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An Overview of Dialysis Treatment and Its Outcome on Dialysis Patient: A Systematic Literature Review

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ABSTRACT

Dialysis is used to treat renal failure by eliminating harmful chemicals and waste materials that the kidneys would typically eliminate. There are two types of dialysis: hemodialysis and peritoneal dialysis. We performed this systemic literature review to provide combined information on the dialysis topic and various factors to be considered during dialysis. We conducted a literature search using Medline, Embase, and PubMed from 2000 through 2024. Specifically, we included articles that provide information on dialysis along with its relevant data parameters. 25 articles met the inclusion criteria for the study and were included for systematic analysis. Survival on synthetic membrane=1.64(95%I:1.10 to 2.45) was better in comparison to cellulose membrane=1.20(95%CI:0.73 to 1.97). Similarly, the instantaneous functional success rate on laparoscopic peritoneal dialysis (97.8%, p=0.014) was better than that of blind peritoneal dialysis. Groups with higher magnesium levels (≥2.77 mg/dl, n=254, p=0.001) compared to lower magnesium levels (<2.77 mg/dl, n=261, p=0.001) have less cardiovascular death. C-reactive protein (chi-square = 21.11, p = 0.0001) predicts cardiovascular death in hemodialysis patients. Duration of catheter 0.0001) was the most common cause of sepsis among dialysis patients, while the most common cause of peritonitis is negative staphylococcus species (11.4%). Hemodialysis technique was the most used method of dialysis in comparison to peritoneal dialysis. Monitoring of serum magnesium level, CRP level, and PTH level; anemia management; and use of different types of dialysis membrane are important factors to be considered to improve the quality of life and reduce mortality among dialysis patients.

Keywords: Hemodialysis, Peritoneal dialysis, anemia, dialysis membrane, peritonitis

INTRODUCTION

Dialysis is the technique used for eliminating waste and fluid from the circulatory system when the kidneys are incapable of doing so due to dysfunction or when poisons or toxins need to be eliminated promptly to avoid harm. Dialysis treats renal failure by eliminating harmful chemicals and waste materials that the kidneys would typically eliminate [1]. Around 2030, it is anticipated that the number will be 5.5 million dialysis patients worldwide [2]. End-stage renal disorders (ESRD) and chronic kidney disease (CKD) are connected to a greater chance of death, a higher hospitalization rate, and a lower lifespan [3]. There are two types of dialysis: Hemodialysis and peritoneal dialysis. Hemodialysis is an extracorporeal treatment where a semipermeable membrane

eliminates uremic retention products from the blood to cleanse it. Dialysis membranes were previously categorized extensively on the basis of their composition (cellulosic or non-cellulosic) and permeability of water (high flux or low flux) [4]. Peritoneal dialysis (PD) is a substitute for renal treatment that employs the peritoneal membrane as the exchange surface for eliminating water and solutes by pumping a sterile solution into the peritoneal cavity via a catheter [5]. When dialysis is started, quality of life metrics and the reduction of uremic symptoms and indicators, including anorexia, exhaustion, cognitive decline, depression, itching, and sleep difficulties, might be affected in different ways. Therefore, the decision to start dialysis should be made jointly by the nephrology team, the patient, and the family [6]. Hemodialysis is the most typical replacement treatment for end-stage renal failure in Latin America. Nevertheless, peritoneal dialysis (PD) is used in several countries for at least 30% of patients. More specifically, Mexico is the nation that uses PD the most globally [7]. The patient's clinical state and the degree and pace of decline in remaining kidney function will probably influence the choice of when to begin RRT. Dialysis is unpredictable and can have adverse reactions that are possibly fatal, yet RRT may be life-saving in some circumstances [8, 9, 10]. The term health-related quality of life (QOL) describes the assessment of a patient's overall health perception, functioning, and well-being in the three areas of physical, psychological, and social health [11]. Patients' perceptions of their quality of life (QoL) are significantly impacted by the severity of their physical and mental illnesses. At the same time, the presence of restrictions brought on by the illness or adverse dialysis therapy symptoms (such as pain, insomnia, depression, weakened blood pressure fluctuations, and stomachaches) lowers quality of life and makes the illness seem troubled [12]. The frequency of medication-related problems (MRPs) rises with the severity of CKD and medication use. A significant risk of MRPs, which might have negative consequences, is present in patients who are taking an average of 12 medications [13]. In order to prevent the expenses of medication-related issues, such as adverse drug events and hospitalizations in the ESRD population, it is imperative to provide medication reconciliation and treatment management services [14]. Anemia is a serious side effect of chronic renal failure (CRF) that needs to be cured effectively to prevent long-term consequences. Management with recombinant erythropoietin is essential for more than 90% of dialysis patients with end-stage renal disease (ESRD) [15]. Compared to the general population, dialysis patients had higher rates of coronary artery disease (CAD) and CAD-related mortality. Patients with end-stage renal disease (ESRD) are at independent risk for elevated levels of low-density lipoprotein (LDL) cholesterol [16]. Thus, pharmacists play an important role in the management of hemodialysis and improving the quality of life of patients [17]. Research published previously did not give much information about dialysis in a single paper. Thus, we performed this systemic literature review to give combined information on the dialysis topic and various factors to be considered during dialysis, which may assist in the development of reliable guidelines to be followed during dialysis.

