Using Time-Driven Activity Based Costing (TDABC) to Examine Virtual Dialysis Rounding at Mayo Clinic

by

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Abstract

The average cost of managing a Medicare beneficiary with End Stage Renal Disease (ESRD) patient is 9 times more than the cost of managing a beneficiary without ESRD. The demand for a Kidney transplant in the U.S. is higher than any other organ and is expected to continue to rise. For health systems around the country, properly managing the costs associated with dialysis while providing high quality care should be a significant public health priority to meet the needs of this patient population. This essay uses Time-Driven Activity Based Costing (TDABC) to measure the cost impact of implementing virtual dialysis rounding compared to traditional in-person provider dialysis rounding. Using data observed at Mayo Clinic Rochester, virtual dialysis rounding is found to be between 25%-35% less costly than rounding in person. Although TDABC analyzes the costs associated with these two rounding methods, it did not incorporate any quality data into the analysis, which has therefore been determined to be outside the scope of this essay.

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Preface

My sincerest thank you to all members of the Division of Nephrology and Hypertension at Mayo Clinic Rochester for their support throughout my Administrative Internship. I would like to specifically thank Rachel Amundson, M.H.A, the Operations Administrator of Nephrology and Hypertension, for her mentorship throughout my internship and the opportunity to contribute to the study.

1.0 Introduction

1.1 Kidney Disease and Dialysis

End Stage Renal Disease (ESRD), or kidney failure, occurs when chronic kidney disease (CKD), reaches an advanced state. CKD is rated by stages 1-5 based on the kidneys ability to filter waste and excess fluids from your blood, with stage 5 being kidney failure (Appendix A). The treatment of CKD focuses on controlling the cause of the disease with the goal of slowing the progression of kidney damage. However, this treatment may not stop the diseases progression and can result in ESRD, which can be fatal without artificial filtering (dialysis) or a kidney transplant (Mayo Clinic, 2021).

For many patients with ESRD, dialysis treatment becomes the only way their body can successfully remove waste products and excess fluid from their blood. Patients can either receive dialysis through hemodialysis or peritoneal dialysis. With hemodialysis, patients will typically undergo a minor surgical procedure to place an Arteriovenous fistula (AV fistula) or Arteriovenous graft (AV graft) to make it easier to access their bloodstream. Inserting one of these AV access points enlarges the connected artery and vein allowing for blood to flow in and out of the body faster, which makes dialysis easier (Cleveland Clinic, 2021). For patients who choose hemodialysis they are required to receive regular treatment typically between 3-5 times per week at a dialysis center or at home with the use of machine that filters their blood through a dialyzer, also known as an artificial kidney (Cleveland Clinic, 2021). Each dialysis treatment typically lasts between 3 and 5 hours depending on the patient’s condition, which is determined by the judgment of a Nephrologist (kidney physician) or an Advanced Practice Provider (APP) practicing under a Nephrologists supervision.

1.2 Rationale for Targeted Issue

According to the National Institute of Diabetes and Digestive and Kidney Diseases, nearly 786,000 people in the United States are living with ESRD, with 71% on dialysis and 29% with a kidney transplant (United States Renal Data System, 2020). In 2021, a total of 22,817 kidney transplants were completed in the United States and as of January 2022, 90,324 people were on the waiting list for a kidney transplant. To add some context to this number, the total number of candidates on the waiting list for a solid organ transplant of any kind in the United States as of January 2022 was 106,669 (U.S. Department of Health and Human Services, 2022). Therefore, kidney transplants make up 85% of the total demand for solid organ transplants in the United States (Table 1).

Table 1. United States Transplant Waiting List

Transplant Type	Number of Candidates	% of Total
Kidney	90,324	85%
Pancreas	835	1%
Kidney/Pancreas	1,799	2%
Liver	11,521	11%
Intestine	194	0%
Heart	3,480	3%
Lung	1,058	1%
Heart/Lung	36	0%
Total	**106,669**	

**Data as of 1/22/22*
**All candidates will be less than the sum due to candidates waiting for multiple organs*

For the roughly 558,000 people in the United States living with ESRD, without a Kidney transplant, dialysis is the treatment keeping them alive. For those who are waiting for a suitable kidney, the median time spent on dialysis waiting for transplant is 4 years (United States Renal Data System, 2020). With long wait times for kidney transplants and the adjusted incidence rate of ESRD oscillating from positive to negative between 2009 and 2018, we can expect dialysis to continue to be the primary treatment modality for the vast majority of ESRD patients in the future (Figure 1; United States Renal Data System, 2020).

