vascular access care was a specific competency. Well-functioning vascular access directly influences dialysis treatment outcomes and patient quality of life. 95.5% of respondents indicated good knowledge of early signs of infection, 59.1% patient and family education was one of the specific competencies, 18.2% care for the patient's general condition, care for the patient's psycho-emotional state was considered by 13.6% of physicians. Hemodialysis patients need psychological support to adapt to their current condition and nurses can provide it, to overcome their fears of the disease. Those who indicated other (communication skills, teamwork) as competencies made up 4.5%.

Do they possess these specific competencies a high percentage of 86.4% of respondents are definite in their assessment with "Yes, completely", 13.6% with "Yes, partially" (Fig. 27).

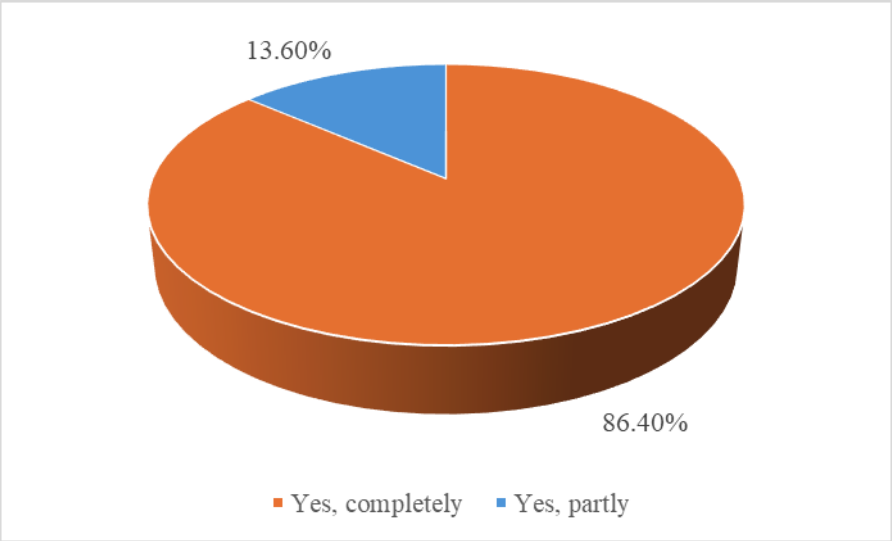


Fig. 27 Do nurses have specific competencies for working in the dialysis unit?

The physicians' opinion on ways to improve nurses' specific competencies was that 66.7% indicated conducting pre-service training in the dialysis unit, followed by working with a mentor during the work shift until competencies were mastered, and engaging in qualification courses during off-hours with an equal percentage of 33.3%.

Regarding supportive pre-employment training, nurses are likely to have in mind the

need to have basic theoretical knowledge. For those, who expressed the view of working with a mentor until competencies are acquired, the aim is to focus only on learning practical skills during a work shift (Figure 28).

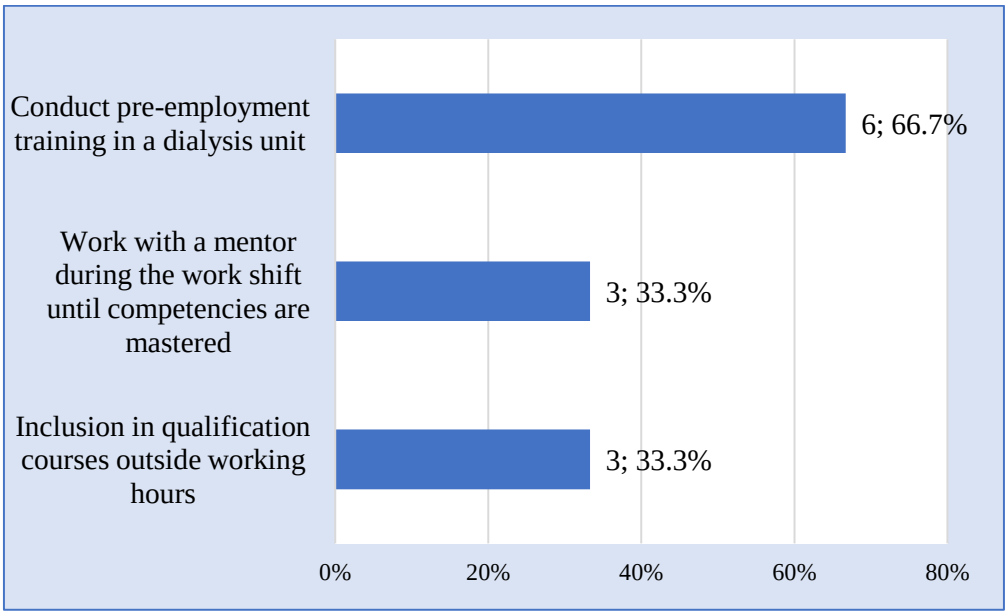


Fig. 28 Doctors' views on ways to improve nurses' competencies

Doctors in the study also support the introduction of a specialty Dialysis nurse - 95.5%, while 4.5% could not decide, this is probably due to little experience in dialysis structure and lack of specialty.

An examination the relationship between infections and treatment-related costs

Table 6 Patient demographic and clinical characteristics

Charachteristics	Number	%
Gender	**34**	**100.0%**
male	21	61.8%
female	13	38.2%
Diagnosis	**34**	**100.0%**
Diabetic nephropathy	9	26.5%
Chronic glomerulonephritis	15	44.1%
Hypertensive nephropathy	2	5.9%
ADPKD	4	11.8%
Chronic interstitial nephritis	3	8.8%
Chronic pyelonephritis	1	2.9%
Year of placement of TC	**34**	**100.0%**
2017	9	26.5%
2018	8	23.5%
2019	10	29.4%
2020	2	5.9%
2021	4	11.8%
2022	1	2.9%

The study included 34 patients who were hospitalized at the University Hospital "Georgi Stranski", Pleven in the time frame 01.2017 - 12.2022 due to complications related

to infections caused by tunnelled catheters (catheter-associated infections and infective endocarditis).

