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Early vs Late Referrals to Nephrology and its Effect on Patient Outcomes in End-Stage Renal Disease (ESRD) Patients Who Are on Renal Replacement Therapy (RRT) a Retrospective Chart Review

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Early vs Late Referrals to Nephrology and its Effect on Patient Outcomes in End-Stage

Renal Disease (ESRD) Patients Who Are on Renal Replacement Therapy (RRT) a

Retrospective Chart Review

Tricia Brown, BSN, MSN, RN, FNP-C
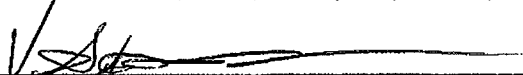
Department of Nursing, Otterbein University

2023
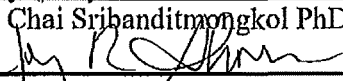
In Partial Fulfillment of the Requirements for the Degree

Doctor of Nursing Practice

DNP Final Scholarly Project Team:

_____
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Executive Summary

End-stage renal disease may greatly affect a patient's overall health and outcomes. This project aimed to look at early versus late nephrology referrals. A retrospective chart review of patient's demographic and health outcome data was reviewed through a patient's electronic health record. The patient data from the chart review, along with the evidence obtained from the review of the literature has been utilized to describe findings and develop evidence-based practice-guided recommendations for nephrology referrals in clinical practice. This project has been completed at a dialysis center in rural Ohio. The patient population included around 60 patients who had dialysis at the clinic within the past year. Excluding patients with a genetic or an acute kidney disease. This project has taken place from August 2022 to March 2023. The model of the project was a retrospective quantitative chart review. The patient's charts were reviewed looking for demographic information, stage of chronic kidney disease at initial contact with a nephrologist and lab values. Information was then collected on time to start dialysis, fistula placement, lab values including, potassium, phosphorous, hemoglobin, blood urea nitrogen, mortality, and hypertensive control. The information was organized in a data collection sheet. The information was then organized into an excel spreadsheet which was password protected to keep information private. Barriers to this project included missing medical history from electronic health records (EHR), patient compliance with treatment plans and available patient population. The data collected showed a clear correlation between earlier nephrology referrals and improved patient outcomes. Improved outcomes included blood pressure control, decrease in potassium levels, decrease in time prior to having to start HD. Given the evidence presented patients should be referred to a nephrologist when a patient is approaching a stage 3a. Providers should be referring

patients earlier prior to a significant decrease in kidney function. This project will improve

clinical practice, health, and the life expectancy of patients with ESRD.

Keywords: nephrology, end stage renal disease, chronic kidney disease, referrals

Early vs late referrals to nephrology and its effect on patient outcomes in end-stage renal disease (ESRD) patients who are on renal replacement therapy (RRT) a retrospective chart review.

Background

The kidneys are organs in the body that filter out toxins and help eliminate extra fluid. Chronic kidney disease (CKD) occurs when the kidneys cannot keep up with the demands of the body (CDC, 2021). Toxins and fluid then build up in the body causing diseases such as hypertension, heart disease, stroke, and early death (CDC, 2021). CKD is a growing problem in the United States (Pal et al., 2020). One in seven or 15% of adults in the United States is estimated to have CKD (CDC, 2021). Some patients do not realize they have CKD. Two in five adults with severe CKD do not know they have a CKD diagnosis (CDC, 2021). Patients are often undereducated about their disease which can cause further harm to their kidneys. The general problem is that patients are not receiving treatment for their kidneys until they are facing dialysis. This project evaluated the effects of early vs late nephrology referrals on mortality and patient outcomes in patients who are on renal replacement therapy.

Early signs and symptoms of CKD are not obvious or apparent at the beginning of the disease progression. Pal et al. (2020) states that "CKD is often symptom-free in its early stages and is often missed. However, if detected early and managed appropriately, the rate of deterioration in kidney function can be reduced by as much as 50% and may even be reversible" (p. 3812). Patients do not start to typically develop symptoms until later in their disease process. Given that patients do not develop symptoms until around stage 5 primary care physicians should be vigilant in screening and monitoring their patients for CKD. Pal et al. (2020) states that "Primary care and family physicians act as a bridge between the nephrologist specialist and the

CKD patients" (p. 3813). Bridging the gap between nephrology and primary care physicians could help improve patient outcomes and reduce the number of patients needing dialysis.

CKD can have a large effect on the health of an individual overall. Risk factors for CKD include diabetes mellitus, hypertension, obesity, family history, past kidney damage, and age (CDC, 2021). Many primary care patients suffer from at least one of the risk factors listed above. Patients have a higher risk for developing CKD when patient have uncontrolled hypertension or uncontrolled diabetes. Many commonly prescribed medications for these diseases can have a large impact on kidney function (Peralta & Estrella, 2017). Optimizing early nephrology consults of high-risk patients could help prevent the progression from CKD to dialysis.

The general problem is that patients are being screened for CKD and referred later in the disease process. The U.S. Preventative Services Taskforce in 2012 placed screening for chronic kidney disease as inactive and does not give recommendations for screening of CKD. The taskforce recommends that providers consult other sources for current evidence on this topic (USPSTF, 2012). The most commonly recommended source is KDIGO (Kidney Disease, Improving Global Outcomes). KDIGO is a global nonprofit organization developing and implementing evidence-based clinical practice guidelines in kidney disease (KDIGO, 2013). KDIGO recommends referral of patients to nephrology with a GFR of less than 30ml/min, acute kidney injury or abrupt fall in GRF, or a consistent finding of albuminuria (KDIGO, 2013). When patients reach one or more of these qualifications, they are suggested to be referred to nephrology.