MATERIALS & METHODS

A. Eligibility Criteria: Article describing the following characteristics was included:

- ❖ Articles describing HD or PD treatment.
- ❖ Articles with End Stage Renal Disease.
- ❖ Articles describing Dialysis at in-centre dialysis, home dialysis, Self-care dialysis or nocturnal dialysis
- ❖ Articles that have taken patients above 18 years of age.

B. Information sources and Search Strategy: A literature search was conducted by using Medline, Embase, and PubMed from 2000 through 2024. In Medline,

Embase, and PubMed, the following combinations of terms were used as our source strategies: ("Dialysis treatment" AND "Dialysis patient" AND "Factors affecting Dialysis" AND "Renal Replacement Therapy" AND "Renal insufficiency" AND "Hemodialysis" AND "Peritoneal Dialysis"). The articles' reference sections underwent extra screening to find more hits. Searches were restricted to full-text English-language research on adults (those with adults over 19).

C. Screening of studies: After looking at study titles and abstracts, we read the complete texts of those that seemed pertinent. We applied the inclusion/exclusion criteria to the remaining 339 studies. The 339 papers' titles were filtered by the primary author, and 284 research papers were not included. After separately reviewing the abstracts of the remaining 55 articles, the first and second writers eliminated 30 of them. Following an independent screening of the entire texts of the remaining 25 research papers by both authors, 25 papers were added to the literature review as they satisfied all the requirements.

D. Data collection process: The literature was searched for certain data parameters, which were then compiled into an Excel spreadsheet and evaluated. These factors included the research design, duration, and setting; the number of patients involved; the types of interventions; the relevant outcomes; the findings; and the available statistical values. Only results that provide quantitatively measurable information, such as outcome data, the quantity, or clinician acceptance rates, were included in abstracted publications.

RESULT

Study Selection: A total of 368 citations were found through the search of the Embase, Medline, and PubMed databases. In order to find other publications that our computerized search could have overlooked, we also looked through the reference lists of pertinent research. Ten more articles that met the requirements were discovered. 339 studies were left after duplicates were eliminated. After examining the titles and abstracts, it became evident that 314 of these studies did not fit the requirements; thus, they were eliminated. The remaining 25 studies' whole texts were looked at more closely. 25 papers in all satisfied all review requirements and were subsequently examined Figure 1.

Study Characteristics: All of the assessed research was published between 2000 and 2025. Egypt, Syria, Brazil, Romania, Nepal, Europe and South America, the Netherlands, China, Canada, Australia, and New Zealand were included in one research study. One study came from 9 European countries. Two studies were represented from Japan. Spain and Italy presented three studies. Four studies come from the USA, while one study was presented from France, Germany, Italy, Spain, the United Kingdom, Japan, the United States, Australia, Belgium, Canada, New Zealand, and Sweden. Our research article includes one epidemiological study [18], three retrospective studies [21, 32, 37], two cross-sectional studies [22, 23],Three prospective study[25 42], two cohort studies [26, 34], four randomized studies [28, 38, 40, 41], one meta-analysis [29], and the remaining 9 articles mentioned only observational study[19,20,24,27,30,31,33,35,36]. Eight patients were included in the smallest study [33], whereas 14,406 individuals were included in the biggest study [35]. All of the study was done on patients who were above 18 years of age and compared to peritoneal dialysis, the majority of the investigations were conducted on hemodialysis patients. Most of the studies done were observational studies and based on the establishment of relationships or associations of various parameters in dialysis patients running various parametric or nonparametric tests and comparing with p-values. A detailed overview of the study characteristics is shown in Table 1.