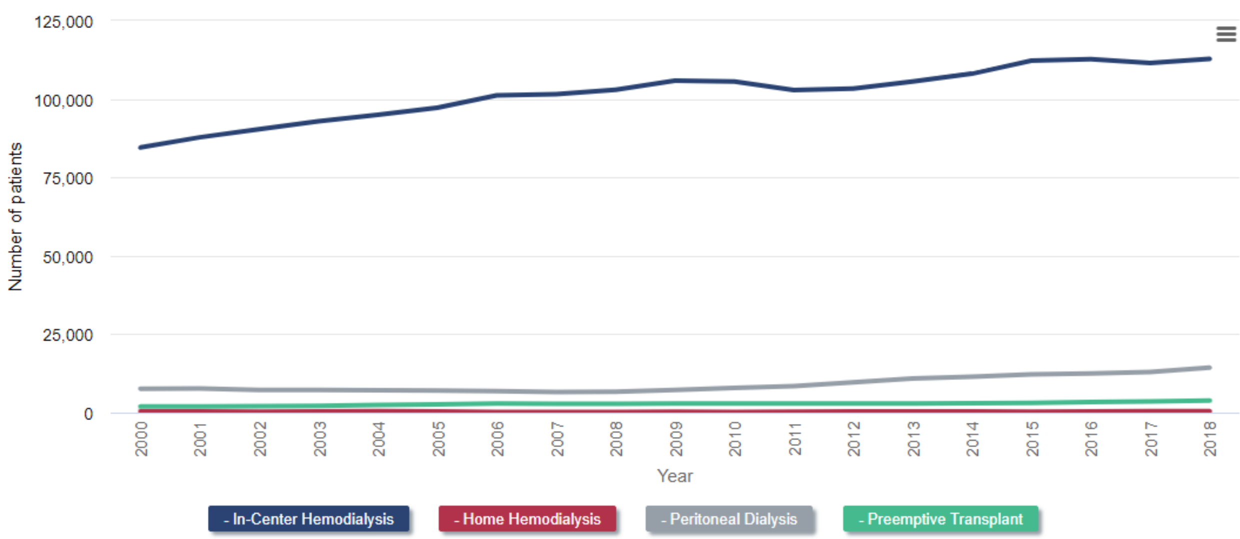

Figure 1. Number of ESRD Patients, by Modality, 2000-2018

In 1972, Medicare eligibility was extended to any persons with “irreversible kidney failure”, and as a result most people who have ESRD are covered by Medicare Fee for Service (FFS). At the end of 2018, patients with ESRD on hemodialysis represented approximately 0.9% of the Medicare FFS population, but accounted for approximately 7.2% of total spending, or $36.6 billion (United States Renal Data System, 2020). On a per person per year basis the average spending on a Medicare beneficiary in 2018 was $10,229, while over the same time frame the average for a person with ESRD on hemodialysis was $93,191, or about 9 times more (CMS.gov, 2021; United States Renal Data System, 2020). Difficulty managing the costs associated with in-center hemodialysis is by no means a recent phenomenon. Medicare has changed reimbursement mechanisms for this outpatient service six times since 1972, with the most recent guidelines taking effect in 2004 (Anumundu, 2020).

Outpatient hemodialysis currently reimburses providers using a tiered FFS model which pays Nephrologists according to how many times they see a patient in each month, up to four times per month (Anumundu, 2020). An APP practicing under the supervision of a Nephrologist can see patients for one of the monthly visits without affecting the payment amount. The goal of this FFS model is to provide economic payment incentives to see these patients more frequently which would improve the quality of care and outcomes (Anumundu, 2020). Mayo Clinic, however, sets a standard that a Nephrologist sees each patient at least twice a month, with the other two visits being completed by an APP. For organizations like Mayo Clinic, with large dialysis patient panels, frequent face-to-face visits by providers during the Covid-19 pandemic became a challenge. For the quality of care of dialysis patients to remain at pre-pandemic levels, organizations like Mayo Clinic were forced to innovate and implement new care pathways to maximize quality and minimize costs.