KDIGO places patients into 5 stages of CKD. The 5 stages are dependent on a patient's eGFR (estimated glomerular filtration rate) and urine albumin-creatinine ratio (ACR) (NKF, 2022). See figure 1 below to see the current chronic kidney disease nomenclature. Once a

patient's eGFR drops below 30ml/min that places them in stage 4 (KDIGO, 2013). Stage 4 is the

current recommended guideline for referral. Once patients enter a stage 5 they are becoming very

close to starting dialysis. Patients that are referred later in their disease have been shown to have

poor outcomes. This has been proven by the literature review and this project.

Figure 1

Current Chronic Kidney Disease Nomenclature

© 2013 KDIGO

CURRENT CHRONIC KIDNEY DISEASE (CKD) NOMENCLATURE USED BY KDIGO

CKD is <u>defined</u> as abnormalities of kidney structure or function, present for >3 months, with implications for health and CKD is <u>classified</u> based on cause, GFR category, and albuminuria category (CGA).

Prognosis of CKD by GFR and albuminuria category

				Persistent albuminuria categories Description and range		
				A1	A2	A3
Prognosis of CKD by GFR and Albuminuria Categories: KDIGO 2012				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30-300 mg/g 3-30 mg/mmol	>300 mg/g >30 mg/mmol
GFR categories (ml/min/ 1.73 m²) Description and range	G1	Normal or high	≥90	Green	Yellow	Orange
	G2	Mildly decreased	60-89	Green	Yellow	Orange
	G3a	Mildly to moderately decreased	45-59	Yellow	Orange	Red
	G3b	Moderately to severely decreased	30-44	Orange	Red	Red
	G4	Severely decreased	15-29	Red	Red	Red
	G5	Kidney failure	<15	Red	Red	Red

Green: low risk (if no other markers of kidney disease, no CKD); Yellow: moderately increased risk; Orange: high risk; Red, very high risk.

Significance to the Profession

Chronic kidney disease has a significant impact on patients and the healthcare system in the

United States. CKD affects more than 37 million adults in the United States (CDC, 2021). Many

patients do not realize that they have a decrease in kidney function. 40% of people with severely

reduced kidney function are not aware of having CKD. (CDC, 2021). In the US, every 3 out of 4 cases of CKD are caused by diabetes and hypertension (CDC, 2021). Developing evidence-based practice guidelines could change the everyday practice of many providers. Patients could receive proper early education on CKD and their risk factors. This could lead to a decrease in hospital admissions. In turn could help reduce the load on nurses within the hospitals. The goal of this project is to improve patient outcomes and perhaps prevent or slow patients from progressing into end-stage renal failure.

Chronic kidney disease has a high financial burden on patients and communities. Medicare spends more than 87 billion per year on CKD treatment (CDC, 2021). Early detection could help reduce costs and improve patient outcomes. CKD admissions are associated with higher costs and longer hospital stays (Pollock et al, 2022). As CKD progresses the economic burden also increases (Pollock et al, 2022). Patients with CKD that are admitted to the hospital cost more on average than a typical admission to the same floor (Pollock et al, 2022). In addition to the already high cost of CKD once patients reach end stage renal disease their cost increases exponentially. The United States spends $30 Billion annually in Medicare funding for end-stage renal disease (Peralta & Estrella, 2017). This project could help decrease the economic burden of CKD and ESRD patients.

Literature Review

The goal of this literature review was to analyze studies that discuss nephrology referrals and patient outcomes. This literature review was used to look at clinical studies that helped guide and develop this project. Eight peer reviewed articles were used in this literature review. All studies that were reviewed were of adults 18 and older. All the studies were retrospective chart

reviews. The studies were all performed after the treatment of patients had already occurred.

Looking at past data can cause some inconsistent variables where the data was missing. All the

articles were peer-reviewed and stated that they did not receive any compensation for their

research. None of the articles stated a conflict of interest.

The studies reviewed had variable limitations. A common limitation of the studies was

that almost all the studies were focused on one geographic area or clinic. The studies were

almost all patients of similar race or geographic location, and little diversity was noted in the

populations. One article does state that minorities such as African Americans were associated

with higher adverse outcomes (Koraishy et al., 2017). In developing countries, the outcomes for

patients are even worse. To put the numbers in perspective the United States has the highest

number of nephrologists and there are only 28 nephrologists per million population (Dhanorkar

et al., 2022). Almost half of the nephrology patients in the United States have only been

following with a nephrologist for a year (Selim et al., 2007). Other common limitations noted

within the studies included a patient's socioeconomic status and access to health care. One study

was able to show a significant difference in early versus late referrals based on a patient's

socioeconomic class (Dhanorkar et al., 2022). This is likely due to a patient's resources including

access to health care (Koraishy et al., 2017). These are noted barriers in patient care and

outcomes.

All the articles reviewed had a similar definition of early referrals. The articles define

early referrals as 6 months to a year before starting dialysis (Dhanorkar et al., 2022; Koraishy et

al., 2017; Dogan et al., 2005; Seilm et al., 2007). Most studies looked at how early referrals

affect the patient once dialysis is initiated. This project looked at the stage that patients were

referred to onset of dialysis. which is different from the time frame discussed earlier. For The project followed KDIGO guidelines and stages for the referral timeline.