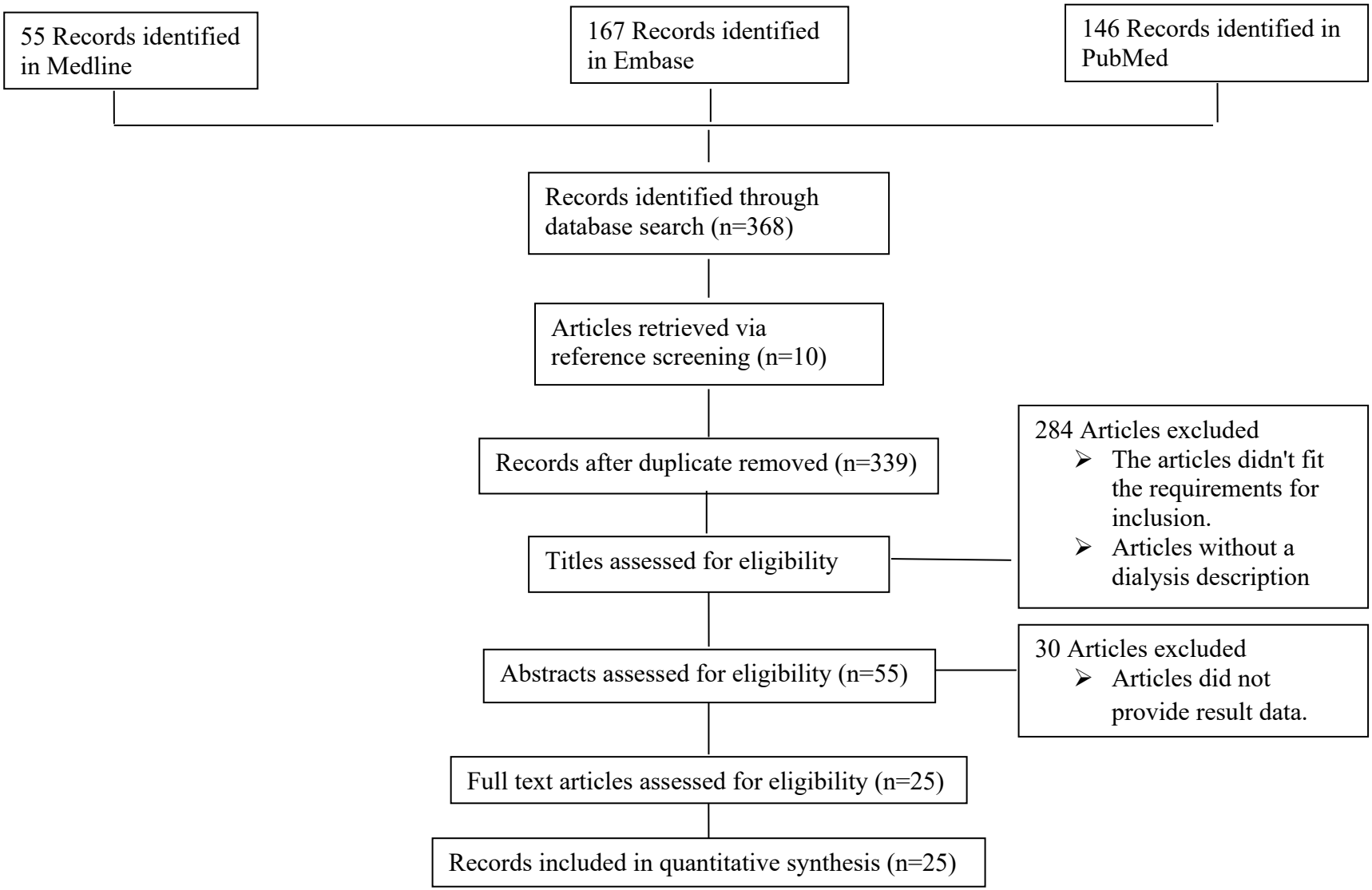

Fig 1: Process of the systematic literature review

First author, year, Reference No.	Research Design	Sample Size	Location of study	Results	Remarks
Ahmed zaran (2011) [18]	Epidemiological Study	N=514	Egypt	Mean Age=52.03±14.67, 60.3% male and 39.7% female	Hemodialysis treatment is required at older ages because of minimized kidney function or GFR.
Ghamez Moukehet et al. (2006) [19]	Observational study	N=550	Aleppo city, Syria	Incidence Rate (IR)=60 ppm and Prevalence Rate (PR)= 226 ppm	The incidence and prevalence rate of hemodialysis were 60 ppm and 226 ppm.
A.L.M. De Francisco et al. (2008) [20]	Observational Study	N=1183	Spain	High Blood pressure (75.6%), Diabetes Mellitus (32.9%), Vascular (29.0%) and Osteoarticular (27.3%)	High blood pressure was recognized as the most common comorbidity in hemodialysis patients due to the affection of the renin-aldosterone-angiotensin system.
Luis AB et al. (2009) [21]	Retrospective study	N=878	Western Parana, Brazil	Cardiovascular Diseases (34.6%)	The most common cause of mortality among hemodialysis patients was cardiovascular diseases.
Gascon et al. (2001) [22]	Cross sectional study	N=131	Huesca and Teruel, Spain	Diabetic Nephropathy (30%), Tublointerstitial Nephropathy (19%) and Chronic glomerulonephritis (16%)	The major cause of renal failure was identified as diabetic nephropathy, which focuses on controlling diabetes to prevent chronic kidney diseases.
Gasim I et al. [23]	Cross sectional study	N=353	Sudan	HBs Ag prevalence=4.5% Anti HCV prevalence=8.5%	HBs Ag and anti HCV prevalence among hemodialysis was 4.5% and 8.5%.
Rafel PG et al. (2012) [24]	Observational Study	N=7316	Spain	Mean duration =230 min and Gross mortality rate=12%	The average duration of hemodialysis was 230 min, and the gross mortality rate was 12%, which shows high mortality among hemodialysis patients.
PK chhetri et al. (2008) [25]	Prospective Study	N=100	Nepal	Blood Transfusion=88% and Erythropotein= 12%	Blood transfusion was recognized as the most popular method for the correction of anemia.
Massinopetruzzil et al. (2008) [26]	Cohort Study	N=1733	Europe and South America	Thirst symptoms present in patient =64% % of patient thirsty during day=79% % of patient thirsty during night=51% % of patients thirst influenced social life=33%	Hemodialysis results in thirst, and they reported that it has influenced their social life.
Angel L.M.F. et al. (2006) [27]	Observational Study	N=8963	9 European countries	% of renal transplantation=5%	Renal transplants were performed on 5% of patients.
Johanna C. Korevaar et al. (2003) [28]	Randomized Control trial	N=38	Netherland	Mean QALY for HD=59.1 (SD=12) Mean QALY for PD=54.0 (SD=19)	A little variation in QALY scores was noted across patients, favoring those receiving hemodialysis.