Of the 34 patients included, 13 (38.2%) were women and 21 (61.8%) were men. The mean age of the subjects was 58.5±13.802 years. The mean age of females in the sample was 58.9±12.449 years and for males was 58.2±14.872 years (Table 6).

Tab. 7 Hospitalizations related to catheter-associated infections and infective endocarditis

Hospitalizations	**N**	**Mean number of days since TC placement or last hospitalization *(Mean±SD)***	**Mean length of hospital stay in days *(Mean±SD)***
One	34	334.*2±361*.236	14.*4±7*.652
Two	18	97.*8±97*.6	13.*7±8*.897
Three	6	275.*5±179*.027	15.*3±6*.860

Of the 34 patients hospitalized with infections, 18 had a second hospitalization, 6 had three, and one had four, for a total of 59 hospitalizations for the period. The mean number of days from tunneled catheter placement to first hospitalization was 334. 2± 361.236.

The mean number of days from catheter insertion or last hospitalization to the second hospitalization was 97.8±97.6. The third hospitalization was after 275.5±179.027 mean number of days since the last hospitalization (Table 7) There was one patient with diabetic nephropathy with fourth hospitalization, the number of days since his last hospitalization was 101, the hospital stay was 9 days and the cause was catheter-associated infection.

The mean length of hospital stay in days for the first hospitalization was 14.4±7.652, for the second was 13.7±8.897, and for the third 15.3±6.860 days (Table 9).

Depending on the complication, patients are hospitalized under a specific clinical

pathway by the NHIF.

Hospitalizations related to infectious complications require additional costs beyond those associated with the hemodialysis procedure, which in turn burden the health system and the NHIF (Fig. 29).

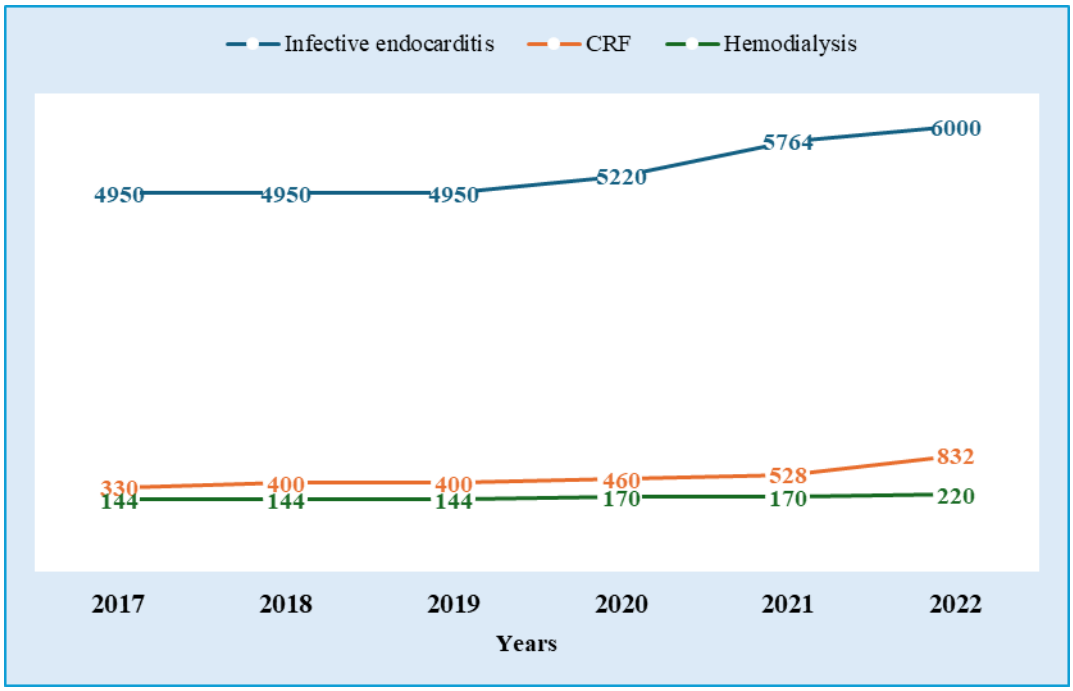


Fig. 29 Evolution of prices of clinical pathways under NHIF for the period 2017-2022 (in BGN)

It can be seen from Figure 29 and Table 8 that the 2017-2022 clinical pathway values for the CKD and HD procedure remain approximately unchanged over the 4-year period.

For the clinical pathways meant for infective endocarditis and CRF /CKD/ there is some increase in the price paid by the NHIF for 2021-2022, while the outpatient procedure chronohaemodialysis' cost is minimally increased for 2021 and 2022.