One variable noted is the type of underlying kidney disease a patient has. The underlying kidney disease can cause patients to deteriorate at different rates. All studies ruled out patients with acute kidney injuries and autoimmune disorders (Dhanorkar et al., 2022; Koraishy et al., 2017; Dogan et al., 2005; Seilm et al., 2007). Decline in kidney function can also be related to other comorbidities such a heart failure, hypertension, and diabetes (KDIGO, 2013). This information helped develop the inclusion and exclusion criteria discussed later in this paper. The following topics were discussed in almost every paper reviewed. These topics were developed into outcomes for the project.

Mortality and Hospitalizations

Earlier referrals to nephrology help improve morbidity and mortality in end-stage renal disease patients. Time until death after starting dialysis treatment was significantly decreased with early referrals (113 months) vs late referrals (69 months) (Seilm et al., 2007). The results discussed in this study are like the other studies in this review. There is a significantly lower survival at 6 months for patients with late referrals (98.7%) vs. early referrals (97.1%) and at 24 months (early referrals 96.4% vs. late referrals 85.7%) (Dhanorkar et al., 2022). Some CKD patients can be very ill and have multiple comorbidities. These patients spend more time in the hospitals. KDIGO (2013) examined early versus late referrals and found that patients who are referred early spend less time in the hospital and mortality was decreased by half. Patients were living longer and staying out of the hospital with earlier referrals to nephrology.

Fistula Placement

Patients with earlier referrals had a higher chance of having a permeant access site such as a Arteriovenous Fistula (AVF). Permeant access sites create less risk of infection and sepsis (Selim et al., 2007). One study showed that bloodstream infections were lower in the early referral group 3% and higher 23% in the late referral group (Dhanorkar et al., 2022). These patients were also able to start other modalities such as peritoneal dialysis or home hemodialysis faster than the late group (Dhanorkar et al., 2022; Dogan et al., 2005; Seilm et al., 2007). Patients in the earlier groups had a less risk for blood stream infections given they had a permanent access site.

Cardiac Outcomes

Due to the etiology of chronic kidney disease many patients have preexisting hypertension or develop hypertension later in the disease. Late referrals have a higher risk for cardiovascular events such as an MI or stroke. (Dhanorkar et al., 2022; Dogan et al., 2005; Seilm et al., 2007). There was no noted difference in heart function shown on an echocardiogram with early vs late referrals (Seilm et al., 2007). Patients who have been following with a nephrologist often have reached optimal blood pressure control by the time they reach dialysis (Dhanorkar et al., 2022). The information gathered shows that patients that are referred earlier have controlled hypertension and a decreased risk for cardiovascular events.

Lab Values

Lab values are an important way that nephrologists determine kidney function and how far along a patient is in their disease. Early referrals in nearly all studies did show an improvement in lab work at the time of dialysis such as hemoglobin and hematocrit, alkaline phosphate, albumin, and calcium (Dhanorkar et al., 2022; Dogan et al., 2005; Seilm et al., 2007). Patients in this group were shown to have shorter hospital stays, and fewer uremic symptoms,

and less long-term effects (Dogan et al., 2005; Seilm et al., 2007). Many different values are used to evaluate CKD. The most common discussed in the literature review were potassium, phosphorous, hemoglobin, albumin, creatinine, and blood urea nitrogen (BUN). These values are used as a guide to help develop outcomes in the project.

Progression of CKD

Patients with CKD typically have a natural linear progression of their disease. Patients whose CKD progresses at a faster rate are more likely to have a referral to nephrology (Koraishy et al., 2017). There is more research needed to determine if earlier nephrology referrals help slow down patients with rapidly decreasing kidney function (Koraishy et al., 2017). The study by Koraishy et al., (2017) states that there is no correlation shown between early nephrology referrals and the rate of kidney function decline. However, the study does state that fast CKD progression was associated with older age, African American race, elevated inflammatory markers, high blood pressure, type 2 diabetes, and obesity (Koraishy et al., 2017). There was no association between the decline in kidney function and smoking or gender (Koraishy et al., 2017). The study in 2017 by Koraishy was the first study published that claimed to attempt to link early referrals to the rate of kidney function decline. More research is needed in this area to develop connections between referrals and the rate of kidney function decline.

The project looked at referral guidelines and patient's outcomes once they started on dialysis. This literature review showed that earlier patient referrals improve patient outcomes once on dialysis. There is insignificant data that shows a correlation between the rate of kidney function decline and the timing of nephrology referrals. Below in table 1 is an overview of the articles sample size and study type used in this literature review.

Table 1

Literature Review Table

|	Sample Size	Type of Study
Article 1	992 Participants	Cohort Study
Article 2	101 Participants	Cohort Study
Article 3	100 Articles	Systematic Review
Article 4	2,244 Participants	Cross sectional Study
Article 5	117 Participants	Cohort Study
Article 6	78 Participants	Cohort Study
Article 7	2,170 Participants	Cohort Study
Article 8	14,382 Participants	Population based cohort Study

Scaffolding the Project

Theoretical Framework

The Iowa model of research and practice is a theoretical framework that helped guide the development of this project. The model uses a step-by-step approach when introducing quality nursing research into practice (Titler et al., 1994). The Iowa model has a very specific plan when introducing a project. The Iowa model looks for triggers that could improve practice through research (Titler et al., 1994). The triggers can be either problem-focused or knowledge-focused (Titler et al., 1994). The triggers help identify a problem or gap in education. Once a trigger is identified research is assembled and evaluated (Titler et al., 1994). If there is enough clinical research evidence the project will be advanced to the next stage (Titler et al., 1994). If there is not enough clinical evidence, more research must be done by conducting research, expert opinion, or scientific principles (Titler et al., 1994). This process helped to guide the project starting with recognizing triggers and completing research.