Sanjay Subramanian et al. (2002) [29]	Meta Analysis	N=867		Survival of synthetic membrane=1.64(95% CI:1.10 to 2.45) Survival of Cellulose membrane=1.20(95% CI:0.73 to 1.97)	Compared to cellulose-based membranes, synthetic membranes seem to offer a notable survival benefit.
Ishimura E. et al. (2007) [30]	Observational Study	N=515	Osaka, Japan	Mortality in lower magnesium group =< 2.77 mg/dL, i.e. < 1.14 mmol/L, n = 261 (p < 0.001) Mortality in higher magnesium group =≥ 2.77 mg/dL, n = 254 (p < 0.001)	Hemodialysis patients' mortality, particularly non-cardiovascular death, is significantly predicted by decreased serum magnesium levels.
Diskin CJ et al. (2007) [31]	Observational Study	N=559	Alabama State, USA	Duration of catheter use=p<0.0001 Intravenous Iron=p<0.01 Mid treatment bolus of Heparin=p<0.046 Depressed serum albumin=p<0.001	Researchers found three important sepsis risk variables, along with the length of catheter usage. The formation of biofilm has been associated with intravenous iron and heparin bolus administration.
Gajjar A.H. et al. (2007) [32]	Retropropsective study	N=75	USA	L-PDCS functional success =97.8% (p=0.014) B-PDCS Placement success=80% (p=0.014)	Comparing Laparoscopic Peritoneal Dialysis (L-PDCS) to Blind Peritoneal Dialysis (B-PDC) implantation, the former provided instantaneous functional success.
Raj DS et al. (2007) [33]	Observational Study	N=8	USA	% of apoptosis after hemodialysis =33.4±7.1%, p<0.01 % of apoptosis before hemodialysis=237±7.7%, p<0.01	Increased peripheral blood mononuclear cell (PBMC) apoptosis results from the production of reactive oxygen species (ROS) caused by intra-dialytic activation of cytokines and compromised mitochondrial activity.
Coen G. et al. (2007) [34]	Cohort Study	N=197	Italy	PTH levels before and after hemodialysis in four groups: (A) 0-150 vs 624.7 ±939 (B)150-300 vs 866.4 ±1080 (C)300- 600 vs 1202.8 ± 1742.3 (D)>600 vs 1872.7 ± 2961.9	Higher PTH levels after dialysis were linked to more cases of hypercalcemia and hyperphosphatemia due to the weakened ability of bones to manage these minerals in poor turnover osteodystrophy.
Lopes AA et al. (2007) [35]	Observational Study	N=14406	France, Germany, Italy, Spain, the United Kingdom, Japan, the United States, Australia, Belgium, Canada, New Zealand, and Sweden	Relative Risk of Death among loss of appetite patient=2.23, 1.90-2.62 Relative Risk of Hospitalization among loss of appetite patient= 1.33, 1.19-1.48	Hemodialysis patients with worse nutritional status, inflammation, depression, and increased risks of hospitalization and mortality can be identified by their lack of appetite.
Szeto CC et al. (2008) [36]	Observational Study	N=1359	China	% of peritonitis caused by negative staphylococcus species=11.4% (232/2037	One of the most frequent causes of peritonitis was found to be negative

				episode)	staphylococcus species.
Holden RM et al. (2008) [37]	Retrospective study	N=255	Canada	Hazard ratio for aspirin= 5.24 (p=0.005) Hazard ratio for warfarin= 3059(p=0.061) Hazard ratio for aspirin and warfarin combination= 6.19(p=0.008)	Aspirin and warfarin considerably raise the risk of severe bleeding events in hemodialysis patients; however, warfarin by itself did not achieve statistical significance.
Lugivernaglione et al. (2004) [38]	Randomized controlled trial	N=33	Italy	Serum CRP level with atorvastatin=5mg/l Serum CRP level with placebo=7mg/l	Usually provided to patients on long-term HD treatment, atorvastatin is safe and causes a substantial drop in blood CRP levels, which raises serum albumin levels.
Jane Y. Yeah et al. (2000) [39]	Prospective Study	N=91	USA	C Reactive Protein (Chi square= 21.11 p=<0.0001)	C-Reactive Protein Forecasts Cardiovascular and All-Cause Death in Hemodialysis Patients
Francesco Locatelli et al. (2000) [40]	Randomized controlled trial	N=84	Italy	Hemoglobin levels increased in high flux biocompatiable membrane=9.5±0.8g/dl(p=0.069) Hemoglobin levels increased in standard membrane=9.8±1.3g/dl(p=0.069)	According to this study, individuals treated with high-flux biocompatible membranes and those treated with standard membranes did not significantly vary in their elevated hemoglobin levels.
Bruce A. Cooper et al. (2010) [41]	Randomized study	N=828	Australia and Newzealand	% of patients died in early start group=37.6% % of patients died in late start group=36.6% Hazard ratio with early vs late initiation= 1.04(95%CI;0.83-1.30, p=0.75)	Clinical results did not show an improvement in survival when dialysis was started early in individuals with stage V chronic renal disease.
Hiroshi Nishi et al. (2023) [42]	Prospective Cohort	N=3063	Japan	Hazard ratio of hemoglobin variability of (Q4/Q1) group=1.44(95%CI :0.99-2.08, p=0.056)	Groups with higher hemoglobin variables are likely to have higher rates of all causes of death.

