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The Relationship between Nephrologist Characteristics and Home Dialysis Usage

Meagan Marie Wilson
Walden University

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Walden University

College of Health Professions

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Meagan Marie Wilson

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Walden University
2022

Abstract

The Relationship between Nephrologist Characteristics and Home Dialysis Usage

by

Meagan Marie Wilson

MHA, University of Phoenix, 2014

BS, University of Phoenix, 2010

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Health Services

Walden University

February 2022

Abstract

Home dialysis is a cost-effective and efficient means of treating end-stage renal disease. Under-utilization of home dialysis results in higher than necessary Medicare spending and loss of quality of life for patients. The purpose of this study was to understand the relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture (JV) financial arrangement with a home modality program, and the use of home dialysis and home modality education using a quantitative, correlational design. Roger's diffusion of innovation theory explains the varying willingness of individuals to accept innovation. Secondary data were collected from Medicare and the Illinois Department of Health. Nephrologists were identified for inclusion based on having a specialty of nephrology, having billed for the HCPCS codes 90951-90970 in the year 2018, and having an address in the state of Illinois. Multiple linear regression analysis calculations run using SPSS determined a statistically significant relationship of .341, with a physician belonging to a JV practice accounting for 11.6% of the variance in home dialysis usage, length of time in practice did not have a statistically significant effect. Data were not available to analyze if a relationship between nephrologist characteristics and home modality education existed. Understanding the relationship between nephrologist characteristics and home dialysis usage provides the opportunity for improved nephrologist relationships regarding JV practices. Additionally, it may provide new insight for the construction of programs to target a home-first dialysis initiative, supporting the country's Advancing American Kidney Health initiative supporting positive social change.

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Dedication

For the women who came before me, that forged the path, which without I would have never been able to pursue this great academic achievement.

For the members of the dialysis community, the patients of ESRD who allow me to be their voice through this research, who taught me so many important lessons about life, I dedicate this to you.

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To our children- thank you for giving me purpose and joy and pushing me to be a better person. I love you all more than you could ever know.

For My Mom - for showing me the importance of education no matter the obstacles ahead of you and ingraining in me the importance of educating yourself so that your children may have a better life.

For My Dad- for giving me the stubbornness to do what others said I couldn't and the belief that I was capable enough to achieve it.

To Craig- for being you ☺

To My Grandparents in Heaven and my Grandparents I am lucky enough to have here to celebrate this, for the never-ending love and support.

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Chapter 1: Introduction to the Study

Introduction

The renal community has recognized peritoneal dialysis and home hemodialysis, collectively known as home dialysis, as effective means to treat end-stage renal disease (ESRD) for many decades. Despite the popularity in other countries, the United States has demonstrated an overwhelming preference to use the more expensive in-center hemodialysis (Rivera & Mehrotra, 2014).

The nephrologist plays a prominent role in the treatment decision-making process; this is crucial information in understanding patient placement on home dialysis. The locations in which a nephrologist has privileges to see patients, their feelings about the effectiveness of particular forms of treatment, and the format in which they share information with patients all play a role in a patient's decision to choose a dialysis facility and modality (Cassidy et al., 2018). The current literature has primarily focused on the qualitative aspects of placing a patient on home dialysis. The themes that emerged focus on the patient rather than the nephrologist, such as quality of life, support system, and perceived independence (Cassidy et al., 2018). Generally, the nephrologist's role in the modality decision is categorized under the support system; however, this does not sufficiently explore the role of the nephrologist in a patient's decision-making. One can theorize that the push for home dialysis is relatively new, and therefore, many physicians may be resistant to change. Gupta et al. (2017) indicated that physicians in other specialties who have been in practice longer find it more challenging to implement change. From the studies performed in these fields, one would conclude that

nephrologists who have been in practice longer generally would not refer to home dialysis more than their younger counterparts would, a study in Germany found that older nephrologists were more likely to do so (Pommer et al., 2018).

Additionally, in other areas of medicine, physicians demonstrated a clear connection between their financial interest in a facility and their utilization of services in that facility. Hollingsworth et al. (2009) reported that urologists who participated in a Joint Venture were more likely to perform procedures in their ambulatory surgery centers (of which they are Joint Venture partners) and averaged more cases per year than those that did not participate in Joint Ventures. Hollingsworth et al. (2009) directly correlated this with financial incentives through ownership. Previous literature indicates that patient characteristics have an impact on the utilization of home dialysis. They also concluded that physician characteristics and participation in financial ventures, such as Joint Venture Practices, influence the usage of a home dialysis modality. No conclusive studies on nephrologists' length of time in practice or participation in a Joint Venture exist to date. Joint Ventures intend to align the interests of both dialysis providers and nephrologists, thus also increasing patient satisfaction (Berns et al., 2018). Berns et al. (2018) failed to explore what those interests are and how this affects the usage of home dialysis. Berns et al. (2018) stated that the transparency of how Joint Ventures work in dialysis is alarming low. These operations are perhaps the least understood of all operations in the renal realm. In this study, I addressed the relationship between the nephrologist characteristics of the length of time in practice and participation in a Joint Venture Practice on home dialysis usage.

Successful implementation of home dialysis as a first choice in treatment would result in enormous savings for the Medicare system, the primary payer of the ESRD population. Home dialysis is far more economical than its in-center counterpart. Additionally, patients who participate in home dialysis have shown lower levels of depression, continued to work, and participated in social activities, leading to a better quality of life through various studies (Walker et al., 2017). Increased understanding of the relationship between nephrologist characteristics and the likelihood of placing a patient on home dialysis provides patients with the empowerment to choose physicians to meet their needs. Additionally, the normalization of home dialysis would allow increased education, resources, and support for these patients.

In this chapter, I discuss the purpose of this study, the problem that I sought to address, and the current literature gaps. Additionally, I explore the theoretical framework used to conduct this study and the data's limitations. Finally, I will discuss the potential for social change from the findings of this study.

Background

The cost of dialysis in the United States is staggering and continues to grow as the number of new patients grows yearly (United States Renal Data System, 2019). Many dialysis patients have Medicare as either a primary form of insurance or a secondary form of coverage. ESRD is the only chronic disease to have its own federal government program. Given the frequent concern over the Medicare program's state currently, ESRD is a controllable area. Modality choice of home dialysis is a factor that could make a sizeable difference in Medicare spending (Neil et al., 2009). Anderson and Friedman

(2013) described mandating a home-first dialysis system in the United States to address the ever-increasing contribution of ESRD expenditures to Medicare spending. Liu et al. (2014) explored the steps to encourage home dialysis usage by Medicare, which started with the bundling of dialysis services billing in 2011. It is important to note that while many of the above references are not recent, they are unique in their information; during the time ESRD Medicare bundling took place, this topic was of interest not seen since. This reform highlighted home dialysis's profitability for many dialysis providers, though with low success rates.

What makes the underuse of home dialysis in the United States even more puzzling is the success that it has seen in other, even perhaps less well-developed countries. Thodis and Oreopoulos (2011) examined the difference in utilization between home dialysis in the United States and countries with a home-first paradigm. Regarding patient quality of life and finances, they determined that new ESRD patients should be recommended for home dialysis. Walker et al. (2014) reached similar conclusions when comparing home hemodialysis and in-center hemodialysis costs and benefits. Much of the literature reiterates the same message of widespread benefits of home dialysis modalities, with extreme underuse in the United States.

It is widely touted in dialysis communities that modality is a patient choice. Therefore, it makes sense that most of the current research aimed to understand the underuse issue from the patient's standpoint. Mehrotra et al. (2016) explored race disparities in home dialysis initiation as the first treatment modality. Similarly, many attempts were made to understand why patients opt for in-center care instead of home

dialysis. An appropriate understanding of treatment options, attributed to receiving proper nephrology care before starting dialysis, was highlighted as an essential factor (Gillespie et al., 2015). Though the focus does seem to stay primarily on the patient, having exhausted many prominent factors such as demographics and socioeconomic factors, interest has started to turn to other possible influences. Walker et al. (2010) analyzed patient characteristics, their dialysis facility characteristics, and how this relationship affected home dialysis patient utilization. This natural path of research eventually led to physician characteristic research.

Osterlund et al. (2014) conducted a study leading to a basis for this study. They explored facilitators and barriers to home dialysis in Canada, including physician characteristics such as bias, participation in a home dialysis venture, physician knowledge of home dialysis, and experience with home dialysis. While some of their conclusions could have been used to build a hypothesis in this research, this was a qualitative study with the primary aim to understand barriers and facilitators to home dialysis utilization, specifically in Canada. Additionally, the Canadian healthcare delivery and payment system are that of a single-payer system. Therefore, financial incentives could differently influence providers and patients when applied in the United States.

Berns et al. (2018) also provided research that I used to build this study upon, discussing the potential conflicts of interest in the Joint Venture ownership of a dialysis clinic for a nephrologist. Among these conflicts is the possibility of a physician to hand-select healthier patients, have a better potential for more ideal results, and are considered the best patients. Though this article does not particularly call into question home dialysis

versus in-center dialysis, it does question how having a stake in a clinic's profitability may influence the provider's decision-making. I explored the role that participation in a Joint Venture played in the utilization of home dialysis, which was not covered in this article.

To fully understand and address home dialysis underuse in the United States, the relationship between nephrologist characteristics and home dialysis usage must be explored. Patient characteristics have been studied exhaustively, and little progress has been made in increasing home dialysis usage. This study was necessary to understand if a relationship existed between physician time in practice, participation in a Joint Venture, and home dialysis usage so that future interventions can be made to increase home dialysis usage.

Problem Statement

The problem the United States faces is severe underuse of home dialysis, without an explanation of why. Without an understanding of why the problem cannot be addressed. The studies performed regarding physician characteristics fail to yield usable results. Researchers have conducted studies on patient characteristics and the relationship with home dialysis usage, yet the United States does not rise above the single digits in usage. Under-utilization of home dialysis is costly for the Medicare system and patients who could benefit from a form of treatment that allows them more freedom with better outcomes.

Chronic kidney disease (CKD) and ESRD have been a rapidly growing health concern, with reportedly more than 114,000 people reaching ESRD in the United States

in 2012 (Gillespie et al., 2015). Due to the overwhelming cost, at over \$28 billion per year for Medicare alone, and the ongoing nature of this treatment, ESRD is the first chronic disease of its kind to have its own Medicare sponsored program, which was introduced in 1972 (United States Renal Data System, 2018). Given the high costs of ESRD treatment, mandating the modality of dialysis in favor of home dialysis (such as peritoneal dialysis and home hemodialysis) rather than in-center dialysis may help control dialysis costs, providing substantial savings for Medicare (Anderson & Friedman, 2013). Despite the known savings of 20 to 50% for peritoneal dialysis patients over in-center dialysis, only an estimated 6% of patients choose to begin treatment using peritoneal dialysis (Anderson & Friedman, 2013). In 2013 Medicare covered nearly 356,000 patients, and this number was estimated to have increased to 400,000 by 2017 (Liu et al., 2014).