Once the clinical research is complete and there is enough evidence the next stage is started. The next stage includes developing interventions, outcomes, a pilot program, and evaluation (Titler et al., 1994). At this point after evaluation and modifications of the project, the question is asked: "Is the change appropriate for adoption in practice" (Titler et al., 1994 p. 309). If the answer is yes, practice changes are implemented and outcomes are monitored to ensure the change is creating the correct outcomes (Titler et al., 1994). This project will follow Iowa guidelines to direct the project. Figure 2 below shows how this project will be consistent with the Iowa model.

Figure 2

Example of Iowa Model in Practice.
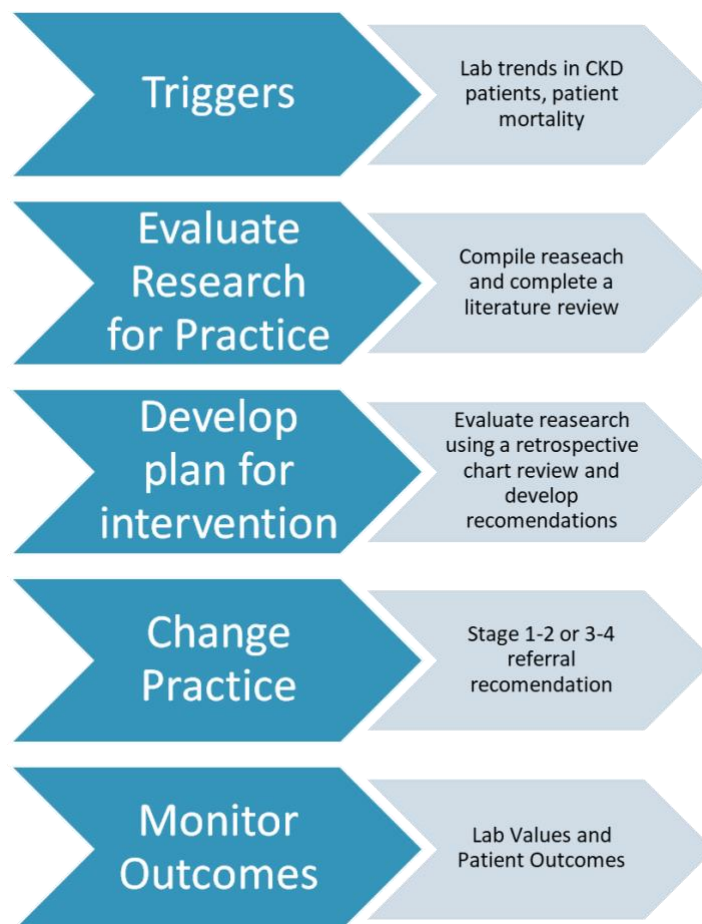
This project was highly based on research and will look for triggers that can improve nephrology practice and patient outcomes. The research aspect of this model was what makes this an excellent fit for the project. Triggers have already been identified through personal and professional experience in the field of nephrology. Clinical research was the next step of this project. Clinical research was completed by looking at previous studies and patient chart reviews to collect data and form inferences about the data. In the future, a pilot program could be developed based on the project presented.

Project Purpose and Objectives

This project aimed to evaluate the effects of early vs. late nephrology referrals on mortality and patient outcomes in patients who are on renal replacement therapy. The general problem was that some patients are not receiving treatment for their kidney disease until they emergently need dialysis. Patients who are preparing for dialysis should be educated before starting renal replacement therapy to prevent complications. Most kidney damage is preventable or slowed down by education, lifestyle modifications, or medication adjustments (Pal et al., 2020). This project focused on specific topics that affect patients who have ESRD. These topics included fistula placement, uremia, mortality, anemia, hypertension, potassium, and phosphorous control. These topics were developed through an in-depth literature review of 8 similar research studies. The literature review has shown that patients have improved outcomes when they are referred to nephrology earlier in their disease progression.

Time From Consult to First Dialysis

The first outcome that was evaluated is time from the first dialysis appointment to the start of their first hemodialysis sessions. Patients were be placed into stages based on their eGFR and tracked from their first appointment to the start of hemodialysis. This project looked at the

timeline from their first consult appointment with a nephrologist to the time they started on

Hemodialysis. This helped in understanding how long a patient is able to stay in each stage.

Mortality

The second outcome that was evaluated was mortality. KDIGO (2013) looked at early

versus late referrals and found that patients who are referred early spend less time in the hospital

and mortality was decreased by half. The literature review also showed that patients in the early

referral group were shown to have shorter hospital stays, fewer uremic symptoms, and fewer

long-term effects (Dogan et al., 2005; Seilm et al., 2007) This outcome specifically looked at the

time from the start of dialysis to death compared to the time of the nephrology referral. A cohort

study of 992 participants showed that there is a significantly lower survival rate for patients at

6 months and 24 months than with late referrals (Dhanorkaret al., 2022). The literature shows

that earlier referrals have a decreased risk for mortality.

AVF Placement

The third outcome looked fistula placed prior to hemodialysis or if it was necessary to

place and emergent central venous catheter. There is a much higher risk for bloodstream

infections from using temporary access such as a tunneled CVC compared to permeant access

such as a fistula. Patients with earlier referrals had a higher chance of having a permeant access

site. Permeant access sites create less risk of infection and sepsis (Selim et al., 2007). One study

showed that bloodstream infections were lower in the early referral group by 3% and higher by

23% in the late referral group (Dhanorkar et al., 2022). AVF placement is associated with

improved patient outcomes and decreased risk for infection or sepsis.