Table 8 Prices of clinical pathways under NHIF for infective endocarditis, chronic renal failure, hemodialysis procedure (in BGN)

Clinical trail	2017	2018	2019	2020	2021	until 30.04. 2022	01.05. 2022
Infectious endocarditis	4950	4950	4950	5220	5764	5764	6000
CRF	330	400	400	460	528	528	832
HD	144	144	144	170	170	220	220

The largest cost of treating catheter-related infections associated with tunneled catheters is in 2022, 7184 BGN, shown in Figure 30

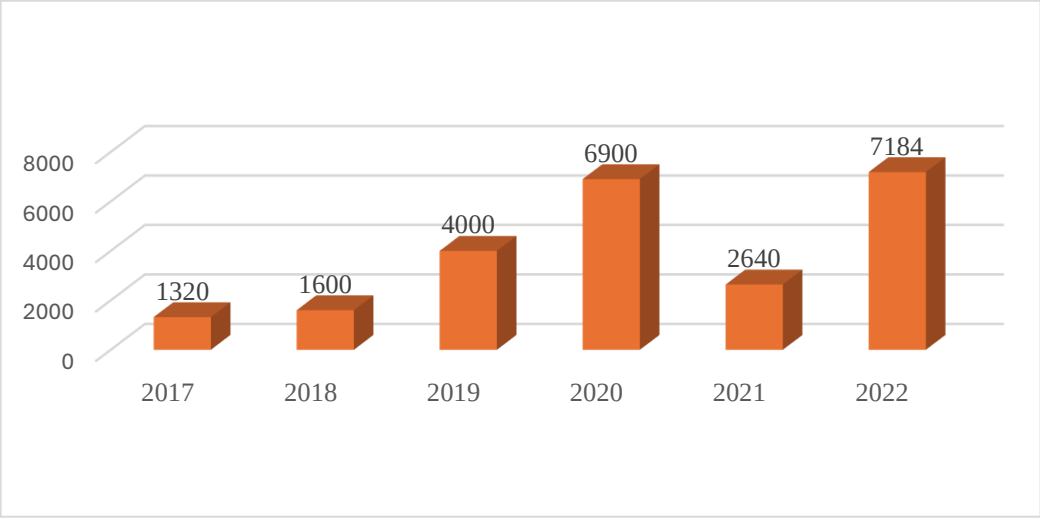


Fig. 30 Costs of treatment of catheter-associated infections for the period 2017-2022 (in BGN)

All patients with catheter-associated infection should be treated with systemic antibiotics for 2-6 weeks, depending on the type of microorganism isolated, the severity of infection, and the presence of complications. Antibiotic solutions to fill the catheter lumen may be used as adjunctive treatment. According to non-randomized studies, solutions that co-administer the anticoagulant heparin or citrate and an antibiotic in different proportions reduce the risk of developing infections by up to 100%. There are observational studies that suggest that the administration of intraluminal antibiotic solutions, along with the administration of a systemic antibiotic, results in a reduction in the need to change or remove the tunneled catheter.

In 2018, where the highest costs were for the treatment of infective endocarditis as a complication in patients with a tunneled catheter on hemodialysis, there were 5 cases (Fig. 31).

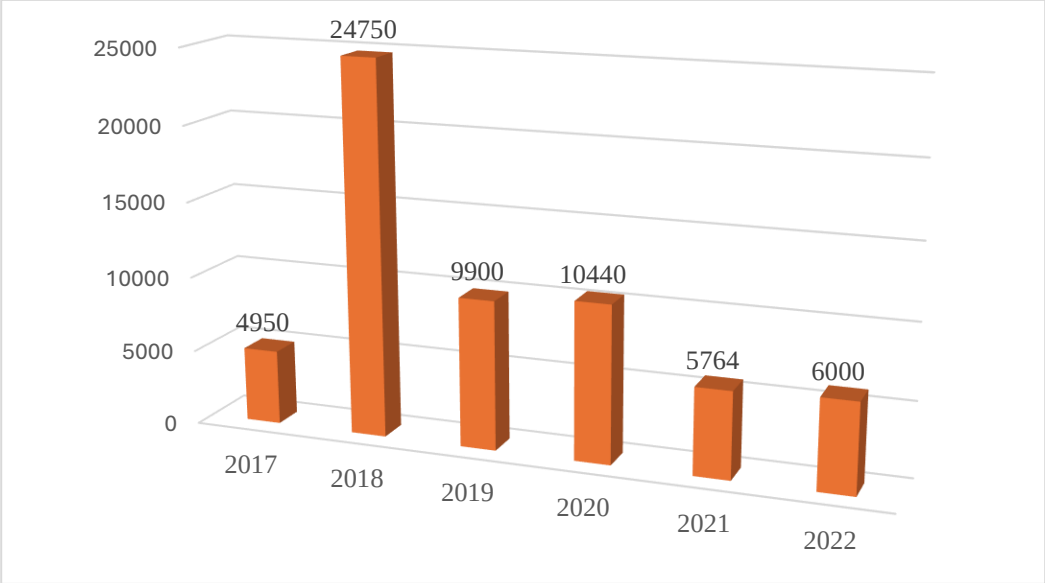


Fig.31 Costs for treatment of infective endocarditis for the period 2017-2022 (in BGN)

In our study, 12 cases of infective endocarditis occurred during the study period. Hemoculture was taken in all the patients in which the infectious agent was proved. 7 patients were found to have Gram (+) bacteria while 5 patients were found to have Gram (-) bacteria. Gram (+) bacteria or (58.3%) St. Aureus and St. Epidermidis were isolated. Gram (-) or 41.67% of the isolated causative organisms - Ps. Aeruginosa, Ochrobacterium

anthropi and Enterobacter cloacae. Echocardiographic examination was also performed in the same patients and they were treated in parallel by cardiologists and nephrologists at a distance of 4-6 weeks.

If we compare the cost of treating infectious complications (26,350 BGN) and hemodialysis treatment per patient (20,736 BGN) in 2018, for example, the cost of complications is actually, roughly, as much as it costs to carry out a year's dialysis treatment on one patient, with the consequences of these infections carrying a risk and impairing the patient's quality of life.

In fact, if quality health care is delivered to patients with a tunneled catheter, the likelihood of complications is reduced, and hence the additional costs of treatment are reduced.

A study of the average "survival" of tunneled catheters and their complication rates

Vascular access is a prerequisite for hemodialysis treatment in patients with terminal renal failure. Worldwide, it reaches 14.3%.