1.3 Mayo Clinic Overview

Mayo Clinic is a nonprofit Academic Medical Center headquartered in Rochester Minnesota and is consistently ranked the number one hospital in the nation according to U.S. News and World Report Best Hospitals Honor Roll. In addition to Minnesota, Mayo Clinic operates hospitals and health care facilities in Arizona, Florida, Iowa, and Wisconsin and serves over 1.3 million patients every year from all 50 states and over 140 countries. Mayo Clinic Rochester is also ranked number one in more specialties than any other hospital in the nation. One of the most unique things about Mayo is that all faculty physicians are salaried. This salaried model reduces overutilization of healthcare services that you occasionally see in volume-based incentive compensation structures.

The division of Nephrology and Hypertension at Mayo Clinic Rochester is ranked first in the nation by U.S. News and World Report and operates eight outpatient dialysis centers spread across the Midwest. Prior to the pandemic, the divisions providers were required to visit these various dialysis centers in-person to round on patients which meant driving long distances. Through leveraging telemedicine, the division responded to the challenges associated with Covid-19 through developing and implementing telemedicine rounding, that allowed providers to round virtually at each of the Mayo Clinic dialysis units. This virtual dialysis initiative has notably been a success for provider satisfaction, but the question remains as to how cost effective is telemedicine rounding in comparison to face-to-face rounding?

1.4 Essay Objective

The objective of this essay is to examine face-to-face and virtual dialysis rounding through using the method of Time Driven Activity-Based Costing (TBADC). One question this essay will look to answer is given how expensive the management of dialysis patients is, is virtual dialysis rounding a cost-efficient tool that can help organizations like Mayo Clinic more efficiently manage their dialysis patient population?

2.0 TDABC

2.1 Background on TDABC

TDABC was developed by Harvard University professors Robert Kaplan and Michael Porter in the 1980s and first began as Activity-Based Costing (ABC). ABC was created to address deficiencies in traditional standard-cost systems which used only three cost categories: labor, materials, and overhead to measure the cost of production (Kaplan & Anderson, 2007). Initially developed for the manufacturing industry, ABC separated costing by individual customer to measure total cost of customer product production against customer profitability (Kaplan & Anderson, 2007). As labor and material usage is fairly easy to track on a customer by customer basis, ABC added value in attribuiting which overhead costs belonged to which customers. This allowed managers to identify the customers of the highest value by comparing the resources spent producing their products against profitability. In theory, traditional cost systems might show that all customers were profitable when examining costs in aggregate, but in economic reality a minoritry of customers earned earned between 150 and 300 percent of profits, and unprofitable customers lost 50 to 200 percent of profits (Kaplan & Anderson, 2007).

ABC seemingly solved the the inacuracy of overhead allocations by customers by tracing indirect and support costs to the specific activities performed by the organizations shared services, then assigning these activities costs down to the orders, products, and customers based on consumption (Kaplan & Anderson, 2007). However, ABC was not universially accepted in the manufacturing industry mainly due to the time-consuming and costly nature of building, maintaining, and reporting ABC metrics on a regular basis. Fortunatly, the drawbacks associated with ABC led to the innovation of TDABC, a far less resource intensive, simipler, and more powerful tool compared to its predecessor (Kaplan & Anderson, 2007). TDABC simplifies the the costing process by eliminating the need to allocate costs by department activities and requires only two estimations. First, it calculates the cost of supplying resource capacity, or the total cost of all the resources – personel, supervision, equipment, and supplies – required for the department or process to operate (Kaplan & Anderson, 2007). Then it divides this total cost of capacity by the time available from the employees actually performing the work to obtain the capacity cost rate (Kaplan & Anderson, 2007). Second, TDABC uses this capacity cost rate and applies it to the capacity required for each transaction – typically time (Kaplan & Anderson, 2007). This model does not require all transactions to be the same and allows for the time estimate to vary based on the specific demands of each transaction, therefore capturing far more variation and complexity without forcing processes to be simplified into inaccurate models (Kaplan & Anderson, 2007).

2.2 TDABC in Healthcare

Although not initially intended to be applied in healthcare organizations, TDABC has become a valuable tool for administrators and clinicians to measure the total cost of a process or operation in isolation. Tracing the path of a patient throughout the continuum of care allows for the actual cost of each resource, such as personnel, space, medical supplies, and equipment to be accounted for on a case-by-case basis (Kaplan, 2014). Since Robert Kaplan published the paper "Improving value with TDABC" in 2014, which touted the opportunities TDABC presented in enhancing quality of care and outcomes while reducing costs in healthcare, TDABC studies in the industry have exploded. Nearly 80% of the current TDABC literature in healthcare was published in the last 10 years and shows no signs of slowing down (Keel et. al, 2017). Healthcare organizations from all over the world are using TDABC to measure costs in everything from head and neck surgery to primary care visits. The most common applications to date are in the surgical field, but more and more studies are using TDABC as a foundation for value-based payment arrangements of all services and specialties (Keel et. al, 2017).