Per Liu et al. (2014), most nephrologists felt that at least half of their patients were capable and candidates for a form of home dialysis; however, only 9% of patients received home dialysis. They cited numerous barriers to why patients chose to do in-center dialysis, including education, convenience, financial, and quality of life. Thodis and Oreopoulos (2011) noted the success of other countries in the world that have high usage of peritoneal dialysis, naming Mexico (85%) and Australia (42%) specifically. Their research indicated that not only is a home dialysis first system ideal for new patients and should be implemented, but it is cost-effective. Turenne et al. (2018) corroborate this idea. They indicate that since bundled payment was implemented and

then reformed, providers now have a financial incentive to remove barriers for patients receiving forms of home treatment.

Researchers have primarily focused on patient characteristics and how this affects the modality decision-making process (do Couto Nobre et al., 2017). Many acknowledge physician characteristics and beliefs, but there has been a failure to examine relationships between these variables and the underuse of home dialysis. Instead, this information is often labeled as demographic factors (Osterlund et al., 2014). Even findings that seem to be right on the cusp of exploring what may motivate a physician to utilize or not utilize home dialysis, such as participation in a Joint Venture, stop short of formally establishing a relationship (Berns et al., 2018).

The literature does not indicate if a nephrologist's characteristics, such as length of time in practice and Joint Venture financial arrangements, influence how many patients they refer for home dialysis. Nephrologists acknowledge that many more of their patients are capable and qualified for home dialysis than are placed on it (Liu et al., 2014). Further, barriers such as modality education on the different modalities available for treatment, which is a decision under the nephrologist's control to provide for the patient before starting treatment, are cited in the literature.

Purpose of the Study

The purpose of this quantitative study was to identify the relationship between the length of time a nephrologist has been in practice and the percentage of patients placed on home dialysis. I also explored the relationship between a nephrologist belonging to a Joint Venture financial arrangement with a home modality program and the percentage of

patients placed on home dialysis. Additionally, the relationship between the length of time a nephrologist has been in practice and the percentage of patients receiving modality education before starting dialysis was examined. The independent variables in this study were the referring nephrologist years in practice and if the physician is part of a Joint Venture financial arrangement with a home modality program. The dependent variables were physician rate of placement on home modality and patient receipt of modality education. The modifiers were age and place of treatment, which are accounted for by the HCPCS codes. The specific HCPCS codes that I used in this study require that the patient be over 20, excluding pediatric patients. Additionally, the codes specify that the patient is treated in the outpatient setting, excluding patients receiving treatment in the hospital setting. These codes also exclude patients that are receiving treatment for acute kidney failure.

Research Question and Hypotheses

Research Question 1 (RQ1): What is the relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percent of patients age 20 and over placed on outpatient home dialysis?

Null Hypothesis (H_0): There is no statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percent of patients age 20 and over placed on outpatient home dialysis.

Alternative Hypothesis (H_1): There is a statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percent of patients age 20 and over placed on outpatient home dialysis.

I used multiple linear regression to model the relationship between the independent variables, the nephrologists' length of time in practice and participation in a Joint Venture practice, with the dependent variable, the percent of patients being placed on home dialysis before starting dialysis to decide to either accept or reject the null hypothesis. I chose HCPCS codes that controlled for patient age, including only patients that were age 20 and older to eliminate pediatric patients, and were specific to outpatient dialysis, eliminating patients that received treatment in the hospital. I used a significance level of $p < 0.05$.

Research Question 2 (RQ2): What is the relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis?

Null Hypothesis (H_0): There is no statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis.

Alternative Hypothesis (H_1): There is a statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint

Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis

I used multiple linear regression to model the relationship between the independent variable, the nephrologists' length of time in practice and participation in a Joint Venture practice, with the dependent variable, the percentage of patients receiving modality education before starting dialysis to decide to either accept or reject the null hypothesis. I chose HCPCS codes that controlled for patient age, including only patients that were age 20 and older to eliminate pediatric patients, and were specific to outpatient dialysis, eliminating patients that received treatment in the hospital. I used a significance level of $p < 0.05$.

Theoretical Foundation

I used Roger's diffusion of innovations theory (Rogers, 1962) as the theoretical foundation for this study. Roger's theory indicates that the adoption of innovation occurs at different rates and occurs in five primary stages. These stages are knowledge, persuasion, decision, implementation, and confirmation. Rogers (1962) theorized that characteristics of the adopter and innovation, time, communication channels, and social channels influence the process of diffusion of innovation. That uptake of innovation can be a slow process (Rogers, 1962). I intended to show the relationship between the nephrologist's characteristics and willingness to utilize home dialysis, often viewed as innovation. Its underuse can be interpreted as an unwillingness to accept changing innovation in the industry. In this study, I examined the aspects of Roger's theory that address adopters' classification structure to understand the relationship between

nephrologist characteristics and home dialysis utilization and modality education. This classification theory states that early adopters will embrace and readily implement change.

In contrast, late adopters are skeptical and reluctant to adapt to change until the vast majority of their peers have done so (Rogers, 1962). Lin et al. (2016) framed their study on adverse drug events and CKD patients using Roger's theory of innovation. They used three areas of the theory's framework for their study: innovation, communication, and social system. Lin et al. (2016) focused on the compatibility of an adopter's needs, routines, and values with the proposed innovation. The more complex an innovation, the more difficult that innovation was to add to the adopter's routine, which created a barrier to adoption.

In their study, Lin et al. (2016), referred to the favorable characteristics of the innovation in comparison to the current system of the adopter as relative advantage. They examined communication in the context of understanding how cultures of communication influenced innovation uptake. Finally, to understand the decision-making process social systems were examined, which directly affects innovation uptake. Lin et al. (2016) found that innovation must be convenient, efficient, and easily adapted to be adopted by a clinician. Based on Lin et al. (2016) study, by examining the relationship between a nephrologist belonging to a Joint Venture with a home dialysis program and the percentage of patients placed on home dialysis or receiving home modality education I am examining the aspects of communication and social channels in Roger's theory.

Nature of the Study

The nature of this study was quantitative research with a correlational design consistent with understanding the relationship between a nephrologist's length of time in practice, their participation in a Joint Venture financial arrangement with a home modality program, their referral of a patient to modality education, and a nephrologist's rate of placement on home modality. I used a multiple linear regression analysis to analyze the relationship between each variable and the dependent (referral to patient modality education, nephrologist's rate of placement on home modality) and independent variables (nephrologist's length of time in practice, their participation in a Joint Venture with a home modality program). I highlighted the role that referring nephrologist characteristics play in a patient's modality choice.

Definitions

Many terms have multiple meanings or can be used in alternative ways; therefore, it is essential to define terms commonly used in this study as they are intended to be interpreted.

Chronic Kidney Disease (CKD): Kidney damage consists of four stages, which may worsen over time. Once Stage 5 is reached, transplant or dialysis is needed (American Kidney Fund, 2021).

End-Stage Renal Disease (ESRD): For this study, this term refers to the last stage of chronic kidney disease (CKD), known as Stage 5. In this stage, a patient can no longer sustain life without a form of treatment, which is either transplant or dialysis (American Kidney Fund, 2020).

Home Modality: Home dialysis, or home modalities, for this study, refers to two types of dialysis. First, peritoneal dialysis (P.D.) utilizes a lining in the person's abdomen to complete dialysis. The second type of treatment is home hemodialysis. A patient and a partner are trained on the hemodialysis process for several weeks and then given a setup to perform the procedure within their home (Washington University School of Medicine in St. Louis, 2021).

Joint Venture Partnership (JV): In this study, Joint Venture Partnership refers to a dialysis facility formed through a business relationship between a dialysis provider and a single nephrologist or nephrology group. They share ownership of the facility and are responsible for the risks and responsibilities of ownership (DaVita, 2004-2021). In this study, joint venture partnerships are determined by the Ohio Department of Health Facility report, listing all dialysis facilities' owners.

This study had two independent variables: nephrologist's length of time in practice and nephrologist's participation in a Joint Venture practice with a home modality program. For this study's purpose, a nephrologist's length of time in practice was the number of years between when they graduated from medical school to 2018. I selected the year 2018, as this is the most recent Medicare Provider Utilization and Payment Data: Physician and Other Supplier PUF report available, and the report used to provide the data for this study. I defined a nephrologist's participation in a Joint Venture as a nephrologist that is either individually or as part of a group of nephrologists is listed as a co-owner of a dialysis facility. Covariates were necessary to control for possible bias in this study. These were the following: age and place of treatment. The HCPCS codes that I

used in this study were for patients aged 20 years and older, thus eliminating pediatric patients from the study. These codes also are only for outpatient treatment, eliminating treatments of patients done in the hospital. Finally, I determined the dependent variables to be the percentage of patients placed on home dialysis, defined as those receiving either peritoneal dialysis or home hemodialysis as determined by HCPCS codes. For this study, the nephrologist must have performed modality education and bill utilizing an appropriate HCPCS code. I did not include forms of community education provided by outside services or for free.

Assumptions

For this study, I made two assumptions. First, I assumed that if a nephrologist belonged to the group practice listed as owners in the Illinois facility profile report, they were a Joint Venture doctor. Second, I assumed that if no HCPCS code was listed for modality education, the doctor did not provide the patient modality education.

Scope and Delimitations

The population of nephrologists treating dialysis patients in the United States exceeds 8,000. Due to the volume of data, sampling was limited to nephrologists located in Illinois, reducing the population to roughly 281 nephrologists. The methodology of this study could be applied to each state as needed to replicate the study if desired in future research. Given the data sets that I used and the covariates that I selected to control for validity, this study should be able to be replicated in nearly any setting in the United States to determine the relationship between nephrologist characteristics and home

dialysis usage. The only threat to external validity is the ability to obtain a report of Joint Venture ownership from each state.

The HCPCS codes that were used for this study already control for age and setting of treatment. The codes used are for patients receiving treatment aged 20 and older, eliminating pediatric patients that could skew the data. Many pediatric patients may use this form of treatment more frequently than adult patients due to their size and other factors. Additionally, these codes are only used for outpatient dialysis patients, eliminating dialysis treatments received in the hospital setting, which could distort data by capturing acute patients.