A retrospective study of a sample of 207 patients was performed. A total of 266 tunneled catheters were placed. An ultrasonographic examination of the veins of the superior vena cava system was performed before manipulation. The Seldinger technique for catheter insertion was applied.

The Kaplan- Meier method was used to analyze catheter survival.

In their distribution by main renal disease, it is striking that the largest number of patients had diabetic nephropathy, followed by those with chronic glomerulonephritis and hypertensive nephropathy (Fig. 32).

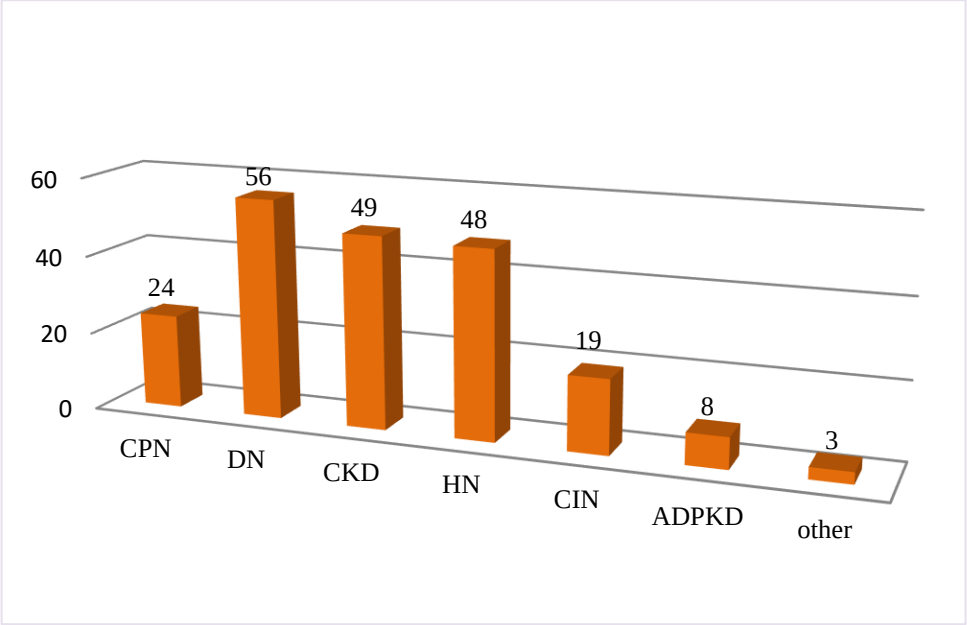


Fig. 32 Distribution of patients by primary kidney disease leading to CKD (n=207)

(CPN - chronic pyelonephritis, DN - diabetic nephropathy, CKD - chronic glomerulonephritis, HN - hypertensive nephropathy, CIN -chronic interstitial nephritis, ADPKD - autosomal dominant polycystic kidney disease, other nephropathies)

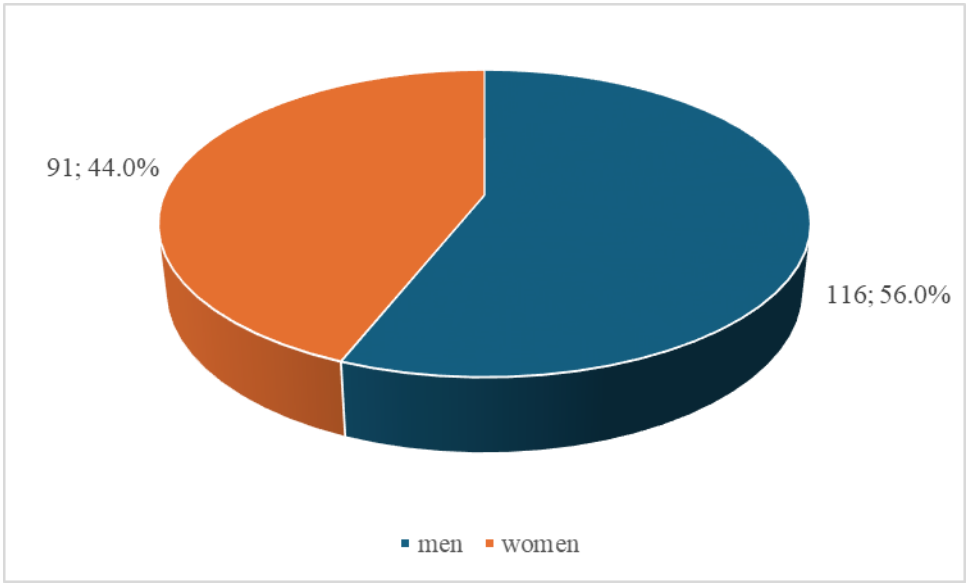


Fig. 33 Distribution of patients by sex (n=207)

The total number of patients was 207, with a mean age of 62.0±12.371 years, with

116 males and 91 females (Fig. 33).

We found no statistically significant difference in age between the two sexes (U=5021.000, z=-0.622, p=0.534). The more events that occur, the lower the cumulative survival proportion and the lower the survival curve (i.e. along the y-axis).

The survival curves of the two groups (males and females) are approximately the same (Figure 34).