Table 1: Detailed Description of the Study

Synthesis of outcomes: An epidemiological study on hemodialysis patients conducted by Ahmed Zaran in 2011 among 514 patients in the Menofia Governorate, Delta region, Egypt, shows the mean age was 52.03±14.67, 60.3% were male, and 39.7% were female [18].

Another study done by Ghamez Moukenet et al. Among 550 hemodialysis patients in 2006 in Aleppo City, Syria, the incidence rate (IR) was 60 ppm and the prevalence rate (PR) was 226 ppm [19]. A. L. M. de Francisco et al. (2008) did an epidemiological investigation on 1183 elderly chronic renal failure hemodialysis patients in Spain that demonstrates that high blood pressure (75.6%), diabetes mellitus (32.9%), vascular disease (29.0%), and osteoarticular disease (27.3%) are commonly occurring comorbidities among hemodialysis patients [20].

An epidemiological investigation of end-stage renal disease in western Paraná—an experience of 878 patients over 25 years—was carried out by Luis A. B. et al. (2009). Cardiovascular diseases (34.6%) were the most common cause of mortality among hemodialysis patients [21].

A cross-sectional research study was carried out by Gascón et al. (2001) to assess the medical outcomes and treatment circumstances among 131 common hemodialysis patients collected from five hemodialysis units in Huesca and Teruel, Spain demonstrates that diabetic nephropathy (30%), tubulointerstitial nephropathy (19%), and chronic glomerulonephritis (16%) were identified as major renal failure causes [22].

Between February and June 2010, a cross-sectional study was carried out at the Ahmed Gasim Hospital's haemodialysis unit in Khartoum North. Enrolment was open to all 353 individuals who received haemodialysis for end-stage renal illness during the trial period. It shows HBs Ag and anti HCV prevalence was 4.5% and 8.5% [23].

Using information from the EuCliD® database, Rafael P. G. et al. (2010) carried out epidemiological research on 7316 hemodialysis patients treated at FME clinics in Spain: findings from the years 2009-2010. Observational studies were conducted between 2009 and 2010 on patients receiving hemodialysis (HD) at FMC® Spain centers. In order to enhance patients' prognosis and quality of life, it seeks to comprehend patient features and treatment patterns by contrasting them with those of other studies reported in the literature. This study observed that Mean duration was 230 min and gross mortality rate was 12% among hemodialysis patients [24].

In order to determine the epidemiological profile and etiology of CKD 5 patients undergoing hemodialysis (HD) at Nepal Medical College Teaching Hospital, PK Chhetri et al. (2008) carried out research named chronic kidney disease on Hemodialysis at Nepal Medical College Teaching Hospital. This prospective research was conducted over the course of a year in the HD unit. CKD Stage V patients with a GFR of less than 15 ml/min/1.73 m^2 under HD were included in the research, for a total of 100 patients. It indicates that 88.0% of patients had their anemia corrected by blood transfusions, whereas 12.0% got erythropoietin treatment [25].

Prospective cohort research on thirst and oral symptoms in hemodialysis patients was carried out by Massimo Petruzzi et al. (2008). This comprehensive assessment examines the frequency of any oral complaints in hemodialysis patients. It is conceivable that receiving hemodialysis might enhance the occurrence of mouth dryness. The 30 participating clinics' 1733 hemodialysis patients were chosen at random from a cooperative dialysis network spanning Europe and South America. It demonstrates that thirst symptoms were present in 64% of patients, the percentage of patients thirsty during the day was 79%, the percentage of patients thirsty during the night was 51%, and the percentage of patients whose thirst influenced social life was 33% [26].

An epidemiological study of hemodialysis patients based on the European Fresenius Medical Care Hemodialysis Network: Results of the ARO The study was carried out by Angel L.M.F. et al. in 2006. In order to improve patient outcomes, ARO, an observational study of hemodialysis (HD) patients in Europe, attempts to deepen our knowledge of patient characteristics and practice patterns. 134 Fresenius Medical Care institutions treated 8,963 HD patients between 2005 and 2006; these patients were chosen at random from nine European nations (Czech Republic, France, Hungary, Italy, Poland, Portugal, Spain, Slovak Republic, and Slovenia) as well as Turkey. Demographics, medicines, comorbidities, laboratory and dialysis parameters, and results were all recorded. The average duration of patient follow-up was 1.4 years, with a standard deviation of 0.7 years. In research results, 5% of the patients underwent renal transplantation [27].

In 2003, Johanna C. Korevaar et al. carried out a randomized controlled experiment to compare the results of hemodialysis as the first chronic dialysis treatment with those of peritoneal dialysis. Participation was open to all 38 new dialysis patients from dialysis facilities in the Netherlands who had no contraindications to either modality. Hemodialysis or peritoneal dialysis was the initial treatment option for the patients. The mean quality-adjusted life year (QALY) score was the main result. It shows the mean QALY for HD to be 59.1 (SD = 12) and the mean QALY for PD to be 54.0 (SD = 19) [28].