Limitations, Challenges, and/or Barriers

A potential barrier for using secondary data is that another source collects such data, and therefore extra lengths must be taken to ensure that the data's validity is ensured. Additionally, all necessary data were not available from one collective source; therefore, it was necessary to cross-reference utilizing identifiers such as physician NPI numbers. In cases where NPI numbers were not available other unique qualifiers had to be identified and utilized. Matching physicians through identifiers was challenging and required painstaking efforts to ensure that data was valid through the utilization of v-lookups and as few manual entries of data as possible. Furthermore, potential bias exists in the very reporting of the data from the physician, which can alter the results. Efforts were made to limit potential bias, validity errors, and unforeseeable influences by limiting the manual entry of data as much as possible through Microsoft Excel and

focusing on specific HCPCS codes. Finally, co-variates were selected to limit internal validity errors.

Significance

The results of this study may provide much-needed insight into the current underuse of home dialysis in the United States. Explicitly, un-explored and under-explored factors such as nephrologist length of time in practice and Joint Venture financial arrangements, and the relationship with modality education and placement on a form of home dialysis. Policymakers can use information from this study to create new incentives to encourage providers to utilize home modalities. Additionally, conclusions drawn from this research could be used to educate nephrologists and their staff on home modalities, the benefits for patients, and how to overcome barriers and myths. The results of this study may contribute to positive social change by identifying potential barriers to patients utilizing a more effective treatment that provides patients with a higher quality of life. In turn, it is also a more cost-efficient treatment with the potential to save the struggling United States Medicare system from the high burden of in-center dialysis costs, leading to a better quality of care for Medicare recipients.

Summary

The underuse of home dialysis in the United States has been and continues to be a problem that economically challenges the Medicare system and may disadvantage patients who would benefit from this form of treatment (Thodis & Oreopoulos, 2011). Previous researchers have focused primarily on patient characteristics and the relationship between dialysis modality treatments (Cassidy et al., 2018). Though earlier

researchers acknowledge that the nephrologist is a crucial influence in treatment choice, they fail to explore a relationship (Osterlund et al., 2014).

Diffusion of Innovations of Change Theory indicates that change can slow (Rogers, 1962). This theory indicates that change relies on humans and that the rate at which an idea or change is adopted depends on the adopter's category. Rogers categorized these adopters into four ranging from the innovators themselves to the laggards, who are the last to jump on board with a new idea and only do so because no other choice remains. His theory also indicates that how these groups adopt ideas is dependent on external factors such as communication and time. With this research, I seek to establish the relationship between a physician's length of time in practice and their usage of home dialysis. As it can be considered that the push for home dialysis is relatively new in the dialysis world, it is still considered a change. Roger's theory is appropriate in helping to explain physicians' willingness to change their traditional habits of starting a patient on in-center hemodialysis. This quantitative study will use multiple linear regression to demonstrate the relationship between nephrologist characteristics and home dialysis usage. Understanding this relationship can change patient education, physician education, and if successful, influence Medicare spending in the United States.

The basis of this study is built upon the results of previous studies and explores the relationship between nephrologist characteristics and home dialysis utilization in the United States. This chapter discussed the importance of studying this relationship and outlined the specific research questions to be addressed. Additionally, the social impact of this research was discussed. This study's results can change how home dialysis is

addressed in physician education to encourage home dialysis usage. The increased usage of home dialysis would provide substantial savings for Medicare every year as home dialysis is significantly more cost-effective than in-center hemodialysis. Finally, home dialysis offers quality-of-life benefits to patients, such as continuing social activities and employment.

In Chapter Two, I will discuss the current literature about similar and relevant topics used when researching this study.

Chapter 2: Literature Review

Introduction

Forms of home dialysis have been accepted as an effective means of treating ESRD, but it is underutilized. The underuse of home dialysis reasons has varied with most of the literature focused on patient characteristics. Some researchers suggested that home dialysis is utilized less due to patient preference (Morfin et al., 2018). Others have suggested that modality education, access to home dialysis, physician preference, and medical/social barriers contribute to the lack of use (Chiang et al., 2016). Despite efforts to encourage the use of home dialysis, physicians acknowledge that many more of their patients may be medically able to perform dialysis at home than are doing so (Liu et al., 2014). In addition to patient characteristics that may affect home dialysis use, physicians play a role in determining the modality of treatment that a patient chooses. The purpose of this study was to understand the relationship between nephrologist characteristics and the use of home dialysis and home modality education using a quantitative, correlational design. I sought to understand two characteristics of nephrologists, their length of time in practice and their participation in a Joint Venture practice with a home dialysis program, and how this may impact their use of home dialysis and modality education.

Prior studies performed in other medical specialties demonstrated that change could be slow to occur in practice when physicians feel that they must change their knowledge base and unlearn what they felt they knew (Gupta et al., 2017). The longer a nephrologist is in practice, the harder it may be to switch from the traditional view of recommending hemodialysis for patients to encouraging the use of home dialysis. The

current literature does not show clear correlations between a nephrologist's time in practice and a joint venture's financial participation. For instance, there have been findings of inequity in Joint Ventures due to a desire to improve financial outcomes (Trybou et al., 2014). As home dialysis is more financially beneficial for dialysis providers, nephrologists who participate in a Joint Venture with a home program may be more likely to recommend home dialysis (Hollingsworth et al., 2009). Nevertheless, there is a need to research further the relationship between nephrologist characteristics and the use of home dialysis to fill gaps in the literature and make definitive conclusions. As a result of the lack of understanding of the relationship between nephrologist characteristics and home dialysis use, the attempts to increase home dialysis in the United States may be misinformed, not allowing patients to benefit from home dialysis.

In Chapter 2, I provide a literature review to discuss the study problem. I discuss the application of Roger's diffusions of innovations theory to this study and integration into the literature. The chapter ends with a summary.

Literature Search Strategy

I used The Walden Library databases as the primary resource for locating literature related to the research topics. Additionally, I ran searches in well-known government and Kidney and Dialysis advocacy websites, such as the National Kidney Foundation, for information about the topics. Searches of key words initially included: *dialysis, home dialysis, peritoneal dialysis, Medicare, home first dialysis system, home first dialysis, home first dialysis model, End-Stage Renal Disease, Chronic Kidney Disease, home dialysis and nephrologist, and cost of dialysis*. These searches provided a

starting point for information regarding the cost of dialysis and its effects on the Medicare system. Additionally, the literature explained how home first dialysis models are utilized successfully in other countries, which led to the need to search for additional literature that discussed why home dialysis is under-utilized in the United States. I then further conducted searches using the Walden library under the search terms *nephrologist characteristics, home dialysis education, modality education, home dialysis education, underuse of home dialysis, patient choice in dialysis, Joint Ventures in dialysis, nephrologist participation in Joint Ventures, nephrologist years in practice, and nephrologist years in practice and home dialysis utilization*. I set the search parameters for peer-reviewed sources published within the last 10 years of the date being searched.

Theoretical Foundation

Rogers's diffusion of innovations theory indicates that innovation adoption occurs at different rates and occurs in five primary stages: knowledge, persuasion, decision, implementation, and confirmation (Rogers, 1962). The adopter and innovation, time, communication channels, and social channels influence the diffusion of innovation, and that uptake of innovation can be a slow process (Rogers, 1962). I conducted this research to show the relationship between the nephrologist's characteristics and willingness to use home dialysis, an innovation that is not always used in the industry. In seeking to understand the relationship between the length of time that a nephrologist has been in practice and the likelihood that a patient was placed on home dialysis as well as the likelihood of a patient receiving modality education, I examined the aspects of Rogers's theory that address the classification structure of adopters. This classification states that

early adopters will embrace and readily implement change. In contrast, late adopters will be skeptical and reluctant to adapt to change until most peers have done so (Rogers, 1962).

Previous researchers in medicine and the health care field have utilized Rogers's theory to analyze and explain the relationship between physician behavior and the adoption of practices. Innovation characteristics play a role in adopting care management practices of chronic illnesses by physician organizations (Mohammadi et al., 2018). Another study involving Rogers's theory of diffusion of innovation in the field of nephrology and transplantation focused on understanding how a testing procedure was adopted by physicians' depending on their perceptions of it being new to the field (Gordon et al., 2018). Thus, diffusion of innovation theory is used to help establish the relationship between the underuse of a practice or process and the human group with the most direct relationship due to the multilayer cycle, including all subjects. Though this theory has been applied many times to different areas of medicine, it has not been applied to nephrologists and home dialysis.

Rogers's diffusion of innovation theory suggests that ideas or practices are adopted in stages based on the characteristics of individuals (Rogers, 1962). Some are quick to adopt, while others wait until others in their social cohort have already done so. They must adopt or be seen as obsolete. In this study, I hypothesized that nephrologists who have been in practice longer and do not belong to a Joint Venture partnership with a home dialysis program are among the laggards of innovation theory and adopt home dialysis more slowly. Home dialysis is a concept that was not in practice for many

nephrologists when trained, so many may not see a reason to change methods when in-center dialysis has worked well for many years. Older generations of doctors had resisted accepting the new technology in dialysis when dialysis centers were first created, and the newer generations of nephrologists were enthusiastic and proponents (Stanton, 2012). Additionally, suppose the physician is not a part of a Joint Venture partnership with a home dialysis program. In that case, there is no cost incentive for the program to do well, which could override the years in practice factor to encourage home dialysis.

Given the all-inclusive nature of Rogers's theory and its widespread use in demonstrating physician behavior in other process acceptance, adopting the diffusion of innovation theory was a natural choice for this study. The underuse of home dialysis has been attributed to many factors, but there has been little progress. Rogers' theory provides not only a cycle of acceptance but characteristics of the participant during each phase. The steps of Rogers's diffusion of innovation cycle were used to establish the relationship between the nephrologists' years in practice and participation in a Joint Venture and the effects of the use of home dialysis and a patient receiving modality education.

Literature Review Related to Key Variables

In this section, the literature related to the key concepts and principles of the study is reviewed. These concepts include home dialysis, the use of home dialysis, the implication of underuse on Medicare in the United States, influence over patient modality choice, nephrologist time in practice and adoption of innovation, and nephrologist participation in a Joint Venture and adoption of innovation.

Home Dialysis Underutilization

Hemodialysis was introduced in the 1940s as a way to treat patients with inadequately functioning kidneys. Due to the limitations of the technology at the time, the treatment was only successful for those now known as acute patients, whose kidney failure was temporary. The introduction of vascular accesses in the 1960s allowed hemodialysis to become a chronic treatment for patients with irreversible kidney damage. As technology improved the equipment for hemodialysis, it also allowed for the creation of peritoneal dialysis, which allowed a patient to use a sterile solution and the membrane of their peritoneum to perform dialysis at home. The introduction of the peritoneal catheter in 1964 was the catalyst for turning this into a viable treatment option. Advancing technology allowed for more dialysis patients to receive treatment but at an extreme cost.