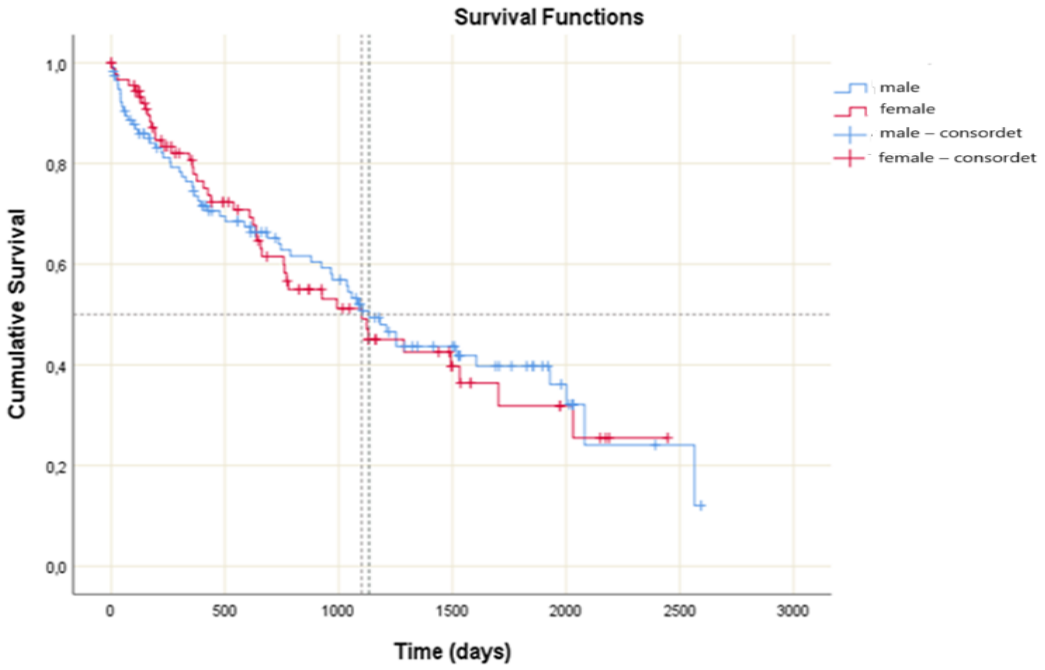


Fig.34 Survival diagram

The percentage of censored cases was similar across groups, 56 (48.3%) for men and 48 (52.7%) for women.

Below Tab. 9 shows the mean survival time and associated statistics for each group. In the Kaplan-Meier analysis, the mean has much less significance than the median as a measure of central tendency. The median catheter survival time in women was 1101 days ≈3 years (i.e., median time to catheter change) with 95% CI of 655 to 1548 days. However, we can see that the male group had a longer mean survival time of 1134 days ≈ 3 yr, and 1 mo with a 95% CI of 950 to 1318 days.

Tab. 9 Mean survival time of catheters

	Mean[a]				Median			
			95% Confidence Interval				95% Confidence Interval	
Sex	Estimate	Std. Error	Lower Bound	Upper Bound	Estimate	Std. Error	Lower Bound	Upper Bound
Male	1305,165	104,939	1099,484	1510,845	1134,000	94,096	949,572	1318,428
Female	1240,553	113,706	1017,690	1463,416	1101,000	227,781	654,549	1547,451
Overall	1295,088	79,294	1139,672	1450,504	1101,000	106,760	891,750	1310,250

a. Estimation is limited to the largest survival time if it is censored.

To determine whether the survival functions are equal, the Log Rank (Mantel-Cox) test was applied. The log-rank test places emphasis on differences at later rather than earlier time points. The null hypothesis that there is no difference in overall survival distribution between groups in the population is tested. Survival distributions for males and females were not statistically significantly different (χ^2 =0.020, df=1, p=0.887).

The distribution of the number of patients according to the primary kidney disease leading to CKD is as follows:

Patients were divided into groups according to the primary kidney disease leading to CKD, which was the reason for the placement of the tunneled catheter: Chronic pyelonephritis - CPN (n=24), Diabetic nephropathy - DN (n=56), Chronic glomerulonephritis - CGN (n=49), Hypertensive nephropathy - HN (n=48), Chronic interstitial nephritis - CIN (n=19), Autosomal dominant polycystic kidney disease - ADPKD (n=9), Systemic lupus LED (n=1) and Myeloma nephropathy - MN (n=1).

Kaplan-Meier survival analysis was performed to compare groups according to catheter survival diagnosis. The percentage of censored cases was not similar in the CPN (66.7%), DN (53.6%), CGN (49.0%), HN (66.7%), CIN (57.9%), ADPKD (44.4%), LED (100.0%), and MN (100.0%) groups.

Differences in the survival of tunneled catheters by diagnosis were not statistically significant (H=4.717, df=7, p=0.694).

Patients diagnosed with primary renal disease, CKD, had a mean catheter survival time of 2565 days ≈7 years (95% CI 1238 to 3892 days). The graph shows that there is

more than a 60% probability of survival of the tunneled catheter beyond the 3rd year in patients with CPN. After the 5th year, the probability drops to 50% (Figure 35).