A meta-analysis was conducted by Sanjay Subramanian et al. in 2002 to ascertain if a more accurate assessment of the impact of membrane composition on Acute Renal Failure survival could be obtained by aggregating the findings of all published studies. A meta-analysis of ten prospective studies was conducted to ascertain the impact of synthetic vs. cellulose-based membranes on the results of patients receiving dialysis for ARF. Using the Mantel-Haenszel test based on fixed effects, the meta-analysis of the data was carried out. It illustrates that survival of the synthetic membrane was4 (95% CI: 1.10 to 2.45) and survival of the cellulose membrane was0 (95% CI: 0.73 to 1.97) [29].

A study by Ishimura E. et al. examined the relationship between magnesium and end-stage renal disease co-morbidity and mortality. We examined the mortality prognostic significance of blood magnesium concentration in 515 patients receiving maintenance hemodialysis at the Shirasagi Hospital Kidney Center in Osaka, Japan (60 ± 12 years, 306 males and 209 females, 24% diabetics). After 51 ± 17 (mean ± SD) months of follow-up, the association between the baseline magnesium concentration (mean of four months) and outcomes was statistically examined. It shows mortality in the lower magnesium group was < 2.77 mg/dL, i.e., < 1.14 mmol/L, n = 261 ($p < 0.001$), and mortality in the higher magnesium group was ≥ 2.77 mg/dL, n = 254 ($p < 0.001$) [30].

In order to determine if intravenous iron and heparin are to blame for the development of biofilm in Eastern Alabama, USA, Diskin CJ et al. conducted observational research. Both are often used during hemodialysis treatments, which may have an impact on the prevalence of sepsis associated with catheter use. A review of 559 individuals who had catheter-assisted hemodialysis was conducted. The use of intravenous iron and systemic heparin, along with all other sepsis risk factors, was examined in sepsis episodes. It demonstrates that the duration of catheter use was $p<0.0001$, intravenous iron was $p<0.01$, mid-treatment bolus of heparin was $p<0.046$, and depressed serum albumin was $p<0.001$ were responsible for the sepsis [31].

In 2007, Gajjar A.H. et al. carried out a retrospective analysis to compare the results of patients whose placement was carried out using the laparoscopic approach (L-PDC) to the conventional "blind" technique (B-PDC). Three tertiary medical center hospitals in the United States that have

affiliations with universities had their records reviewed retrospectively. Results were compared after reviewing data for PDCs put in using the B-PDC (n=30) or L-PDC (n=45) techniques. It determines that L-PDCS functional success was 97.8% (p=0.14) and B-PDCS placement success was 80% (p=0.14) [32].

In an observational research, Raj DS et al. tested the theory that mitochondrial function is hampered by intradialytic activation of cytokines and nuclear factor-κB (NF-κB), which results in the production of reactive oxygen species (ROS) and apoptosis. Eight patients with end-stage renal disease (ESRD) had peripheral blood mononuclear cells (PBMC) extracted from them both prior to hemodialysis (Pre-HD) and during the final ten minutes of HD (End-HD). Dialysis was performed using a brand-new polysulfone membrane (F70, Fresenius). Using flow cytometry, the intracellular production of reactive oxygen species (ROS), mitochondrial redox potential (Deltapsim), and PBMC apoptosis were identified. It indicates that the % of apoptosis after hemodialysis was 33.4±7.1% and p<0.01% of apoptosis before hemodialysis was 237±7.7%, p<0.01[33].

To assess the relationship between parathyroid hormone (PTH) blood levels and coronary calcifications, Coen G. et al. carried out cohort research in Rome. A cohort of 197 hemodialysis patients (133 men and 64 women) participated in the research. The PTH levels of the patients were separated into four groups: 0-150 (A), 150-300 (B), 300-600 (C), and >600 (D) pg/mL. It illustrates that PTH levels before and after hemodialysis in four groups were (A) 0-150 vs. 624.7 ± 939, (B) 150-300 vs. 866.4 ± 1080, (C) 300-600 vs. 1202.8 ± 1742.3, and (D) >600 vs. 1872.7 ± 2961.9 [34].

Data from 340 dialysis centers on 14,406 hemodialysis patients from France, Germany, Italy, Spain, the United Kingdom, Japan, the United States, Australia, Belgium, Canada, New Zealand, and Sweden were used in observational research by Lopes A.A. et al. Its goal was to ascertain how appetite affected hospitalization and death rates for hemodialysis patients. The degree to which patients' lack of appetite upset them (not at all, somewhat, considerably, very much, or excessively) was evaluated using Cox regression to see if it was an independent predictor of hospitalization and mortality. For discovering baseline traits linked to being troubled by a lack of appetite, logistic regression was employed. This study shows that the relative risk of death among loss of appetite patients was 2.23, 1.90-2.62, and the relative risk of hospitalization among loss of appetite patient was 1.33, 1.19-1.48 [35].

Observational research was carried out by Szeto CC et al. to ascertain the cause of peritonitis by coagulase-negative Staphylococcus species. We examined every case of peritonitis that occurred in a dialysis facility between 1995 and 2006. A total of 2037 occurrences of peritonitis were documented throughout this time. It observed that the percentage of peritonitis caused by negative staphylococcus species 11.4% (232/2037 episodes) [36].