Lab Values

The fourth outcome evaluated was laboratory values. With the help of the literature review, this project will focus specifically on hemoglobin, potassium, BUN, and phosphorous. anemia and bone and mineral deficiencies. Early referrals in nearly all studies did show an improvement in lab work at the time of dialysis such as hemoglobin and hematocrit, alkaline phosphate, albumin, and calcium (Dhanorkar et al., 2022; Dogan et al., 2005; Seilm et al., 2007). Patients with improved lab values are associated with better outcomes while on dialysis.

Hypertensive Control

The fifth outcome is hypertensive control. Patients who have been following up with a nephrologist often have reached optimal blood pressure control by the time they reach dialysis (Dhanorkar et al., 2022). Hypertension can lead to other cardiovascular events. Late referrals have a higher risk for cardiovascular events such as an MI or stroke. (Dhanorkar et al., 2022; Dogan et al., 2005; Seilm et al., 2007). Patients who are referred earlier have a higher chance of having improved hypertensive control.

Methods Used and Project Design

This project used a retrospective chart review of demographic and health outcome data retrieved through a patient's electronic health record. The patient data from the chart review along with the evidence obtained from the review of the literature was utilized to describe findings and develop EBP-guided recommendations for nephrology referrals in clinical practice. There was substantial research which suggested that patients who are referred to nephrology specialists earlier may have improved health outcomes and reduced mortality (Dhanorkar et al., 2022; Koraishy et al., 2017; Dogan et al., 2005; Seilm et al., 2007), the anticipated outcome is that development and implementation of the EBP-guided recommendations after the completion of this project will improve clinical practice, health, and the life expectancy of patients ESRD.

This project used quantitative data retrieved from a chart review to develop evidence-based practice guidelines for early nephrology referrals. The data that was collected on patients helped direct the evidence base practice guidelines the project developed. The patients were first categorized into stages based on the KDIGO recommendations discussed earlier in the paper. Within the two stages, data was compiled regarding their primary diagnosis, cause of kidney disease, and demographic information. The demographic information included the patient's age, race, gender, date of nephrology referral, and stage of CKD at the time of referral. The patients primary cause of ESRD and lab values and blood pressures directly prior to starting hemodialysis will be listed.

Target Population and Sample

The target population of this project will be a convenience sample of 100 adults who are older than 18 years of age, who have ESRD and who receive renal replacement therapy at one outpatient dialysis center. The number of patients was chosen based on 3 similar studies within the literature review (Dhanorkar et al., 2022; Dogan et al., 2005; Seilm et al., 2007). This number of patients would also be an obtainable goal with one researcher within the time constraints of the project. Inclusion criteria would be patients who have developed ESRD from chronic health conditions. That would exclude acute kidney injury, genetic and autoimmune disorders causing ESRD. Four studies also ruled out patients with acute kidney injuries and autoimmune disorders (Dhanorkar et al., 2022; Koraishy et al., 2017; Dogan et al., 2005; Seilm et al., 2007) A limitation to the number was the cause of the patients ESRD and limitations of the electronic health records. The total number of patients available for review was 55. This is considered a limitation to the project as well.

Ethical Considerations

The patients have been assigned a numeric value and placed into groups based on their

stages. Patient information was be kept confidential by keeping the information in a password-

protected Excel spreadsheet that only the team leaders will have access to. Patient information

will not be identifiable as to not violate patient privacy. Patients would be identified by number

and not their name or personal information. The location of the dialysis center would also be

kept private as well as the company they are using for dialysis. The chart audit sheet will be

shredded at the facility in a secure shred bin, then placed in burn bags for disposal. All

information will be kept on an encrypted hard drive. Data written on these sheets did not leave

the facility, the sheets remained in a locked drawer at the facility that only has one key. Data was

then arranged using an excel sheet and calculations were completed through the

spreadsheets. The team will include the project leader and two project advisors. The project was

submitted to the IRB at Otterbein University and was approved. The approval notice is listed in

Appendix A at the end of this paper.

<div align="center">**Outcome Analysis Plan (Data Analysis)**</div>

Instruments Used and Data Analysis

An excel spreadsheet was utilized to organize and document data. A chart audit checklist

will be provided in Appendix A. Data was collected in the chart audit checklist and then placed

into the excel spreadsheet. Data was collected by the project leader. The data will be kept for 5

years after completion of the project then will be destroyed. The project leader supervised the

statistical analysis of the data collected. Statistical analysis will be run through the excel

program. The program can do simple and complex calculations of the data collected. Data was

statistically analyzed using descriptive statistics. Data was calculated using an excel spread sheet

to calculate central tendencies specifically average.

Project Success

Project success was measured by data outcomes and recommendations. Success has been determined by the development of an evidence-based practice guideline that can be used in clinical practice when referring patients to nephrology. The clinical practice guidelines can help improve patient outcomes in patients who have ESRD and are on HD. Completion of this project will also be a measure of success.