Two primary forms of dialysis exist to treat ESRD patients: hemodialysis and peritoneal dialysis. Hemodialysis can be performed at an outpatient center, under staff supervision three times per week, or by the patient after receiving specialized training at home (American Kidney Fund, 2020). An artificial kidney, known as a dialyzer, combined with a fluid known as dialysate, is used to clean the blood of waste and excess fluid. The patient's blood is accessed through either a graft or fistula using large gauge needles, which allow the blood cells to pass through without breaking or through a central venous catheter. The second form, peritoneal dialysis, involves dialysate solution and the patients' peritoneal membrane in the abdomen. The solution is placed in the abdomen through a peritoneal catheter and left to dwell for several hours; it is then

drained, and the fluid replaced. Peritoneal dialysis is well documented as a cost-effective and equal, if not sometimes superior alternative to in-center hemodialysis (Anderson & Friedman, 2013). The Veterans Administration recognized the effectiveness of home dialysis and awarded several contracts that demonstrated their support of home dialysis.

Additionally, Congress passed an amendment in 1972, which extended Medicare to those with ESRD; 40% of patients were on home dialysis (Bednar & Latham, 2014). According to the United States Renal Data System (2019), home dialysis reached its most underutilized point in 2007. Home dialysis still only accounts for 4% of all dialysis patients in the United States (including peritoneal dialysis and home hemodialysis). Thus, the United States is behind in its adoption as the modality of first choice.

The quest to understand the underuse of home dialysis in the United States is not a new topic to research. The question has been formed in many ways by multiple researchers. Given the prohibitive cost of dialysis on the United States Medicare system, extensive research has been conducted on the value of a home dialysis first system and what this would mean financially if implemented for the United States. For example, Thodis and Oreopoulos (2011) provided a comprehensive overview of the differences between in-center hemodialysis and home dialysis. They outlined that home dialysis demonstrates better patient outcomes and can be a far more cost-effective alternative to in-center treatment. The literature also highlights the significant variance in usage between countries, with a high rate of usage (85%) in Mexico and low usage in Japan (4%); the United States ranks in between at 14% (Thodis & Oreopoulos, 2011). The most desirable and logical approach may be for the United States to take a peritoneal dialysis

first approach as has been done in other equally developed countries (Wong et al., 2020). A home first approach may have cost savings for both healthcare practitioners and society.

Though home dialysis can help save money and offers positive contributions to the patients' health and well-being, research cannot identify why it is not utilized in the way it should be. The United States has not made much positive movement in patients starting and continuing home dialysis rather than in-center dialysis. In July 2019, President Trump signed an executive order to increase the number of patients who receive home dialysis and improve the quality of treatment for dialysis patients (U.S. Government, 2019). In this order it is desired by 2025, 80% of dialysis patients will be on a form of home dialysis (Hartwell, 2019). However, it will take great efforts to move from the single digits to 80% and identification of the barriers of underuse of home dialysis to meet this goal.

Cost of Dialysis and Social Implications

ESRD is unique in that it is the only disease to have its own government program. Most patients receiving dialysis will become recipients of Medicare at some point in their lifetime. Even those who have commercial health insurance through an employer, or family member's employer, become insured primarily by Medicare 36 months after starting dialysis, and their commercial insurance becomes secondary (Centers for Medicare & Medicaid Services, 2019). The rising number of patients needing dialysis has thus created a great interest in understanding what can and should be done to control the spending that dialysis treatments inflict upon, specifically Medicare, every year.

Anderson and Friedman (2013) predicted that by 2022, the federal government is likely to have a debt above \$22 trillion growing over time due to the heavy economic burden of Medicare costs such as dialysis. In their study, Anderson and Friedman (2013) recommended many methods not currently in place to reduce the cost of the dialysis burden on Medicare. These include restricting access to dialysis, delaying the onset of dialysis, and mandating a home first dialysis system. These suggestions support the research done by Liu et al. (2014). Their findings indicated that a rise of home dialysis patients (and thus reducing in-center patients) at steady intervals over 5 years could pose a savings of as much as \$350.9 million under the current Medicare bundled payment system.

In contrast, a decrease in home dialysis could pose an extra expense of upwards of \$120 million. United States Renal Data System (2019) reported that peritoneal dialysis is a significantly less expensive treatment option per patient at \$78,159 per year versus in-center hemodialysis at \$91,795 per year. As the United States moves forward into a time where technology continues to increase the average American lifespan, and the generation of those entitled to Medicare is expected to cause strain on the Medicare budget already, the extreme cost difference between the two modalities is worth noting.

Modality Choice

Literature to date has explored many aspects of the underuse of dialysis. Researchers have evaluated quantitatively and qualitatively the demographic and socioeconomic factors of patients that may prohibit them from utilizing dialysis. Some

studies have also focused on quality-of-life factors that dissuade patients and caregivers from choosing the modality. This exhaustive research has reached a limit of effectiveness. Nearly all aspects of the patient that can be manipulated and modified have been evaluated and acted upon by an entity in recent history with little result in the United States. What has become clear from the research is that the nephrologist is the driving force in patient decision-making when choosing a form of dialysis. The current literature fails to evaluate the nephrologist on the same level that previous literature has evaluated the patient. Demographics of the nephrologist have not been explored for relationships to their utilization of home dialysis.

For some, the question was what informs a patient's decision to receive home dialysis. Tranter (2016) conducted a qualitative study among patients in Australia with Greek backgrounds and determined that age and cultural influences influenced a patient's choice in dialysis modality. Interestingly, one theme that emerged from her research was "the doctor told me," indicating that the doctor told the patient to do in-center hemodialysis. The study specifically cited examples of patients stating they are not physicians and felt they should do what their doctor said because he knew best. However, this study did not explore the characteristics of the nephrologist, nor did it evaluate why those physicians did not feel these patients were suitable for home dialysis. Walker et al. (2016) assessed the physician's role in their study of New Zealand patients. They determined that the nephrologist was the most influential factor in the patient's decision-making process. The authors went so far as to conclude that it was essential that nephrologists advocate for home dialysis and recommend it to their well-suited patients.

They failed, to explore reasons why nephrologists do not suggest or advocate for home dialysis for their well-suited patients or the factors that influence why a nephrologist may not favor home dialysis. Osterlund et al. (2014) had similar findings in their Canadian conducted study. Though their research did include the characteristics of nephrologists surveyed, including time of years in practice, it was not included in overall findings. Their conclusions acknowledged that physician perception was a determining factor in the recommendation of home modality, but they did not explore in-depth reasons for physician preference. The authors briefly alluded to the possibility of lower reimbursement rates for home dialysis as a reason that physicians may not favor home dialysis. Additionally, they indicated that modality education was a critical factor in selecting home dialysis but did not explore the relationship between patient referral for education and nephrologist characteristics.

Some, such as Do Couto Nobre et al. (2017), have taken a more straightforward approach, whose research quantitatively measured patients' demographics to determine the likelihood of choosing peritoneal dialysis. Factors such as race, gender, educational status, marital status, and socioeconomic status were evaluated as indicators of the use and success rate of peritoneal (home dialysis) usage. Demographic data is a popular study approach due to the availability of data via government reporting agencies publicly on a routine basis, making it readily available and relatively dependable. All dialysis facilities collect it as part of their reporting processes. Unfortunately, having been well researched, this data provides little value beyond the surface information already known to the dialysis community. It does not explore how those factors are impacted by nephrologist

behaviors or other factors that could alter the outcome of choosing dialysis, such as receiving modality education. Morfin et al. (2018) focus on the underuse of home dialysis in the United States, despite it being the treatment of choice by many professionals if they were to need dialysis themselves. Per their study, it is determined that patients choose to steer away from home modalities due to lack of modality education, poor timing in decision making, anxiety, psychosocial challenges, and lack of resources. Despite their in-depth conclusions, one area the authors fail to explore is why patients experience this lack of education, poor timing in decision-making, anxiety, and the nephrologist's role.

Nephrologist Length of Time in Practice

It is clear from the literature that the nephrologist plays a role in a patient's decision-making process when choosing a treatment modality. What is unclear is how and what influences the nephrologist to decide what treatment modality to recommend and why. Additionally, there is an underlying question regarding the relationship between the length of time a physician has been in practice and its effect on their adoption of home dialysis as an acceptable treatment option. Gupta et al. (2017) conducted a study involving 15 physicians ranging in years of practice (1-15 years). From the interviews they conducted, it became clear that it was more difficult for physicians to implement change when it involved what the researchers referred to as "unlearning" rather than simply adding another step to their process. When physicians felt that their knowledge base, what they were well versed in, was changed, and had to be converted to something new, they found this challenging and often fell back into an outdated method or habit. Hemodialysis has been the most popular and widely used treatment method for many

decades. One could theorize that the longer a physician has been in practice, the less likely they will be comfortable educating on home dialysis and recommending it. The physicians may find themselves falling back into the outdated method of supporting hemodialysis. Thus, understanding the relationship between the nephrologist's length of time in practice and utilization of home dialysis is key in addressing the underuse of home dialysis.

Scott et al. (2008) conducted a study on the adoption of Heart Health Kits in Canada. They suggested a direct negative relationship between the years a physician has been in practice and the adoption of the kit. They proposed and cited additional studies which supported that the longer a physician has been in practice, the less willing they are to adopt new techniques, concepts, or treatments. Pommer et al. (2018) address a correlation between nephrologist age and the use of home dialysis in their study conducted in Germany. They found that home dialysis options were offered more frequently in centers where the physicians were of a higher age group. They offered possible explanations of higher levels of experience and expertise but noted that only a tiny proportion of ESRD patients in Germany were utilizing home dialysis (5%). The authors ultimately determined, in their study, that it was the more experienced and enthusiastically home dialysis supportive staff of the physician that made the difference. Glickman and Seshasai (2018) sought to understand the connection between the training of nephrologists and the use of home hemodialysis. Their study found that 61.7% of recent graduates self-reported a lack of training in home hemodialysis. They concluded that the lack of training in this area could lead to the new physicians' disinterest and lack

of modality use. Similarly, a study of 133 nephrologists who completed their training in the United States between 2004 and 2008 found that 44% self-reported not feeling competent in the care of peritoneal dialysis patients (Mehrotra, 2018).

While literature reviews of studies conducted on physicians outside of the specialized area of nephrology seem to indicate that a shorter length of time in practice would indicate a higher likelihood of referral to home dialysis, studies that focus more specifically on the specialty appear to indicate otherwise. The conflicting information leaves an unanswered question of whether the amount of time a nephrologist spends in practice harms their referral to home dialysis. Understanding the relationship between the length of time in practice and referral to home dialysis is vital to making future predictions of home dialysis referral as physicians retire and enter the field.