Holden RM et al. carried out a retrospective analysis to ascertain how exposure to antiplatelet agents and warfarin contributed to the occurrence of the first significant bleeding events in hemodialysis patients. Retrospective chart reviews of eligible hemodialysis patients were conducted. The number of initial significant bleeding episodes divided by the total exposure duration for each treatment combination was used to calculate the incidence rates. The risk of experiencing a significant bleeding episode for the first time was calculated. It shows the hazard ratio for aspirin was 5.24 (p=0.005), the hazard ratio for warfarin was9 (p=0.061), and the hazard ratio for the aspirin and warfarin combination was 6.19 (p=0.008) [37].

Six-month randomized controlled research was established by Lugi Vernagilone et al. to ascertain the impact of atorvastatin on serum C-reactive protein levels. Patients on

long-term hemodialysis who had been receiving HD treatment for at least six months were included. Following randomization, 16 patients received atorvastatin (10 mg/d orally) in group A, whereas 17 patients received a placebo in group B. Hemoglobin, serum CRP, albumin, creatinine, lipids, enzymes, body mass index, normalized protein catabolic rate, and mean blood pressure were measured at baseline and six months later. It indicates that the serum CRP level with atorvastatin was mg/L and the serum CRP level with placebo was mg/L [38].

A prospective research study was conducted by Jane Y. Yarah et al. to ascertain the relationship between cardiovascular diseases and serum C-reactive protein. In October 1995, we took albumin and CRP readings from 91 HD patients. The frequency and cause of mortality were ascertained throughout a 34-month follow-up period. Researchers used serum albumin values (<3.5 [lowest quartile], 3.5 to 3.8, 3.9 to 4.0, and >4.0 g/dL [highest quartile]) to categorize the patients into four groups. The Cox proportional hazards model multivariate analysis revealed that the only factor that predicted mortality was CRP level (chi-square 21.11; P=< 0.0001) [39].

A randomized controlled experiment was carried out by Francesco Locatelli et al. to ascertain the impact of high-flux dialysis on the management of anemia. 84 hemodialysis patients who attended 13 dialysis centers had a 12-week follow-up. High-flux biocompatible membranes were used to treat 42 randomly chosen patients, whereas standard or conventional membranes were used for the remaining 42 patients. It shows hemoglobin levels increased in the high-flux biocompatible membrane to 9.5±0.8 g/dL (p=0.069), and hemoglobin levels increased in the standard membrane to 9.8±1.3 g/dL (p=0.069) [40].

Bruce A. Cooper et al. carried out a randomized trial to ascertain the impact of early vs. late dialysis beginning on patient survival. We chose at random 828 individuals with progressive chronic renal disease whose estimated glomerular filtration rate (GFR) ranged from 10.0 to 15.0 milliliters per minute per 1.73 square meters of body surface area (determined using the Cockcroft–Gault equation) to anticipate dialysis start-up. When the predicted GFR was between 10.0 and 14.0 milliliters per minute (early start) or between 5.0 and 7.0 milliliters per minute (late start). Any cause of death was the main result. It indicates that the percentage of patients who died in the early start group was 37.6%, the percentage of patients who died in the late start group was 36.6%, and the hazard ratio with early vs. late initiation= 0.83-1.30, p = 0.75) [41].

Using Cox regression models, Hiroshi Nishi et al. performed a prospective cohort analysis using data from 3063 hemodialysis patients from the Japanese Dialysis Outcomes and Practice Patterns analysis (J DOPPS) from 2012 to 2018 to ascertain the association between hemoglobin variability and mortality rate. Based on hemoglobin variability, patients were categorized into four quartiles: Q1<1.2, Q2 (1.2-1.7), Q3 (1.8-2.5), and Q4>2.6. The hazard ratio of hemoglobin variability for the (Q4/Q1) group is 1.44 (95% CI: 0.99-2.08, p=0.056) over a median follow-up period of 2.5 years [42].

DISCUSSION

We conducted a systematic review on the dialysis treatment, factors influencing dialysis treatment and their outcomes, and demographic characteristics of dialysis patients utilizing various articles: Prospective Study, Randomized Controlled Trial, Retrospective Study, Meta-Analysis, and Observational Study. The majority of patients with end-stage renal disease are over 50 and receiving dialysis treatment. As people age, hemodialysis becomes necessary due to decreased kidney function, or GFR [18]. The rising prevalence of end-stage renal illnesses is driving the demand for hemodialysis treatment in the current environment. 60 ppm and 226 ppm, respectively, were the incidence and