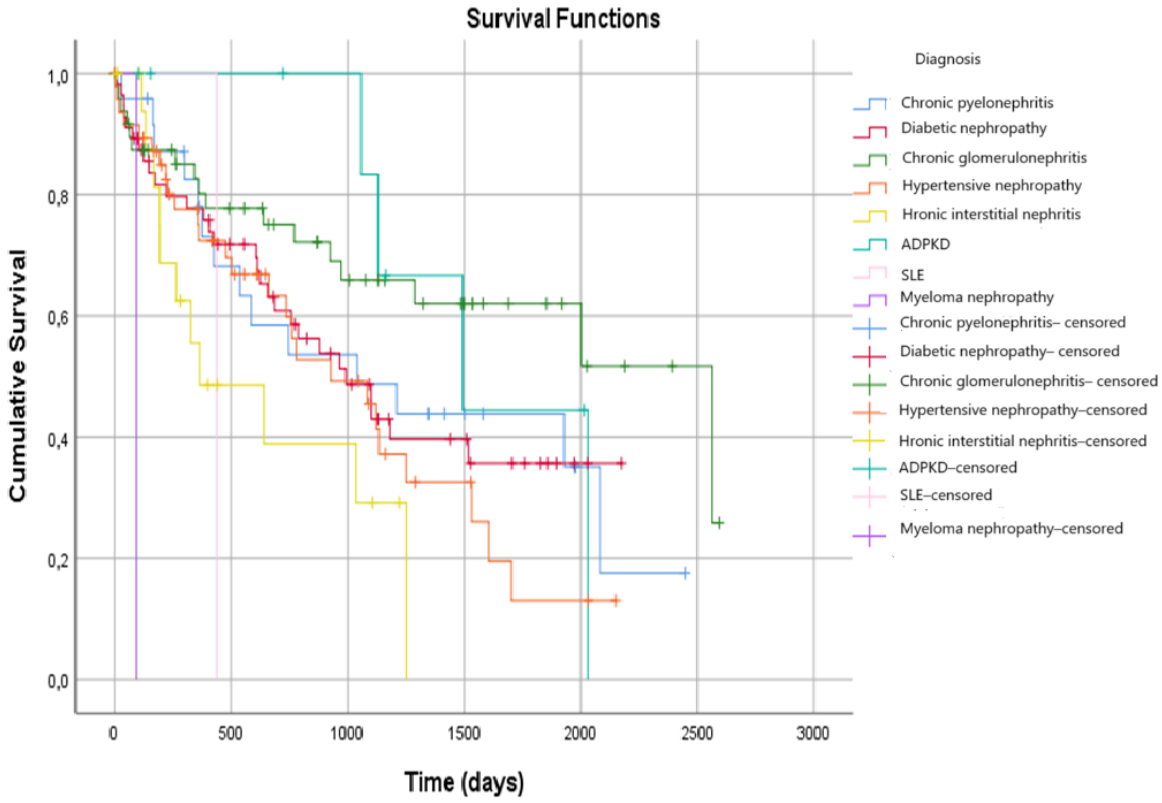


Fig.35 Differences in the survival of tunneled catheters versus primary kidney disease

A log-rank test was performed to determine if there was a difference in the distribution of catheter survival for the different diagnoses. The survival distribution according to the diagnosis of primary kidney disease was not statistically significantly different (χ^2 =4.448, df=7, p=0.727).

The most common reasons for removal of tunneled catheters in our study were: functioning catheter in 45 (21.7%), deceased - in 75 (36.2%), CAS in 26 (12.6%), CAI - in 6 (2.9%), PD - in 2 (1.0%), renal transplantation - in 1 (0.5%), restored renal function - in 7 (3.4%), AVA - in 23 (11.1%), AVP - in 3 (1.5%) and CD (n=19) (Figure 36).

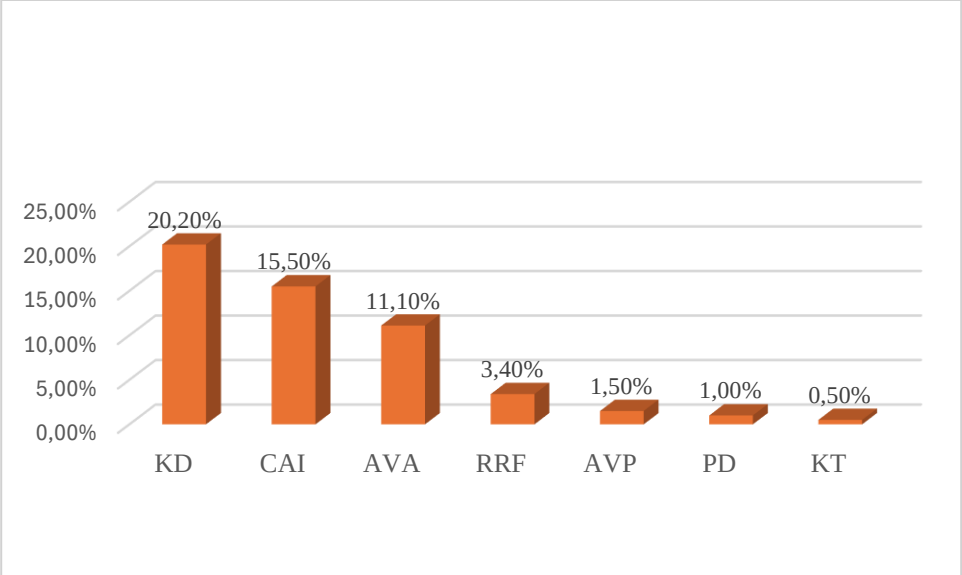


Fig. 36 Reasons for removal of tunneled catheters

That is, 45 patients were found to have a functioning catheter by the time the follow-up period ended; 75 patients had died. In 26 patients the cause of catheter removal was catheter-associated sepsis, in 6 patients catheter-associated infection necessitated catheter replacement. Transfer to peritoneal dialysis was in 2 patients. This is a form of dialysis treatment in which a special fluid (dialysate solution) is infused into the abdominal cavity, periodically drained, and replaced with a new one using a catheter.

Kidney transplantation was performed in 1 patient. During the course of their treatment, 7 patients recovered renal function. In 23 patients, after matting of constructed arteriovenous anastomosis, the tunneled catheter was removed; in 3 patients, after construction of the arteriovenous prosthesis, the catheter was also removed. In 19 patients, catheter dysfunction (CD), i.e. insufficient blood flow required to perform an effective hemodialysis procedure, was detected, for this reason, it was removed and replaced with a new one.

Kaplan-Maier survival analysis was performed to compare the groups according to the reason for catheter survival. The percentage of censored cases in the groups with functioning catheter (95.6%), deceased (98.7%), CAS (0.0%), CAI (16.7%), PD (0.0%), renal transplant (0.0%), restored renal function (0.0%), AVA (0.0%), AVP (0.0%), and CD (0.0%) was not similar.