Joint Venture Participation

Many dialysis facilities are owned by private organizations solely. However, in some instances, in Joint Venture clinics, a nephrologist or group of nephrologists have a financial investment in a facility. The role belonging to a Joint-Venture with a home dialysis program plays in a nephrologist's utilization of home dialysis is also largely unexplored. Joint Venture partnerships are an anomaly of sorts; the loophole to so many well-placed and necessary regulations intended to protect the patient's interest in situations such as these. In dialysis, a nephrologist can be a partner in a Joint Venture practice and refer their patients while being exempt from the very laws that prohibit such actions. These facilities are mainly unexplored in the world of dialysis and lack transparency for those outside looking in. Physicians who participate in Joint Venture

partnerships are not required to disclose their investment in the facility with their patients nor make information about their venture public. Consequently, how this affects patient outcomes, including if there is an effect on if a nephrologist is more likely to place a patient on home dialysis if they participate in a Joint Venture facility with a home modalities program, is unclear.

The promotion of Joint Venture facilities describes them as a way of creating success for patients through clinical outcomes and satisfaction by aligning nephrologist and dialysis provider interests; a lack of research exists to confirm such an assertion (Penn Medicine News, 2018). Berns et al. (2018) raise the question of conflict of interest for physicians- do they cherry-pick healthier patients? Do they start patients sooner? The inference in this study would be that it would be to the physicians' benefit to start patients who have fewer co-morbidities and would presumably have better outcomes in their clinics. However, they fail to establish a clear relationship between the characteristics of a nephrologist belonging to a Joint Venture with a home dialysis program and its effects on home dialysis utilization.

Trybou et al. (2014) explored the many facets of Joint Venture facilities with specialty care. Though this study focused on acute care, which differs from the chronic care of dialysis, several concepts could still be transferred. One of these was the effect on equity of care. Due to the nature of having a vested interest in the finances of the organization, physicians were more likely to send patients who were well insured and with the ability to maximize their profits. This concept is the basis for exploring the relationship between a nephrologist's participation in a Joint Venture partnership and

their use of home dialysis. Based on the cost differentiation of home dialysis and in-center dialysis, a dialysis facility is financially more profitable to treat a home dialysis patient. If a physician has a financial interest in the clinic, based on Trybou et al. (2014), there would be a positive correlation in utilizing home dialysis. Hollingsworth et al. (2009) examined the relationship between Urologist ownership in ambulatory surgery centers and urinary stone surgery. Among the conclusions drawn was that those urologists who were owners in ambulatory surgery centers performed more surgeries in the ambulatory surgery centers than those who were not owners.

Additionally, they determined that owner surgeons performed twice as many procedures as surgeons who were not owners. Therefore, the conclusion was drawn that there was a strong association between urologist ownership in the ambulatory surgery center and increased use of this particular surgery. Trybou et al. (2014) indicated a positive correlation in using a center when a physician has a financial interest. It is logical to conclude that nephrologists who have a financial investment in a Joint Venture clinic would be more likely to use home dialysis if they are a Joint Venture partner. Hollingsworth et al. (2009) further supported this indicating that physicians are twice as likely to perform a procedure in a clinic where they have financial ownership. Unfortunately, no specific study to date seeks to explain the relationship between a nephrologist's participation in a Joint Venture and its effect on their utilization of home dialysis. While the findings of other areas of medicine can be applied with some confidence, there is still a large void of certainty to be filled as there are significant operational differences between Dialysis Joint Ventures and outpatient surgery centers.

Summary and Conclusions

Home dialysis underuse is a problem that needs to be researched and studied for the profession to act upon. The research conducted to date appears to categorize this problem as patient based. It fails to specify how nephrologist characteristics, length of time in practice, and participation in a Joint Venture, impact the utilization of home dialysis and modality education. This chapter highlighted current literature on the underuse of home dialysis in the United States and highlighted themes common to barriers in the use of home dialysis. Additionally, gaps within the research identified a notable theme of lack of data regarding the relationship between nephrologist characteristics and the utilization of home dialysis. In Chapter 3, the research methods utilized in this study's design will be discussed. Additionally, the rationale, methodology, the validity of data collected, and ethical procedures will be addressed.

Chapter 3: Research Method

Introduction

The purpose of this quantitative, correlational study was to identify the relationship, if any, between the length of time a nephrologist is in practice, belonging to a Joint Venture practice with a home dialysis program, and the use of home dialysis programs and home modality education. I included modifiers of patient age and venue of treatment (in-patient, outpatient).

I conducted this quantitative study using a correlational design and utilized multiple linear regression analysis to demonstrate the relationship between the dependent and independent variables of the study. In this chapter, I will discuss the methods used for selecting and collecting the data, and the threats to the validity of the data, such as selection bias.

Research Design and Rationale

There were two independent variables relating to the nephrologist used in this study. I identified Nephrologists as belonging to a Joint Venture practice or not belonging to a Joint Venture practice. The two dependent variables in this study were the percent of patients placed on home dialysis and the percent of patients who received modality education. In both instances, the variable held the possibility of being indicative of the provider being supportive of home dialysis. The field of nephrology uses data from patient cases to determine relationships and future trends in treatment. In this way, correlational research is the optimal research design when studying nearly any relationship between variables in the field. Correlational research is not intended to be

experimental but somewhat predictive and explanatory of relationships among variables, which made the use of this design for this study logical (Seeram, 2019).

The central focus of this study was to understand the relationship, if any, between the characteristics of the nephrologist, namely length of time in practice and participation in a Joint Venture partnership with a home dialysis program, and the percent of patients with placement on home dialysis and who received modality education. A longer length of time in practice in other fields has been tied to a resistance to change in practice, such as using new techniques or treatments when physicians felt they must change their knowledge base (Gupta et al., 2017). Adversely, it was found that nephrologists who participate in Joint Venture facilities demonstrate higher usage of services, though this was not specific to home dialysis (Trybou et al., 2014). Understanding the relationships of these variables, if any, can direct those involved in the field more constructively.

Methodology

Population

Dialysis patients account for 1% of the U.S. Medicare population and approximately 7% of the Medicare budget, with nearly 750,000 people living with kidney failure in the United States. It is estimated that 90% of the ESRD population receives treatment using in-center hemodialysis, with the remaining population receiving transplants or home dialysis (The Regents of the University of California, 2002-2020). Over 8,000 nephrologists treat Medicare-insured dialysis patients for 2017 (U.S. Centers for Medicare & Medicaid Services, 2020).

Sampling and Sampling Procedures

Non-probabilistic sampling, though convenient, does bear the burden of sampling errors that cannot be easily identified. This study required a specific subset of patients and physicians, which could only be accomplished through purposive sampling.

Sampling needed to include physicians who treat dialysis patients at onset specifically and include specific HCPCS codes to account for adult dialysis patients in the outpatient setting. As not all nephrologists treat these patients, some are pediatric physicians, or some only treat patients before starting dialysis, purposive sampling is the ideal choice.

The data were first narrowed down from CMS Provider and Other Supplier Utilization File CY 2018 report to nephrologists located in Illinois, as Joint Venture ownership information is available on these physicians through Illinois Health Facilities Services Review Board (HFSRB). Following this, I narrowed down the dataset further by HCPCS codes 90951-90966 and 90967-90970. I then cross-referenced nephrologists to identify their year of graduation from medical school to determine their number of years in practice. Finally, I matched nephrologists to determine participation in a Joint Venture facility. I excluded nephrologists who did not have a year of graduation listed from the dataset.

I ran a power analysis to determine the effect size, power, and sample size for the study using G*Power 3.1.9.4 software. I set the input parameters as follows: effect size: 0.15, error probability: 0.05, Power 0.95, Number of Predictors: 4. I set the number of predictors at 4 to account for the two independent variables, and the two covariates were

used to account for bias. I determined the total sample size was needed to be 129, which the sample more than exceeded.

Procedures for Recruitment, Participation, and Data Collection

I used publicly available data from the CMS to obtain data related to HCPCS codes and nephrologist information, including years in practice. Illinois provides facility profile reports to the public, and this report was used to identify participation in a Joint Venture facility. Data were obtained from public sources, specifically the Centers for Medicare and Medicaid Website and the Illinois HFSRB website, and do not require special access. There was no need for special permission or out-of-the-ordinary procedures to access the datasets.

CMS datasets are widely used as benchmarks in the United States for many types of reporting in healthcare and provide a reliable and consistent data source. The PUF is a comprehensive file of data gathered from CMS administrative claims for Medicare beneficiaries participating in the fee-for-service program. The used file contains data collected for the calendar year 2018 and is "100% final-action physician/supplier Part B non-institutional line items for the Medicare fee-for-service population" (Centers for Medicare & Medicaid Services, 2019, p3). Access is available to the public through the CMS website and does not involve additional permission. I identified nephrologists and filtered them based on the "Physician and Other Supplier Aggregate table CY2018" report. Filters narrowed nephrologists down to those with a practice address registered in the state of Ohio. I then set the filters to narrow down the number of beneficiaries using HCPCS codes 90951-90966 for in-center hemodialysis patients and 90967-90970 for

home dialysis patients. I determined the HCPCS codes using the document "End Stage Renal Disease (ESRD) and Dialysis-Related Services Fact Sheet" (CGS Administrators, LLC., 2020). I removed physicians who did not have patients in the code range for the year from the dataset. I determined the number of years a physician was in practice using the Physician Compare National Downloadable File. After narrowing Physicians down by specialty to Nephrologist, a v-lookup was used to match the physician to their year of graduation from medical school based on their NPI number. I determined the years in practice by subtracting their graduation year from the year 2018. If I could not positively confirm the number of years a physician had been in practice or if a physician participated in Joint Venture, the data were eliminated from the study.

I collected Joint Venture information using the Facility Profiles and Summary Sheets available on the HFSRB website for Illinois. I selected the 2018 ESRD Questionnaire Data File, which provided an excel sheet that included several different tabs, one of which was "facility information". On this tab, I found that each facility in the state was listed out along with the owners, and types of owners. I narrowed the facilities down to those that offered home dialysis. After doing this, I then filtered down to those facilities that had owners who were listed as JV or Partner.

Operationalization of Variables

In this study, I identified two independent variables: nephrologist's length of time in practice and nephrologist's participation in a Joint Venture practice with a home modality program. The number of years since graduation from medical school as of 2018 determined a nephrologist's length of time in practice. I also categorized nephrologists

according to participation in a Joint Venture practice with a home modality program. Nephrologists that belonged to a group of nephrologists identified to have ownership in a dialysis facility as of December 2018 that had a home dialysis program, were categorized as a Joint Venture participating nephrologist.