The methodology used for TDABC is not dissimilar from its use in manufacturing. Rather than the investigator tracking the production of a customer good, and the activities and resources used in that production, the healthcare process tracks a specific medical condition and the care process for that condition. Table 2 illustrates the seven-step process that most TDABC projects in healthcare follow. Frequently, steps 3,4, and 5 are the most laborious and difficult to quantify. However, not all projects are alike and require some require variation to this framework depending on the process itself.

Table 2. Stepwise Description of Healthcare TDABC Process

Step	Description
Step 1	Select the medical condition
Step 2	Define the care delivery value chain, i.e. chart all key activities performed within the entire care cycle
Step 3	Develop process maps that include each activity in patient care delivery, and incorporate all direct and indirect capacity-supplying resources
Step 4	Obtain time estimates for each process, i.e. obtain time estimates for activities and resources used
Step 5	Estimate the cost of supplying patient care resources, i.e. the cost of all direct and indirect resources involved in care delivery
Step 6	Estimate the capacity of each resource and calculate the capacity cost rate
Step 7	Calculate the total cost of patient care

3.0 Literature Review

To date, limited research on the cost effectiveness of virtual dialysis rounding has been completed. At the time of this essays writing, Mayo Clinic and Harvard University have partnered on a publication using the data sited in this essay. This data was collected at the Division of Nephrology and Hypertension at Mayo Clinic in Rochester, Minnesota, and with the help of Robert Kaplan, and TDABC experts at Harvard University, a formal publication of findings is in progress. Additionally, limited research has been completed on the quality of care associated with dialysis patients who are rounded on virtually. For the purposes of this essay comparing the quality of virtual dialysis rounding care to the quality of care provided in-person has been considered out of scope.

4.0 TDABC Case Study: Virtual Dialysis Rounding at Mayo Clinic

4.1 Case Study Design

This case study examines the costs associated with in person (face-to-face) dialysis rounding and virtual (telemedicine) rounding at three Mayo Clinic outpatient dialysis centers in Albert Lea, Wabasha, and Fairmont, Minnesota. Due to time restrictions, the project team chose these three sites (out of a total of eight Mayo Clinic outpatient dialysis units across the Midwest) for this study. These sites were chosen based on numerous factors including, patient panel size, rounding Nephrologists and APP's, travel distance from Mayo Clinic Rochester, and unit support staffing levels. The project team determined that these three units would be the best sample to exemplify Mayo Clinic Outpatient Dialysis' overall footprint.

Dialysis patients at the Albert Lea, Wabasha, and Fairmont, Minnesota sites dialyze in-center for treatment three times a week on either a Monday, Wednesday, Friday or Tuesday, Thursday, Saturday schedule. Each unit operates two shifts per day to accommodate an average patient panel size of 22, 45, and 71 for Wabasha, Fairmont, and Albert Lea, respectively. It's important to note that patients are assigned to a dialysis center based on preference and availability, not by level of disease acuity or other health related factors. The Nephrologists and APP's who care for the patients at these locations are based out of Mayo Clinic headquarters in Rochester. Each provider is a salaried employee and does not receive incentive compensation based on visit volume or relative value units (RVU's). The dialysis nurses and technicians who assist with telemedicine rounding at the dialysis centers are also salaried Mayo Clinic employees. For this analysis, four nephrologists and three APP's that provide a combination of in-person and virtual dialysis rounding were included.

4.2 Process Mapping

Following the steps outlined for a TDABC project in Table 2, the team created a process map for both face-to-face and telemedicine rounding through interviews with the Nephrologists and APP's included in the analysis. A simplified version of these process maps is outlined below (Tables 3 & 4). These process steps are for one shift of dialysis patients and are identical for the second shift for both teledialysis rounding and in-person rounding.