Limitations and barriers

Limitations to consistent results was variations in patients. Not all patients are compliant with treatment recommendations. The area selected for this chart review could be seen as a barrier due to socioeconomic status of the patient population. This could be a barrier to consistent results. There was a significant difference in early vs late referrals based on a patient's socioeconomic class (Dhanorkar et al., 2022). This is likely due to a patient's resources including access to health care (Koraishy et al., 2017). The limitation of location and specific demographic of dialysis patients in one location places a similar barrier on the project. Another barrier noted was variations in electronic chart records. Not all chart records may be comprehensive of the patient's history prior to the onset of dialysis. During the literature review, this was identified as a problem for many studies (Dhanorkar et al., 2022; Koraishy et al., 2017; Dogan et al., 2005; Seilm et al., 2007). Part of the problem is that many dialysis centers use a private non shared their EHR that does not include all relevant past medical information. Incomplete data, patient compliance and socioeconomic status were all barriers present in this project.

Facilitators

Staff at dialysis facilities were very helpful in finding information on patients. Each dialysis center has a social worker, registered nurse, and dietician that works with each patient.

The staff have known these patients for many years and often recall pertinent information. These facilitators were highly beneficial to the project. The dialysis patients have also been known to the physician for multiple years who oversees their dialysis who would be able to assist or help as a resource. The physicians typically see their patients 4 times a month and are familiar with the patients.

Timeline & Budget

Timeline of Project Implementation

This project was completed by Tricia Brown MSN. The project was under the direction of a professor at Otterbein University. This project was a large time investment over the past two years. During this timeline there has been a lot of researching and refining the topic of the project. In the summer of 2022, a large amount of time was spent researching and developing the aim and objectives of the project. In the fall of 2022, the projects scaffolding, and project design were developed. The chart review portion of this project started in February 2023. In February charts were reviewed each month and placing the information collected into an excel spreadsheet. Data collection and calculations will be completed by the beginning of March. By using the data collected in conjunction with the literature review this evidence-based data has helped develop nephrology referral guidelines. In March and April the project was finalized and disseminated. The analyzed data has been placed into this report that includes recommendations nephrology referrals.

Budget

The budget for this project will totaled around 1,000-2,000 dollars. Most of the cost will occur from the project team's time analyzing data information. There was minimal cost for supplies. The supplies needed were a notebook, pens, and highlighters. There will be a cost for

the excel program within this project. The computer that is being used is a password protected computer that has already been purchased. Currently, excel is free through tuition already paid at Otterbein University. To be able to fully utilize all that excel has to offer in the realm of statistical calculations a class was taken to further develop skills with statistics. The cost of this class was 35 dollars. The costliest part of this project was the time involved. This project could also be possibly shared at conferences and continuing education seminars in the future. This could lead to further expenses for the team.

Results and Discussion

Time to Hemodialysis

Patients time is valuable. Patients want to stay off dialysis for as long as possible. Patient perception of dialysis is that the longer they do not have to be on renal replacement therapy the better their quality of life will be. Patients who are referred earlier in their disease have a longer time of being off hemodialysis. The data shows that patients who are referred in stage 3a have approximately 3,262 days before starting RRT. Patients who are in stage 3b have approximately 1,927 days before starting RRT. Patients who are referred at stage 4 have approximately 1057 days to RRT. Finally, patients who are referred at stage 5 only have 265 days prior to starting RRT. This shows that when patients are referred earlier have more time off RRT. Below in table 2 shows the difference in the CKD stage and amount of time to RRT.

Table 2

Average Number of Days from Consult to The Start of Hemodialysis

Average Number of Days to Dialysis
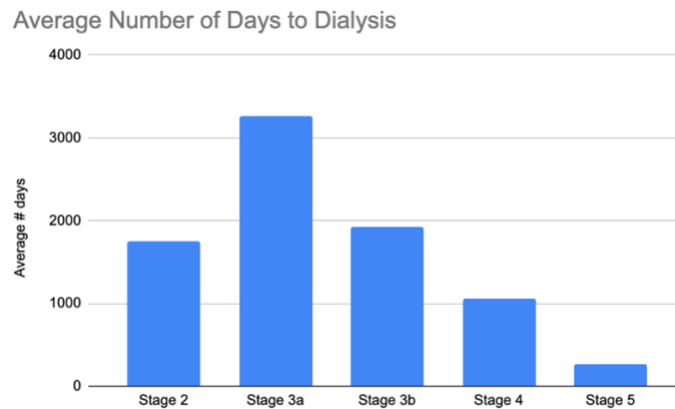
Mortality

      The data in this stage may be distorted by the number of patients in each stage. The data

showed that 0% of patients in stage 2, 3a and stage 5 have passed away. 20% of patients in stage

3b and 25% of patients in stage 4. There is no discernable trend within this data set. A larger

sample size may help detect a trend in mortality. Once starting dialysis patients in this data sheet

lived from 1-6 years after starting renal replacement therapy.

Fistula

      A fistula is a connection that is surgically placed in the body to be able to preform

dialysis. After the connection is made the fistula must mature for 3-6 months before use (Up to

Date, 2023). Patients who have a fistula placed have a decreased risk for infection from their

access. Infections from Central lines typically develop into sepsis. Sepsis is a blood stream

infection that can be deadly. The other name for sepsis is bacteremia which means there is

bacteria in the blood (Up to date, 2023). Table 3 shows the trends in AVF placement. Patients

who are referred earlier have a much higher chance of having a fistula placed and avoiding a

blood stream infection.