I identified two covariates to control for possible selection bias in the study. These are already controlled for within the HCPCS codes. They are the age of the patient being 20 or older and place of treatment. Limiting the data to patients aged 20 or older ensures that pediatric patients who may be more likely to use home dialysis due to its continuous and gentler nature are omitted. Outpatient treatment setting ensured that patients who are hospitalized and being treated for acute kidney failure were not included in the data.

In this study two dependent variables are specified: the percent of patients placed on home dialysis and the percent receiving modality education. I created the dependent variables at the physician level using data in the CMS report. The number of patients placed on home dialysis by each physician divided by the total number of patients receiving dialysis provided the percent of patients being placed on home dialysis. The number of patients who received modality education by physician divided by the total number of patients provided the percent of patients receiving modality education. The tests were run using physician length of time practice and Joint Venture participation as the independent variables and the percent of patients placed on home dialysis as dependent variables. The test was then repeated but with the percent of patients receiving modality education as the dependent variable. Multiple linear regression analysis was intended to determine both variables.

Data Analysis Plan

Data were analyzed using IBM SPSS software. Nephrologists that do not have results for any of the identified HCPCS codes were eliminated from the study. Using SPSS, tests of assumptions for linearity, multicollinearity, normality, and homoscedasticity were run. Collinearity diagnostics were run in addition to a standard probability plot. The absence of multicollinearity was assessed utilizing the coefficients table and the VIF values; a value below 10 indicates that the assumption was met.

Research Question 1

Research Question 1 (RQ1): What is the relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percent of patients age 20 and over placed on outpatient home dialysis?

Null Hypothesis (H_0 1): There is no statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percent of patients age 20 and over placed on outpatient home dialysis.

Alternative Hypothesis (H_1 1): There is a statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percent of patients age 20 and over placed on outpatient home dialysis.

To model the relationship between the independent variables, the characteristics of the nephrologist, with the dependent variables of the percent of patients being placed

on home dialysis, to decide to either accept or reject the null hypothesis, multiple linear regression was used. I used a significance level of $p < 0.05$ by performing a t test on the regression coefficient. Variation in the dependent variable is explained in the ANOVA table, with a value of less than .05, indicating that the variation shown has a low probability of resulting from chance (Sage Publishing, 2019).

Research Question 2

Research Question 2 (RQ2): What is the relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis?

Null Hypothesis (H_02): There is no statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis.

Alternative Hypothesis (H_12): There is a statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis

To model the relationship between the independent variables, the characteristics of the nephrologist, with the dependent variable of the percent of patients receiving modality education before starting dialysis to decide to either accept or reject the null hypothesis, multiple linear regression was used. I used a significance level of $p < 0.05$ by

performing a *t* test on the regression coefficient. Variation in the dependent variable is explained in the ANOVA table, with a value of less than .05, indicating that the variation shown has a low probability of resulting from chance (Sage Publishing, 2019).

Threats to Validity

External Threats

External threats to validity include incorrect data entry from the source. As this is secondary data, errors cannot be verified or fixed and therefore leave room for a margin of error. Data were sourced from two different agencies and may lead to conflicting or missing information. Potential selection bias for Joint Venture participation existed and could bias the results of this study. Suppose a physician is a larger proponent of home dialysis. In that case, they may also be more likely to participate in a Joint Venture practice with a home program, thus causing potential selection bias. These physicians can have larger than average numbers of home dialysis patients. They often work in large group practices and may take on patients from partners who do not follow home dialysis patients. In this way, patients could be falsely classified when determining who provided modality education, as this occurs before starting dialysis. Additionally, the following physician may look falsely inflated for the number of starts and the initial nephrologist falsely low. External threats were minimized to the best of my ability by excluding missing or non-verifiable information.

Internal Threats

As all information was not available in one location and had to be combined, an error is an internal threat. Additionally, as I worked in the field for a substantial amount of time, careful consideration had to be given to ensure that internal bias did not play a part through an assumption of information. All information was combined and filtered utilizing systems such as Microsoft Excel to minimize errors and bias where filters could be applied using specific parameters.

Ethical Considerations

This study used publicly available secondary data that did not require special permission or agreements to access. All data is available via the internet and is public knowledge. This study acknowledges the ethical principles of consent, beneficence, non-maleficence, and justice. By submitting data to CMS and other public reporting agencies, physicians know that their information may be utilized for research, and additional permission is not required to utilize this data. This study does not intend to release individual provider statistics; thus, confidentiality concerns are eliminated. Data were stored on a hard drive protected by a password that was changed every six months. Upon completion of the study, the dataset will be erased from the hard drive.

Summary

This chapter discussed the correlational design of this quantitative multiple logistical regression study which utilizes secondary data to determine the relationships between a nephrologist's length of time in practice, participation in a Joint Venture

financial arrangement, and the percent of patients being referred for home dialysis and modality education.

Utilizing data from CMS and the Illinois HFSRB, I used multiple linear regression to determine the relationships of the variables. Data collected from CMS and the Illinois HFSRB was utilized to determine the number of patients placed on home dialysis by physicians in the year 2018. Nephrologists were grouped based on years in practice based on their medical school graduation date and whether they participated in a Joint Venture practice. Multiple linear regression was utilized to determine the relationship between the percent of patients placed on home dialysis and receiving modality education and the independent variables. Threats to validity and ethical considerations were discussed. The following chapter will discuss the study and results.

Chapter 4: Results

Introduction

The purpose of this study was to understand the relationship between nephrologist characteristics and the use of home dialysis and home modality education using a quantitative, correlational design. Throughout the data analysis and collection process, I sought to answer the following two questions:

Research Question 1 (RQ1): What is the relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percent of patients age 20 and over placed on outpatient home dialysis?

Null Hypothesis (H_0): There is no statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percent of patients age 20 and over placed on outpatient home dialysis.

Alternative Hypothesis (H_1): There is a statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percent of patients age 20 and over placed on outpatient home dialysis.

Research Question 2 (RQ2): What is the relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis?

Null Hypothesis (H_0): There is no statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis.

Alternative Hypothesis (H_1): There is a statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis

In Chapter Four, I discuss the study results and the unanticipated challenges that I experienced in the data analysis and collection phase. Additionally, I discuss the results of the statistical data analysis in answering the research questions.

Data Collection

Data collection for this study occurred between July 17, 2021, and August 07, 2021, after final Institutional Review Board (IRB) approval was received on July 16, 2021 (approval #07-16-21-0731749). As this was secondary data, recruitment and response rates were not an issue. Initially, data from the state of Ohio were to be used as the sample for this study. After examining the State of Ohio's Facility Report, I realized that there was no way to reliably match the listed owners/potential Joint Venture partners in their Facility Report to the data in the CMS reports. I researched to find another state that provided a reliable source of information. I found the state of Illinois provided a report for the calendar year of 2018, "Facility Profiles and Summary Sheets", which is publicly available and identified JV partners/physician owners. Thus, I determined that

the State of Illinois would provide a more reliable dataset, and the sample switched to focus on nephrologists in this state.

The sample consisted of 281 unique nephrologists, all of whom were registered in the CMS National Download File as having a primary specialty in nephrology and located in the state of Illinois. Approximately 11% of the sample reported patients receiving a form of home dialysis, which is in line with the national average for adult patients.

Treatment and/or Intervention Fidelity

I used The Medicare National Provider Download to obtain a provider's year of graduation from medical school and the practice that they belong to. The CMS Provider and Other Supplier Utilization File (PUF) CY 2018 contained the data relating to the number of beneficiaries receiving each type of dialysis and by each provider. Initially, I intended to use the Ohio Department of Health Facility Data Report to match nephrologists who were Joint Venture /physician owners. This data proved unreliable in matching the CMS data and eventually, I deemed it unusable.

The State of Illinois provided a report that clearly stated Joint Venture /physician owners, matched the CMS data, and was more reliable. I decided to use the State of Illinois as the sample instead. Beyond this, all other planned analyses were implemented.

Results

Research Question 1

I performed the first analysis to answer the following question:

Research Question 1 (RQ1): What is the relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percent of patients age 20 and over placed on outpatient home dialysis?

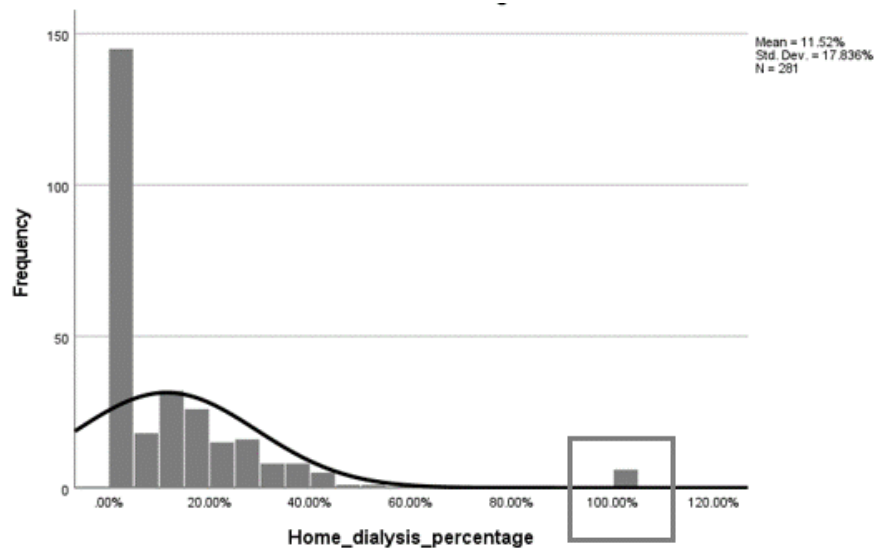
Null Hypothesis (H_0): There is no statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percent of patients age 20 and over placed on outpatient home dialysis.

Alternative Hypothesis (H_1): There is a statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percent of patients age 20 and over placed on outpatient home dialysis.