Table 3. Teledialysis Rounding Steps

Teledialysis Rounding		
Step	**Resource**	**Description**
1	Nephrology Provider	Nephrology provider calls unit and logs into device
2	Dialysis Unit RN/CHT	RN/CHT retrieves telemedicine device and connects with Nephrology provider
3	Nephrology Provider & Dialysis Unit RN/CHT	Discuss patient panel workload and rounding schedule
4	Nephrology Provider & Dialysis Unit RN/CHT	Virtual rounding on patients dialyzing in-center
5	Nephrology Provider & Dialysis Unit RN/CHT	Debrief following rounds and disconnect from the device

Table 4. In-person Rounding Steps

In-person Rounding		
Step	**Resource**	**Description**
1	Nephrology Provider	Drive from Rochester to dialysis unit
2	Nephrology Provider & Dialysis Unit RN/CHT	Discuss patient panel workload and rounding schedule
3	Nephrology Provider	In-person rounding on patients dialyzing
4	Nephrology Provider & Dialysis Unit RN/CHT	Debrief following rounds
5	Nephrology Provider	Return drive to Rochester

4.3 Data Collection

Data for the analysis of each process step was collected through a combination of interviews and shadowing of the Nephrology providers included in the project. Initially, process step duration times were collected through interviews and later revised by observing providers while rounding virtually and in-person. Rounding observations were recorded on 45 patients receiving face-to-face rounding and 60 patients receiving telemedicine rounding. Additional data collection included time stamp activations on the telemedicine tablets used in virtual rounding, financials regarding Nephrology provider and support staff salaries, mileage reimbursement for travel time to and from the dialysis units, and telemedicine technology expenses. While this analysis will include time observation data from the Mayo Clinic study, all cost data will be independently gathered from other sources.

During rounding observations, it became clear that no two patients were alike and the amount of time a Nephrology provider spent with a dialysis patient was dependent on a variety of factors including disease complexity, language barriers, patient cooperation, and the time of day. A typical provider encounter could last anywhere from 1 minute to 12 minutes based on these factors. To account for these variables the team determined that rather than breaking each visit into sub-visit categories, an average of all patient observation times would be the best way to appropriately capture visit time variation without excluding outliers.

4.4 Cost Considerations

4.4.1 Driving Costs

According to the Internal Revenue Service, the national average for milage reimbursement in 2021 was $0.56 per mile (IRS.gov, 2021). Providers have the option of utilizing their personal vehicles for travel when rounding in-person or using a Mayo Clinic fleet vehicle. Both options are a similar cost to the organization after milage reimbursement, and no consideration was made to distinguish these two options. The cost for a provider driving to and from a dialysis unit varies based on which unit they are rounding at. Table 5 illustrates the cost at $0.56 per mile for traveling round trip to each of the dialysis centers included in the study and the total average. These times can often vary depending on weather due to the harsh Minnesota winters.

Table 5. Driving Costs

Driving Costs				
Location	Miles from Rochester MN	Drive Time (minutes)	Round Trip Cost @ $0.56 per mile	Round Trip Cost per minute
Albert Lea, MN	62.4 miles	62	$69.89	$1.13
Wabasha, MN	45.2 miles	52	$50.62	$0.97
Fairmont, MN	119.3 miles	108	$133.62	$1.24
Average	**75.6 miles**	**74.0**	**$84.71**	**$1.14**

4.4.2 Telemedicine Technology

There are numerous options for telemedicine technology in the market and their costs can vary significantly depending on features and software subscriptions for the device. For this analysis a high-tech telemedicine tablet on wheels with digital stethoscope integration and software subscription service was priced as well as a low-cost tablet with a similar subscription service. Each option was depreciated over a three-year useful life with the high-tech option cost at $6,667 per year (AMD Global telemedicine) and the low-cost option $3,000 per year (assumed to be 50% of the high-tech option). Both options are reliable and user-friendly, however they are not immune from malfunctions and glitches which can frustrate providers and patients alike.

Table 6. Telemedicine Equipment Costs

Telemedicine Technology Costs		
Option	All in cost	Cost per year @ 3-year life
High-tech	$20,000	$6,667
Low-cost	$10,000	$3,333
Average	**$15,000**	**$5,000**

4.4.3 Provider and Support Staff Compensation

Salaries for stakeholders in the process for both telemedicine rounding and in-person rounding were calculated based on the national median for their specific job title. The median annual salaries in 2021 for a Nephrologist, specialty APP, dialysis RN, and CHT (dialysis technician) were $259,711, $112,528, $77,427 and $41,000 respectively (salary.com, 2021). Fringe benefits were assumed to be 30% of their base salary and have been added to capture the total cost of each staff members time (U.S. Bureau of Labor Statistics, 2021). Table 6 uses this information to calculate the capacity cost rate, or in the cost per minute for each staff member.