Table 3

Percent of Patients with an AVF Placed Prior to The Start of Hemodialysis.
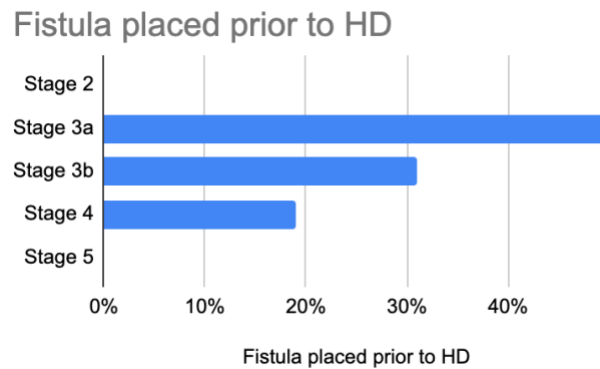

Laboratory Values

Potassium

Patients who are on dialysis are unable to filter some of their blood electrolytes

adequately. Potassium is an essential electrolyte in our body that has a refence range of 3.0 to 5.0

meq/L (Up to Date, 2023). When potassium builds up in the body it can cause muscle weakness,

cardiac arrythmias and cardiac death if levels become elevated (Up to Date, 2023). Through

chart review it is evident that the later patients are referred to nephrology the higher their

potassium levels become prior to hemodialysis. Potassium was reviewed for each patient and an

average was calculated to represent the stage. Given that elevated potassium can cause heart

arrythmias and even death the earlier patients are referred the less risk they have for cardiac

death. Table 4 shows a clear increase in potassium levels from each stage.

Table 4

*Average potassium prior to hemodialysis*

Average Potassium
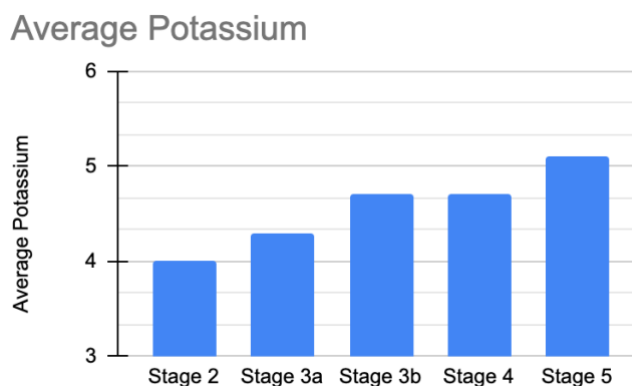
Phosphorous

Phosphorous is involved with bone and mineral absorption. When patients have CKD the kidneys are unable to filter our excess phosphorus. Then phosphorous levels rise and can cause harm to the bones and minerals in the body. When the levels rise, they effect other essential mineral and electrolyte levels such as parathyroid hormone, calcium, and vitamin D (Up to Date, 2023). When reviewing the average phosphorous levels in reach group it showed some variation and no clear pattern. In table 5 the average phosphorous levels have been listed.

Table 5

*Average phosphorous prior to starting hemodialysis*

Average Phosphorous
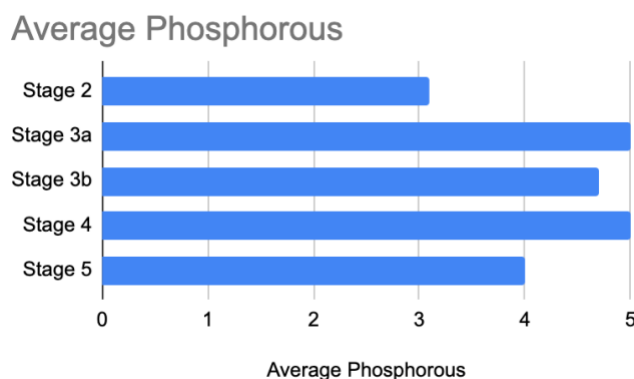
Hemoglobin

When patients have CKD their kidneys do not produce enough of a hormone called erythropoietin which helps with blood production (Up to Date, 2023). Patients who have CKD or ESRD are at a higher risk for being or becoming anemic. Some patients require a referral to a blood doctor or hematologist to replace some of the hormones they are missing. This helps keep their blood counts at a steady level. Table 6 shows the trends of hemoglobin in each stage. Throughout all stages hemoglobin stayed stable and did not show a specific trend.

Table 6

Average Hemoglobin
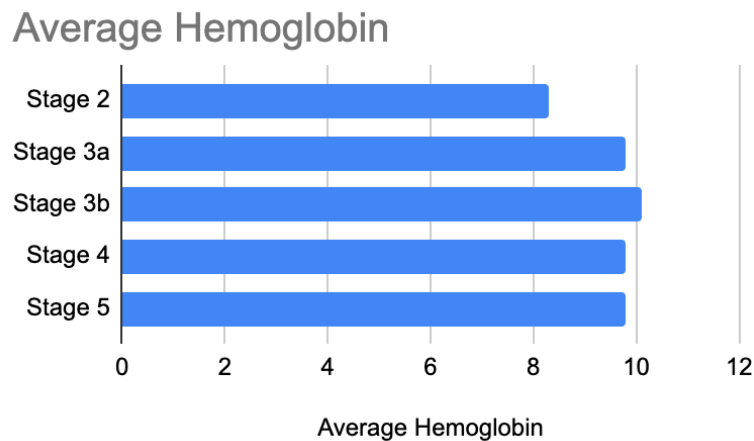
### Blood Urea Nitrogen (BUN)

BUN is a measurement of the toxins built up in the body (Up to Date, 2023). When patients have and elevated BUN it means that their kidneys are not clearing out the toxins in their body. Symptoms of uremia include malnutrition, anorexia, nausea, vomiting, fatigue, sexual dysfunction, platelet dysfunction, pericarditis, and neuropathy. BUN levels prior to dialysis were also variable. No clear pattern was identified. Table 7 shows the average BUN in each stage.