The differences in survival between tunneled catheters were statistically significant

(H=28.653, df=9, p=0.001) (Fig. 37).

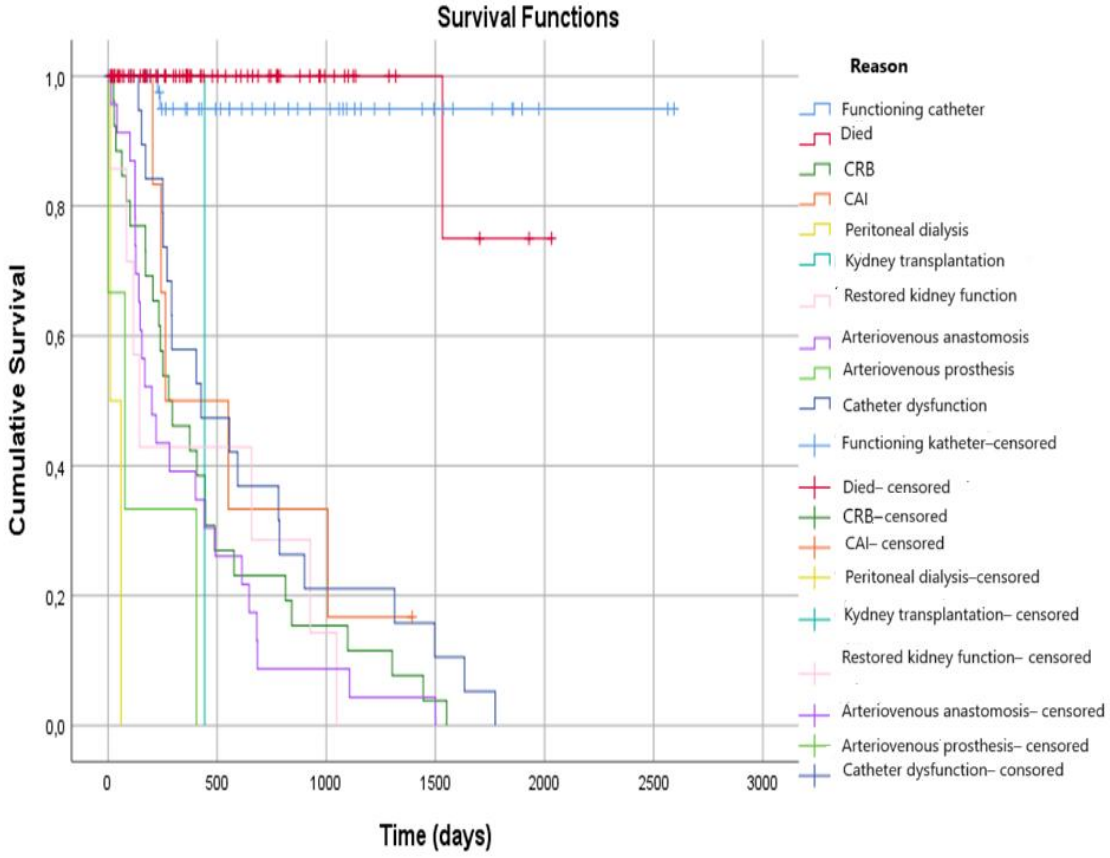


Fig. 37 Differences in the survival of tunneled catheters versus the reason for removal.

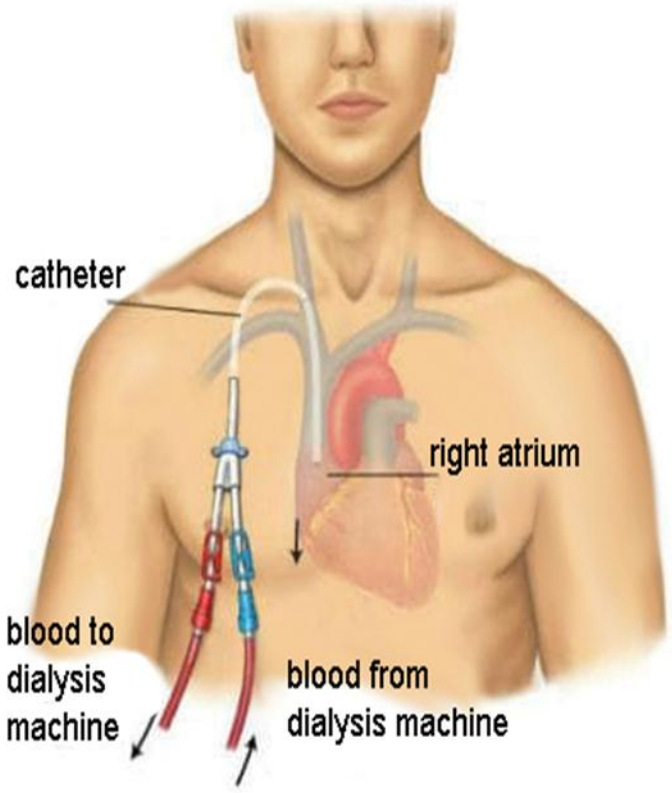
Patients who underwent PD (peritoneal dialysis) had a mean catheter survival time of 10 days and patients with AVP 78 days (95% CI 0 to 203 days). A log-rank test was performed to determine if there was a difference in the distribution of catheter survival for the different diagnoses. The survival distribution was statistically significantly different (χ^2 =225.786, df=9, p=0.000).

Guideline for patients with a tunneled catheter on hemodialysis treatment

Dear patients,

A tunneled catheter is a flexible catheter that is implanted under the skin and enters a large vein leading to your heart.

It can stay in your body for weeks, months, or years. Your doctor will remove it when he or she decides you no longer need it.