Table 7. Provider and Support Staff Compensation

Provider and Support Staff Compensation		
Stakeholder	**Annual Salary and Benefits**	**Cost per minute**
Nephrologist	$337,624	$0.64
APP	$146,286	$0.28
Dialysis RN	$100,655	$0.19
Dialysis Tech (CHT)	$53,300	$0.10

4.4.4 Cost of Space

The project team concluded that the cost of space required for both in-person and telemedicine rounding is identical and it did not need to be accounted for in this analysis. Both methods of rounding require the use of the same clinical space since the patient dialyzes in-center for both rounding types. Additionally, the provider space required to conduct telemedicine rounding does not need to be included because it could be conducted from anywhere with a trustworthy internet source. Many providers choose to do telemedicine rounding from their office in Rochester, but also have the ability to conduct these visits from their home or other remote locations.

5.0 Case Study Results

5.1 Process Step Times

The total costs for in-person and virtual dialysis rounding were calculated based on the average time required from each resource to conduct their role in both processes and then compared with the capacity cost of that resource. Table 8 and 9 outline the findings for in-person dialysis rounding and virtual rounding times by process step, respectively. Providers spent an average of 5.3 minutes with each patient when rounding in-person and 4.8 minutes when rounding virtually. Average time spent discussing the rounding schedule and workload was consistent across both processes with the provider and Dialysis RN or CHT spending an average of 7 minutes before rounding occurred. The significant differences in resource time occurred during in-person rounding when providers spent an average of 74 minutes traveling from Rochester to the dialysis unit, or 148 minutes round trip. Compared to the virtual dialysis process, where providers only spent an average of 3 minutes accessing the telemedicine platform and connecting with the unit.

Table 8. In-person Dialysis Rounding Time by Process Step

In-person Rounding			
Step	**Resource**	**Description**	**Average Time**
1	Nephrology Provider	Drive from Rochester to dialysis unit	74 minutes
2	Nephrology Provider & Dialysis Unit RN/CHT	Discuss patient panel workload and rounding schedule	7 minutes
3	Nephrology Provider	In-person rounding on patients dialyzing	5.3 minutes (per patient)
4	Nephrology Provider & Dialysis Unit RN/CHT	Debrief following rounds	1 minute
5	Nephrology Provider	Return drive to Rochester	74 minutes

Table 9. Virtual Dialysis Rounding Time by Process Step

Virtual Rounding			
Step	Resource	Description	Average Time
1	Nephrology Provider	Nephrology provider calls unit and logs into device	3 minutes
2	Dialysis Unit RN/CHT	RN/CHT retrieves telemedicine device and connects with Nephrology provider	
3	Nephrology Provider & Dialysis Unit RN/CHT	Discuss patient panel workload and rounding schedule	7 minutes
4	Nephrology Provider & Dialysis Unit RN/CHT	Virtual rounding on patients dialyzing in-center	4.8 minutes (per patient)
5	Nephrology Provider & Dialysis Unit RN/CHT	Debrief following rounds and disconnect from the device	1 minute

5.2 Process Cost

To calculate the total process cost of both in-person and virtual dialysis rounding the cost of each step was determined by taking the cost of the resources(s) used in that step and multiplying it by the total time to complete that step. Since the cost of in-person rounding is largely determined by how far the dialysis unit is located from Rochester, and average distance of the three units, Wabasha, Albert Lea, and Fairmont was used (74 minutes). Additionally, the number of patients who dialyze at each unit is variable, and the process will be longer at larger units like Albert Lea when compared to Fairmont. An average of 46 patients was used when determining the length of time a provider typically took to round on every patient in the unit across all dialysis sites. Results of the TDABC analysis were calculated on an annual basis and are shown below in Figure 2. The annual costs for a Nephrologist to round in-person at dialysis units assisted by a dialysis RN across the Mayo Clinic Health system is $20,525 on average. This is compared to virtual dialysis rounding which cost $14,272, or 30% less on average. When a Nephrologist rounded with a dialysis technologist (CHT) the cost for in-person rounding was similar, but when rounding virtually, the cost was 5% cheaper than when a Nephrologist rounded with a dialysis RN. Furthermore, when an APP rounded in-person at a dialysis unit the average cost was $13,525 when assisted by a dialysis RN compared to an APP rounding on patients virtually, the cost was 25% less, or $10,206 annually, on average. If an APP was assisted by a CHT in-person the cost was relatively unchanged, but in the virtual setting the cost was 7% cheaper than in-person, or $9,209 annually.