Table 7

Average BUN
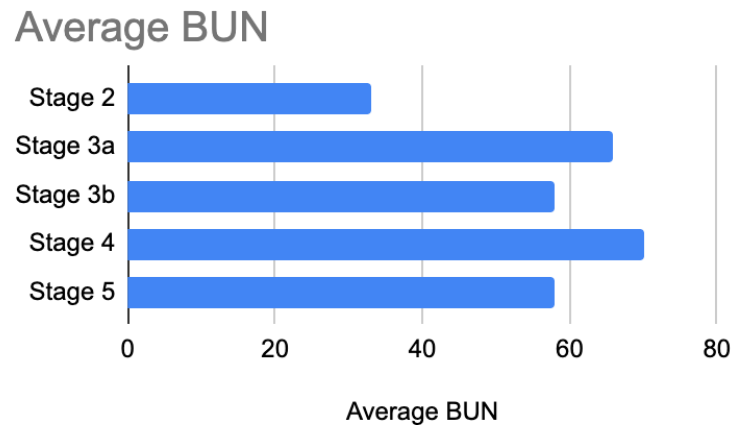
Hypertensive Control

There is a clear relation in blood pressure control and the stage a patient is referred to nephrology. A controlled blood pressure for dialysis patients is 125-130/80 (KDIGO, 2013). AS noted below in Chart 5 100% of patients in stage 3a had controlled blood pressures by the time they reached RRT. Less than 25 % of patients with stage 5 CKD did not have controlled blood pressures when starting RRT. KDIGO states that intensive blood pressure lowering may reduce mortality in patients with CKD (2013). The trends in data collection shown in table 8 clearly show an improvement in patients who were referred to nephrology earlier in their diagnosis.

Table 8

Number of patients with controlled hypertension prior to starting hemodialysis
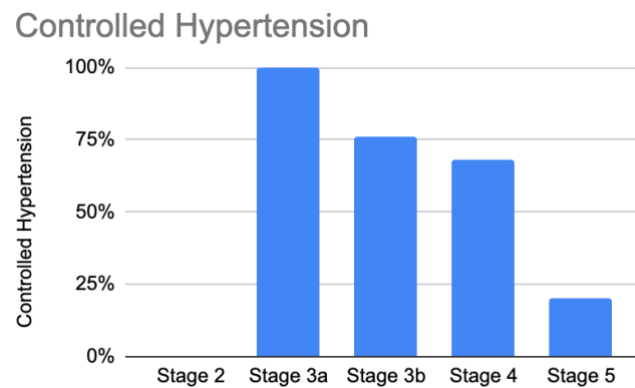
Conclusions and Recommendations

The data collected showed a clear correlation between earlier nephrology referrals and improved patient outcomes. Improved outcomes included blood pressure control, decrease in potassium levels, decrease in time prior to having to start HD. Patient outcomes are improved when they start following with a nephrologist early in their diagnosis. Given the evidence presented patients should be referred to a nephrologist when a patient is approaching a stage 3a. Patients should be educated on the gravity of their situation and what a decrease in eGFR means. Patients need to be educated on a decrease once it occurs from stage 1 to state 2. The literature review supports these claims and many of the studies have similar outcomes.

In the future these recommendations could be used to develop educational programs for primary care physicians regarding patients with chronic kidney disease. Providers should be referring patients earlier prior to a significant decrease in kidney function. This project will improve clinical practice, health, and the life expectancy of patients with ESRD.

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Appendix A

Data Collection Sheet

Age: Did the patient have to use a CVC:

Gender: Was a fistula placed:

Race: BP trends/Control:

Diagnosis leading to ESRD: Date of Death if applicable:

Stage of CKD at first appointment: Labs:

                                                        HGB:

Date of first appointment: Creatinine:

                                                        BUN

Date of first Dialysis: eGFR:

                                                        Potassium

Was the dialysis emergent: Phosphorous:

Appendix B

IRB Approval

INSTITUTIONAL REVIEW BOARD ☒ Original Review
☐ Continuing Review
☐ Amendment

Dear Dr. Hummer,

With regard to the employment of human subjects in the proposed research:

HS # 22/23-48
Hummer & Brown: Early vs. Late Referrals to Nephrology and Its Effect on Patient …

THE INSTITUTIONAL REVIEW BOARD HAS TAKEN THE FOLLOWING ACTION:

☒ Approved   ☐ Disapproved
☐ Approved with Stipulations*   ☐ Waiver of Written Consent Granted
☐ Limited/Exempt/Expedited Review   ☐ Deferred

*Once stipulations stated by the IRB have been met by the investigator, then the protocol is APPROVED.

1. As Principal Investigator, you are responsible for ensuring all individuals assisting in the conduct of the study are informed of their obligations for following the IRB-approved protocol.
2. It is the responsibility of the Principal Investigator to retain a copy of each signed consent form for at least four (4) years beyond the termination of the subject's participation in the proposed activity. Should the Principal Investigator leave the university, signed consent forms are to be transferred to the IRB for the required retention period.
3. If this was a limited, exempt, or expedited review, there is no need for continuing review unless the investigator makes changes to the proposed research.
4. If this application was approved via full IRB committee review, the approval period is one (1) year, after which time continuing review will be required.

5. You are reminded you must promptly report any problems to the IRB and no procedural changes may be made without prior review and approval. You are also reminded the identity of the research participants must be kept confidential.

Signed: <u>Noam Shpancer</u>   Date: <u>2-6-2023</u>
               IRB Chairperson