You may have pain and discomfort at the catheter exit site, check with your doctor what pain medication to take.

If complaints increase, you should let them know. Visit the hemodialysis unit without fail - if bleeding occurs from the catheter exit site and you notice that the dressing is soaked or has a bloodstain, apply pressure to the area in the meantime.

Your catheter is covered with sterile gauze and a tight-fitting dressing. It is changed at each hemodialysis procedure by a nurse.

Dressing placed in the ward after a procedure

You must keep it clean and whole until you come to the ward for your next hemodialysis session.

To keep it dry, put an extra one over your bandage that is waterproof. You can buy it from the pharmacy chain, which is affordable.

Waterproof dressing

Such can be placed in the ward immediately after the procedure is completed.

When taking a shower, make sure the water is warm, not hot, to prevent the waterproof dressing from separating from yours.

Peeled transparent waterproof bandage

This dressing has compromised integrity. This must not be allowed, it is imperative to replace it with a new one. It is necessary to visit the ward where you are having your hemodialysis treatment. A nurse there will replace it with a new one.

Do not immerse yourself in a bath, swimming pool, or the sea.

When inserting it, you should put it on so that it covers the entire dressing that is inserted into the compartment. This will keep it from getting wet.

This will prevent water from getting wet and penetrating, which can cause contamination, and this is a prerequisite for infection.

If you feel pain, irritation, swelling in the area of the catheter, or fever, contact your doctor or the department where you are having hemodialysis treatment. This may be a sign of infection.

Catheter exit site infection

Measure your blood pressure daily at the same time.

Monitor your fluid intake (should not be more than 500ml per day), check your body weight daily.

Limit your salt intake, it's a way to reduce your fluid intake!

If you notice swelling on the limbs, or have shortness of breath, you should promptly notify the dialysis unit team.

Control your general condition and keep your catheter!

This is your chance for a better quality of life with chronic kidney failure!

CONCLUSIONS, RECOMMENDATIONS AND CONTRIBUTIONS

Conclusions

1. The level of patient satisfaction with the health care provided in the HD units is high. In the semi-structured interview conducted, 26.2% of respondents were highly satisfied and 72.6% were satisfied. The overall satisfaction rate as a result of our survey was 98.8%.

2. Patients have a good self-assessment of their own awareness of the disease - 86.9% of respondents, but some need additional knowledge related to its control - 61.9%.

3. The self-monitoring found that the patients had good skills in measuring and recording important parameters of the disease, but they needed to have corrective behavior regarding them. Regarding the preservation of dressing integrity, 42.6% of recorded deviations did not take corrective measures, 20% in blood pressure deviations, and 75% in chills and fever no corrective measures were taken by respondents.

4. Hemodialysis treatment changes the daily life of patients (91.7% of respondents) and their professional and social activity- all patients have an expert decision from the territorial expert medical committees (TEMC).

5. Vascular access-associated infections are a common cause of hospitalizations - 59 in the study period - which substantially increases treatment costs and strains public health funds.

6. Nurses and physicians 100% responding to the survey are of the opinion that specific competencies for health care delivery are required for high patient satisfaction and quality of life.

7. Quality health care is a prerequisite to reduce both complications in patients and the occurrence of burnout syndrome in medical staff.

Recommendations

To the heads of the medical institutions:

- To stimulate continuing education and professional development of nurses in dialysis units.

- To optimize work organization in order to avoid burnout syndrome and staff turnover.

To the Ministry of Health and the Ministry of Education:

- To optimize the system of continuing education for nurses working in dialysis facilities

- To introduce a specialization "Dialysis nurse"

Contributions

With theoretical and cognitive character

1. An in-depth theoretical analysis of the dynamics of morbidity, mortality, and DALYs of chronic renal failure globally and nationally is performed.

2. Important aspects of patients' needs and the need to increase their skills to control their health condition are studied.

With a practical-applied character:

1. A self-monitoring diary for patients on hemodialysis treatment with a tunneled catheter was developed, tested, and implemented.

2. A Patient Guideline has been prepared regarding the care of the tunneled catheter and its general condition.

PUBLICATIONS ON THE DISSERTATION TOPIC

1. Borisov B., Vasileva V., Hemodialysis Tunneled Catheters lock with Taurolock™ versus a combination of Gentamycine and Heparin, Journal of IMAB 2023, Jul-Sep;29(3), https://doi.org/10.5272/jimab.2023293.5045

2. Vassileva V., S. Georgieva. Social significance of chronic renal failure. Fifth scientific conference of BNDH "Challenges for HH in the conditions of health crisis", 11-13.05.2022, Burgas, Black Sea Journal of Medicine and Public Health, ISSN:2738-8654, Vol. 2, 2022, 262-267.

3. Vassileva V., S. Georgieva. Health care for patients with chronic kidney disease Failure- Historical Review.Sixth Scientific Conference of BNDOH

"Public health: challenges for the health system", Proceedings, 26-27 May 2023, Pleven, pp. 168-174.

PARTICIPATION IN SCIENTIFIC FORUMS ON THE TOPIC OF THE THESIS

1. Vassileva V., S. Georgieva, E. Mineva– Dimitrova, Health Care in Hemodialysis Units - Compliance with Patients' Needs, Jubilee Scientific Conference with International Participation, "50 Years of Medical Education and Science in Pleven" 01.-03.2024.

2. Vassileva V., S. Georgieva. Social significance of chronic renal failure. Fifth Scientific Conference of BNDH "Challenges for HH in the conditions of health crisis", 11-13.05.2022, Sofia. Burgas

3. Vassileva V., S. Georgieva. Health care for patients with chronic renal failure-historical review. Sixth scientific conference of BNDH "Public health: challenges for the health system", 26-27 May 2023, Sofia. In the field of health care.