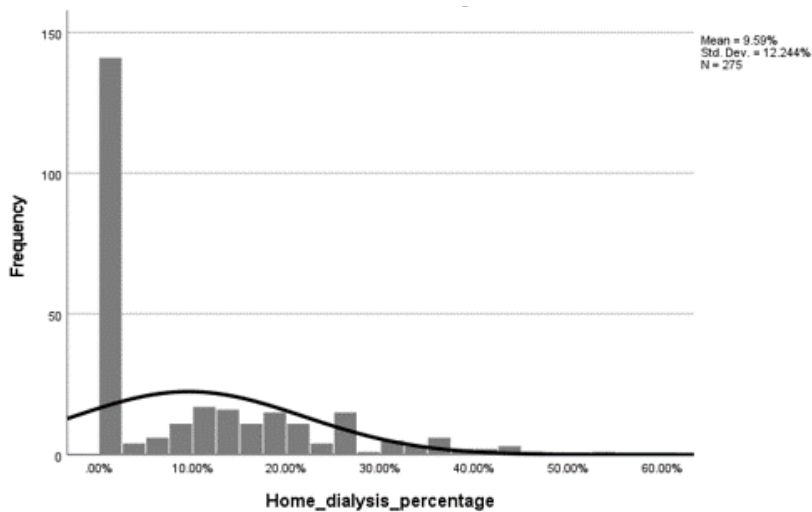
The data included six cases that were univariate outliers on home dialysis percentage and were adversely affecting the results, so these were removed from further analysis (See Figure 1 and Figure 2). Their z scores are 4.96 (i.e., 100 (their score) – 11.52 (the overall mean score) \div 17.84 (standard deviation) = 4.96). Typically, a z score > 3.29 is considered a univariate outlier.

Figure 1

Histogram of Home Dialysis Percentage with outliers

**Figure 2**

Histogram of Home Dialysis Percentage without outliers



Standardized residuals greater than 3.29 can sometimes be a concern, but there was only one case with a higher residual (See Tables 1 & 2, and Figure 3) and is relatively not of concern (it would not change the result and conclusion if excluded).

Table 1

Case wise Diagnostics

Case Number	Std. Residual	Home Dialysis Percentage	Predicted Value	Residual
		Age		
20	3.879	53.33%	8.5303%	44.80304%
21	3.217	45.83%	8.6784%	37.15496%
22	3.113	44.71%	8.7524%	35.95347%
23	3.002	43.31%	8.6255%	34.68160%

Table 2

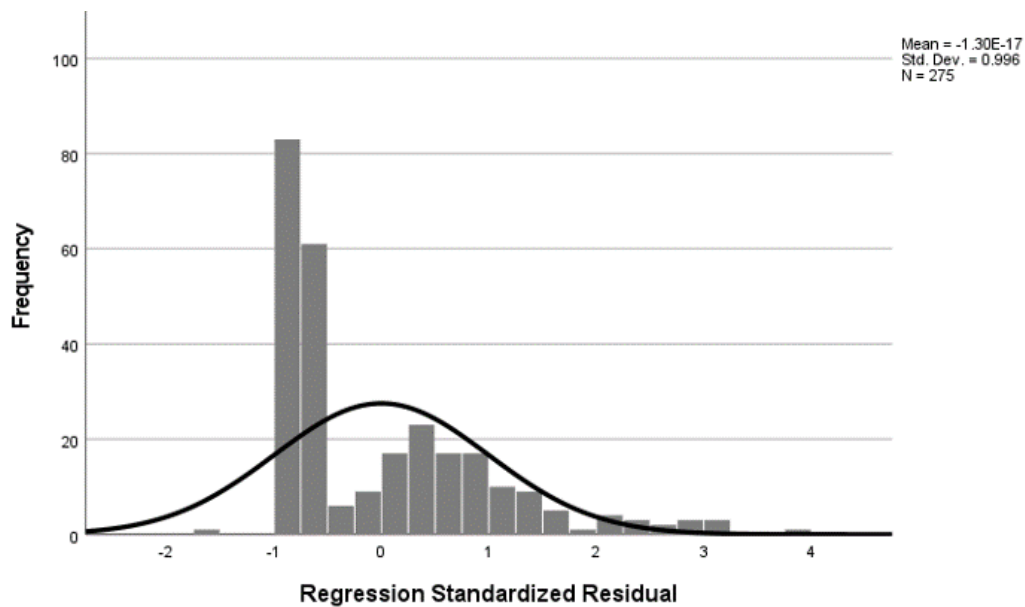
Residual Statistics of Home Dialysis Percentage

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	8.3399%	28.4797%	9.5854%	4.17765%	275
Std. Predicted Value	-.298	4.523	.000	1.000	275
Standard Error of	.714	3.372	1.076	.546	275

Predicted					
Value					
Adjusted					
Predicted	8.1053%	30.2062%	9.5954%	4.18274%	275
Value					
Residual	-18.532%	44.80304%	0.00000%	11.50896%	275
Std.					
Residual	-1.604	3.879	.000	.996	275
Stud.					
Residual	-1.677	3.894	.000	1.001	275
Deleted					
Residual	-20.258%	45.15791%	-0.0100%	11.60920%	275
Stud.					
Deleted	-1.683	4.000	.002	1.007	275
Residual					
Mahal.					
Distance	.049	22.355	1.993	4.338	275
Cook's					
Distance	.000	.087	.003	.007	275
Centered					
Leverage	.000	.082	.007	.016	275
Value					

Figure 3

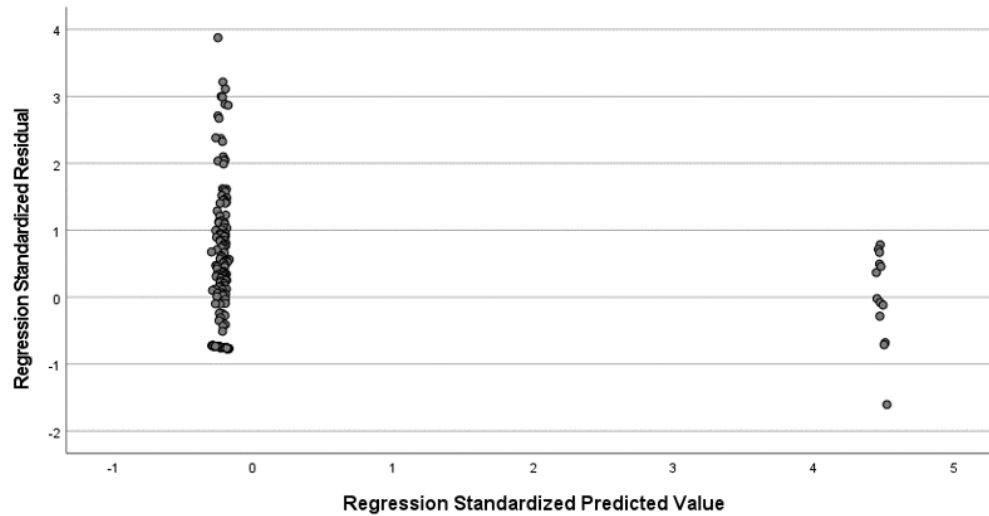
Histogram of the Residuals



The scatterplot for the dependent variable (Home Dialysis) indicates the Yes group (the dots on the right) had relatively normal standardized residuals (i.e., somewhat equal distribution above and below the 0-line). The No group had a less normal distribution of residuals but was acceptable (see Figure 4).

Figure 4

Scatterplot of Dependent Variable



Below is the ANOVA output (see Table 3) examining the mean difference between the No and Yes groups on home dialysis percentage without the six univariate outlier cases ($N = 275$).

Table 3

ANOVA output between-subject factors

JV/Partner	Value Label	N
.00	No	262
1.00	Yes	13

These are the means, standard deviations, and the number of cases in each group without the six outlier cases (See Table 4).

Table 4*Descriptive Statistics for the Dependent Variable*

JV/Partner	Mean	Std. Deviation	N
.00 No	8.6569%	11.66844%	262
1.00 Yes	28.2982%	7.96433%	13
Total	9.5854%	12.24373%	275

Homogeneity of variance was not violated as indicated by significance values greater than .05 for both the mean and median (See Table 5). This gives some confidence in the result even though there were only 13 cases in the Yes group.

Table 5*Levene's Test for Equality of Error Variances*

		Levene Statistic	df1	df2	Sig.
Home_dialysis	Based on Mean	3.399	1	273	.066
_percentage	Based on Median	.602	1	273	.439
	Based on Median and with adjusted df	.602	1	264.696	.439
	Based on trimmed mean	2.590	1	273	.109

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: Home_dialysis_percentage

b. Design: Intercept + partnerjv01

After removing the outliers, 275 nephrologists were left to be analyzed. On average, 9.6% of patients in the study were placed on home dialysis, which was in line with the national average as previously reported. The standard years in practice for a

physician had a mean of 24.18 years. The standard deviation was 11.393 years in practice (see Table 6). More specifically, 7% of the nephrologists had been in practice 0-10 years, 39% had been in practice 11 to 20 years, 26% had been in practice 21 to 30 years, 18% for 31 to 40 years, and 10% for greater than 40 years. Of the physicians in the study, 4.73% (n=13) belonged to a JV Practice.

Table 6

Descriptive Statistics without outliers

	Mean	Std. Deviation	N
Home_dialysis_percentage	9.5854%	12.24373%	275
JV/Partner	.0473	.21261	275
Years_in_Practice	24.18	11.393	275

Multiple linear regression was calculated to predict the percentage of patients placed on home dialysis based on a nephrologist's number of years in practice and participation in a Joint Venture with a home dialysis program. A significant regression equation was found, $F(2, 272) = 17.92, p < .001$, with an R^2 of .116 (see Table 7 & Table 8). I predicted the percent of patients placed on home dialysis is equal to $8.911 -.011$ (Nephrologist years in practice) + 19.674 (JV Participation), where nephrologist years in practice is measured in years, and JV Participation is coded as 0 = No, 1 = Yes. Participation in a Joint Venture was statistically significant, $t(272) = 5.98, p < .001$, uniquely accounting for 11.6% of the variance in home dialysis percentage (i.e., $100 \times \text{Part } r^2 = 100 \times .341 \times .341 = 11.6$). The unstandardized B-weight was 19.67, indicating

the JV Partner group had a home dialysis mean 19.67 points higher than the non-JV Partner group when controlling for years in practice. In the ANOVA below, you will see that controlling for years in practice did not affect the mean difference, 19.64 when not controlling for years in practice. Based on the results, the null hypothesis was rejected as there was a statistically significant correlation between a physician belonging to a Joint Venture practice and a patient being placed on home dialysis.

Table 7

Correlations

		Home_dialysis_percentage	JV/Partner	Years_in_Practice
Pearson Correlation	Home_dialysis_percentage	1.000	.341	.010
	JV/Partner	.341	1.000	.058
	Years_in_Practice	.010	.058	1.000
Sig. (1-tailed)	Home_dialysis_percentage	.	.000	.434
	JV/Partner	.000	.	.168
	Years_in_Practice	.434	.168	.
N	Home_dialysis_percentage	275	275	275
	JV/Partner	275	275	275
	Years_in_Practice	275	275	275

Table 8

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.341 ^a	.116	.110	11.55119%

The overall model was statistically significant, $F(2, 272) = 17.92, p < .001$ (See Table 9 & Table 10), leading to the null hypothesis being rejected.