prevalence rates of hemodialysate [19]. Patients receiving dialysis are more vulnerable to the effects of certain illnesses since the kidneys regulate certain metabolic processes. The problems with the renin-aldosterone-angiotensin system have made it clear that high blood pressure is the most common additional health issue for patients on hemodialysis [20]. Dialysis patients die at a higher rate than those with other illnesses because of imbalances in blood purification and changes in metabolic processes. Cardiovascular diseases were the most frequent cause of death for hemodialysis patients [21]. End-stage renal disorders are thought to be caused by changes in kidney function brought on by a number of non-communicable illnesses. Diabetic nephropathy, which focuses on managing diabetes to prevent chronic kidney disorders, was found to be a major cause of renal failure [22]. It is observed that HCV and HBV were mostly prevalent among dialysis patients. Female sex and rural areas were risk factors for HCV and HBV prevalence [23]. Dialysis patients must get therapy for a few hours in order to consistently obtain the necessary level of blood purification. The gross death rate was 12%, and the average hemodialysis duration was 230 minutes, indicating a significant mortality rate among hemodialysis patients [24]. End-stage kidney disease patients typically have anemia because the kidneys generate the hormone erythropoietin (EPO), which instructs the bone marrow to create red blood cells. The most widely used technique for treating anemia was blood transfusion [25]. Most hemodialysis patients experience thirst, which has been stated to have an impact on their social lives [26]. Many dialysis patients have kidney transplants as a result of their dialysis treatment's ineffectiveness or impairment of their quality of life. Five percent of patients had renal transplants [27]. Dialysis patients have experienced several issues that directly affect their quality of life, such as anorexia, thirst, sleeplessness, dry mouth, etc. There was a little variance in QALY values between patients, with hemodialysis patients scoring higher [28]. Dialysis membrane usage affects dialysis patient quality and symptoms, which in turn affects the patients' long-term survival rate. It appears that synthetic membranes provide a significant survival advantage over cellulose-based membranes [29]. Dialysis patient mortality is more significantly impacted by the magnesium level of the patient. For the benefit of the patient receiving dialysis, the magnesium level must be maintained. The mortality of hemodialysis patients, especially non-cardiovascular death, is substantially predicted by lower serum magnesium levels [30]. Patients with kidney disease who are receiving hemodialysis may develop sepsis. Three significant sepsis risk factors such as intravenous iron, heparin, and serum albumin were discovered in addition to the duration of catheter use. Heparin and intravenous iron boluses have been connected to the production of biofilms [31]. Likewise, the use of the peritoneal dialysis technique to dialyze patients affects their functional success, which is a factor in their safety and recuperation. When comparing the implantation of Laparoscopic Peritoneal Dialysis (L-PDCS) with Blind Peritoneal Dialysis (B-PDC), the former offered immediate functional success [32]. During dialysis, patients undergo apoptosis due to increased peripheral blood mononuclear cell (PBMC) apoptosis resulting from the production of reactive oxygen species (ROS) caused by intra-dialytic activation of cytokines and compromised mitochondrial activity [33]. It is found that increased PTH levels after dialysis were associated with more frequent hypercalcemia and hyperphosphatemia because of poor turnover osteodystrophy's reduced bone buffering ability. Preference should be given to maintaining PTH level [34]. Hemodialysis patients often undergo a lack of appetite, which helps to predict various upcoming risk factors in the future. Hemodialysis patients with worse nutritional status, inflammation, depression,

and increased risks of hospitalization and mortality can be identified by their lack of appetite [35]. During peritoneal dialysis, patients often undergo peritonitis due to the exposure to various gram-negative bacteria. One of the most frequent causes of peritonitis was found to be negative staphylococcus species [36]. Patients were often given anticoagulant agents such as aspirin, warfarin, or a combination of aspirin and warfarin during hemodialysis, which increases the risk of bleeding among hemodialysis patients. Aspirin and/or warfarin considerably raise the risk of severe bleeding events in hemodialysis patients; however, warfarin by itself did not achieve statistical significance [37]. One of the major problems in dialysis patients is the increase in serum CRP level on long-term use of medicines, which causes various cardiovascular-related problems. Usually provided to patients on long-term HD treatment, atorvastatin is safe and causes a substantial drop in blood CRP levels, which raises serum albumin levels [38]. One notable factor is the increase in the C-reactive protein during dialysis, which has been recognized as the major problem in dialysis. C-Reactive Protein Forecasts Cardiovascular and All-Cause Death in Hemodialysis Patients [39]. Another notable factor is variation in the hemoglobin levels during dialysis by the use of different dialysis membranes. According to this study, individuals treated with high-flux biocompatible membranes and those treated with standard membranes did not significantly vary in their elevated hemoglobin levels [40]. Another debating factor is early start to dialysis increases the survival days of the patient in comparison to the late-start group. A randomized clinical study's results did not show an improvement in survival when dialysis was started early in individuals with stage V chronic renal disease in comparison to the late-start group [41]. Variation in the hemoglobin level in dialysis patients is an important factor that predicts early death or increases the chances of death in dialysis patients. A prospective study shows groups with higher hemoglobin variables are likely to have higher rates of all causes of death [42].

CONCLUSION

Hemodialysis technique was the most used method of dialysis in comparison to peritoneal dialysis. Monitoring of serum magnesium level, CRP level, and PTH level; anemia management; use of different types of dialysis membrane; management of sepsis developed from catheter; intravenous iron and heparin; peritoneal dialysis implantation technique; and management of peritonitis and bleeding in dialysis patients are important factors to be considered to improve the quality of life and reduce mortality among dialysis patients. The goal of this review research is to prevent more complications from dialysis by developing new dialysis plans and policies.

Declaration by Authors

Ethical Approval: There was no need for ethical approval because no new patients were enrolled. The study's sole source of data was already published; it was a systematic literature review.

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