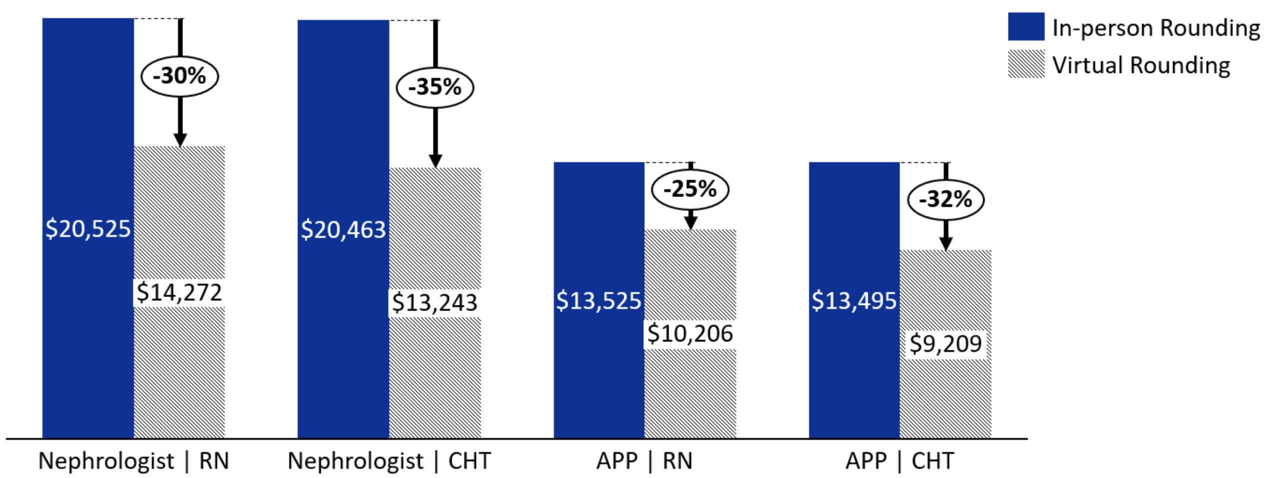

Figure 2. Annual Costs: In-person vs. Virtual Rounding

6.0 Analysis

Taking a closer look into why in-person rounding is more costly than rounding virtually tells us that the travel time for a provider to drive from Rochester to a dialysis unit 74 minutes away on average is where a significant percentage of the cost lies. Figure 3 shows that for a Nephrologist 62% of the total annual cost lies in driving to and from the dialysis unit, and for an APP it is even greater at 74% of the overall cost. Not only are there costs related to the providers time, but also included in that calculation is the average cost of $0.56 reimbursement per mile. For Mayo Clinic, the ability to have providers round on these patients virtually saves these costs in addition to freeing up an average of 400 hours of provider time a year. This is perhaps the largest opportunity cost those providers can spend on other activities like research, administrative time, or seeing additional patients in clinic. Either way, freeing up this time for providers increases provider satisfaction and could create additional revenue for Mayo Clinic if it is used to generate additional revenue.