Table 9

ANOVA of Variables

	Model	Sum of Squares	df	Mean Square	F	Sig.
	Regression	4782.056	2	2391.028	17.920	.000 ^b
1	Residual	36292.978	272	133.430		
	Total	41075.034	274			

a. Dependent Variable: Home_dialysis_percentage

b. Predictors: (Constant), Years_in_Practice, partnerjv01

Table 10
Coefficients

Model 1	Unstandardized Coefficients		Standardized Coefficients		t	Sig.	95.0% Confidence Interval for B			Correlations		Collinearity Statistics	
	B	Std. Error	Beta				Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
(Constant)	8.911	1.638			5.440	.000	5.686	12.136					
JV/Partner	19.674	3.288	.342		5.984	.000	13.202	26.147	.341	.341	.341	.997	1.003
Years in Practice	-.011	.061	-.010		-.172	.863	-.131	.110	.010	-.010	-.010	.997	1.003

a. Dependent Variable: Home_dialysis_percentage

Research Question #2

Research Question 2 (RQ2): What is the relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis?

Null Hypothesis (H_0): There is no statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis.

Alternative Hypothesis (H_1): There is a statistically significant relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint

Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis

For the second research question, what is the relationship between a nephrologist's length of time in practice, a nephrologist's belonging to a Joint Venture financial arrangement with a home modality program, and the percentage of patients receiving modality education before starting dialysis, it was found that no nephrologist reported use of codes G0420 or G0421, the codes approved for dialysis modality education. Therefore, data did not exist to run multiple linear regression analysis for this research. Another billable code is not available for this service. As data did not exist to run the analysis, the null hypothesis cannot be accepted nor rejected.

Summary

Research question one explored the relationship between the nephrologist's years in practice, participation in a joint venture practice with a home dialysis program, and patient placement on home dialysis. Through analysis of the sample of data from the year 2018 from Illinois, the nephrologists' length of time in practice was not predictive of home dialysis; however, belonging to a Joint Venture practice was found to be associated with home dialysis.

Research question two sought to explore the relationship between the nephrologist's years in practice, participation in a joint venture practice with a home dialysis program, and a patient receiving modality education. Unfortunately, the data demonstrated that no nephrologist in the sample group billed for this education in 2018,

and analysis was unable to be performed. In the final chapter, I will discuss the findings of the study and make recommendations.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

This study was conducted to seek a relationship, if any, between a nephrologist's length of time in practice, participation in a Joint Venture practice with a home modality program, and a patient receiving home dialysis or modality education. The data were analyzed using SPSS in a correlational study through multiple linear regression. Through this analysis, I concluded that the nephrologist's length of time in practice did not statistically impact a patient receiving home dialysis. A nephrologist participating in a Joint Venture practice with a home modality program did have a statistically significant impact on a patient receiving home dialysis. No nephrologist in the state of Illinois reported billing for modality education in 2018, and therefore the relationship between nephrologist characteristics and modality education could not be examined.

Interpretations of the Findings

The findings of this study were a positive correlation of .341 between the independent variables, nephrologist time in practice and participation in a JV practice with a home modality program, and the dependent variable, percentage of patients placed on home dialysis. There was a statistically significant relationship between a nephrologist's participation in a Joint Venture practice and the usage of home dialysis. Joint Venture participation uniquely accounted for 11.6% of the variance seen in the relationship between the variables and home dialysis usage. Data were not available to analyze if a relationship exists between the independent variables and the dependent variable of receiving modality education before starting dialysis.

Joint Venture participation in a program with a home modality program demonstrated a relationship with patient home dialysis usage. This is in line with previous literature. Hollingsworth et al. (2009) studied the relationship between urologist ownership in the ambulatory surgery center setting and urinary stone surgery. Hollingsworth et al. (2009) described a positive correlation between the owners performing more surgeries than non-owners in their study. Additionally, Hollingsworth et al. (2009) indicated that those physicians who are owners are twice as likely to utilize their centers of financial interest. Other studies also demonstrate a relationship between physician ownership and center/service usage (Trybou et al., 2014). This aligns with the findings of this study, where a nephrologist would profit from rounding on his or her patient and the overall use of the center in which they have an ownership interest. Per Lin et al. (2016), there must be a relative advantage to the adopter under Roger's theory. The findings of this study demonstrate there is an advantage to the nephrologist participating in a Joint Venture to refer patients to home dialysis.

The lack of modality education reported is somewhat surprising as it is a billable service. There are several possible explanations for the lack of this information. It is possible that the education is being outsourced to a dialysis provider providing group education for free, as several large organizations do this. It is also possible that a nurse practitioner, physician's assistant, or another medical professional that this study did not account for is performing. Osterlund et al. (2014) indicated that modality education is a crucial factor in patient treatment choice. Despite my inability to analyze if a relationship exists, it is still a variable to be considered in further studies.

Nephrologists' length of time in practice is still a somewhat ambiguous variable, as previous literature suggested. Many factors play into the length of time in practice. Some researchers indicate that the longer a physician is in practice, the more comfortable they are with home dialysis (Pommer et al., 2018). Other research seemed to indicate that perhaps it is less the length of time in practice and more the time in which a nephrologist was trained that was the issue. Mehrotra (2018) reported that 44% of nephrologists who completed their training between the years 2004 and 2008 felt incompetent in the area of peritoneal dialysis. Gupta et al. (2017) indicated that physicians find it challenging to implement new techniques the longer they are in practice. Per Roger's theory of innovation (Rogers, 1962), late adopters are skeptical about adapting to change until most of their peers have done so. The findings of this study did not indicate a relationship between this variable and patient home dialysis usage; however, if more physicians in a particular group were to increase their usage of dialysis, the late adopters may do so as well. The factors that influence a physician over their time in practice should be considered in future studies as possible variables of interest.

Limitations of the Study

As this study was conducted using secondary data, I was limited by the categorization and validity of the data collected by those who compiled the reports that I used. It was demonstrated on numerous occasions that typos and inconsistent documentation existed with the reports from Medicare. Thus, the trustworthiness and validity of the data were somewhat compromised. Additionally, the inability to explore

outside the set limitations made it more challenging as some nephrologists also specialize in internal medicine. This eliminated some nephrologists and data from the study to ensure uniformity. The small number of nephrologists who participated in a JV practice with a home dialysis program (13) also presented limitations. Finally, there were no data available on the codes for modality education; thus, the second research question could not be assessed.

Recommendations

Considering the results of this research, it is recommended that several areas be studied further. The first area would be the factors that affect physician length of time in practice and utilization of home modality usage. The previous literature mentioned several times that graduates felt they were inadequately trained on home hemodialysis and peritoneal dialysis (Glickman & Seshansai, 2018). It is recommended that nephrologists' training and their competency levels with the different modality levels be studied further for effects on home modality usage.

The area of Joint Venture practices is still widely unexplored and under transparent in the world of dialysis. It was challenging to find a state that publicly displayed data related to physician ownership. It is recommended that Joint Venture practices and their effects on patient modality usage, quality, and access to care are continuously explored for further transparency.

Finally, the lack of data on modality education raises a need for further research. Given the embraced notion that modality education is essential, there needs to be further

insight into why doctors are not billing for the education. Research needs to be conducted to determine if it is happening in a different format or why it is missing.

Implications

Historically, the focus has been placed on the patient and the patient's decision for treatment. The statistically significant results that participation in a Joint Venture practice has a relationship with a patient receiving home dialysis indicate that focus should be placed on the nephrologist.

Currently, patients are encouraged to choose a form of home dialysis through the incentive of Medicare becoming active sooner, the first date of home dialysis training, instead of waiting 4 months when choosing in-center hemodialysis. It would appear that the wrong group is being incentivized. Physicians with a Joint Venture practice make a financial profit by using a clinic that they are part owners and rounding on their patients. Physicians who are not part of a Joint Venture do not have an incentive to make an effort to refer a patient to a home program, particularly if it would mean handing off their care to a colleague or having to make trips to multiple clinics to see patients (Berns et al., 2018).

Based on the findings of this study, there is room to make positive changes in the effort to increase home dialysis use in the United States. Advocates, politicians, and activists can use this data to re-evaluate policies and procedures that structure the current system that doctors are reimbursed for their work with home dialysis patients. Additionally, dialysis organizations can use this data to help strategically plan for future

investments and projects that may include more nephrologists and joint venture projects to improve the use of home dialysis.

The improved use of home dialysis will positively impact patient quality of life and the Medicare system, as home therapies are a far more cost favorable alternative than traditional in-center hemodialysis. Additionally, the improved use of home dialysis can lead to improved retention of commercial insurance through employers, lessening the burden on Medicare.

Conclusion

The findings of this study are in line with the baseline studies cited in previous chapters, which indicated that surgeons who were part owners of ambulatory surgery centers were more likely to use services at those centers. Additionally, the United States healthcare delivery system is unlike any other developed nation with many payers; it is a capitalistic system, thus perhaps explaining why a physician might be more financially motivated, unlike other countries with single-payer government systems.

Roger's theory of innovation (1962) proposed that there were levels to acceptance of innovation. These ranged from those who were willing to accept innovation early on to those who only did so because everyone else in their field had done so and they were essentially feeling forced to accept the innovation. It can be theorized that nephrologists who participate in a Joint Venture practice with a home dialysis practice are among the early adopters. They are willing to invest in this innovation financially. Given the data shown in this study, they are more likely to use home dialysis and have adopted this innovation where others in their field have not.

Using secondary data in this multiple regression study allowed an avenue for unbiased reporting of home dialysis use from the physicians; they were aware that they were reporting their data to a national database that could be used for research but were not aware of this specific study. The correlational design of this study allowed for the ideal format of reporting of relationships between the variables and allowed me to identify the lack of use of one variable entirely.

In this study, I determined a relationship between a nephrologist's participation in a Joint-Venture practice and the use of home dialysis. As the United States aims to improve its home dialysis usage by double-digit numbers through 2025, the focus should be put on partnering with nephrologists and incentivizing them to use home dialysis. It can be assumed from the results of this study, and others of similar nature in different fields, that financial investment and incentive improves usage of underused services. The findings of this study indicate the opportunity for positive social change. The determination of a relationship between the variables provides valuable insight for advocates, politicians, and dialysis organizations to aide in restructuring their approach towards encouraging home dialysis use. Additionally, increased home dialysis usage has the possibility for positive social impact on the Medicare system. Therefore, to improve the underuse of home-first dialysis in the United States, physician financial investment in the facilities where dialysis is performed will be essential to increase home dialysis.

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