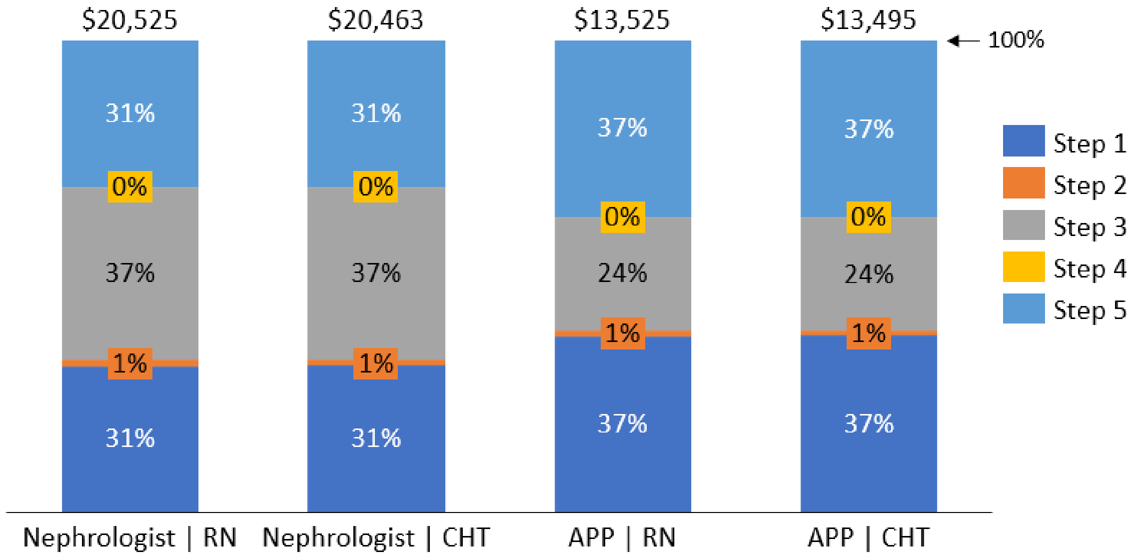

Figure 3. Stepwise Percentage Costs of In-Person Rounding

The process step associated costs with virtual rounding tell a different story from in-person rounding. When rounding virtually, the provider leans on either the RN or CHT to assist with the rounds, mainly to wheel the telemedicine device from patient to patient and use the digital stethoscope as needed. Figure 4 shows that when a Nephrologist or APP is assisted by a CHT rather than an RN the process costs around 4-5% less on average. This allows RNs to devote more time to other patient care activities that require their level of expertise. The cost of telemedicine equipment also plays a large role in the annual cost of delivering care virtually. However, this cost is far less than the costs associated with driving to round in-person.

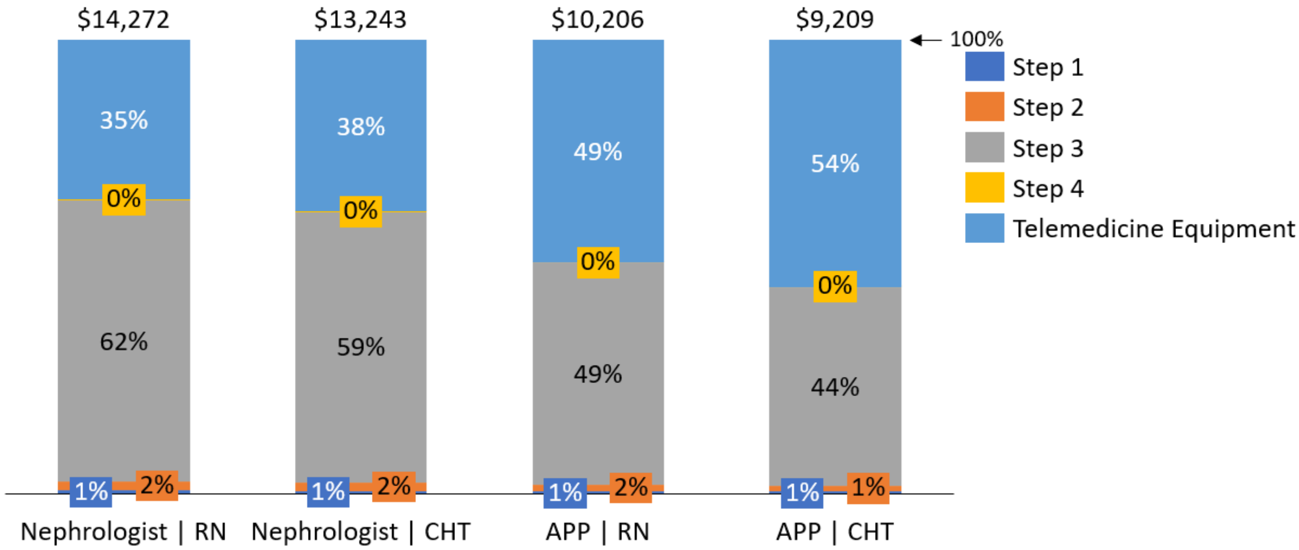

Figure 4. Stepwise Percentage Costs of Virtual Rounding

7.0 Discussion

The cost differences between rounding in-person and virtually are noteworthy and provide Mayo Clinic with a more cost-efficient opportunity to manage this expensive patient population. Through eliminating the need for expensive provider resources (Nephrologists and APPs) to physically travel to these dialysis units to round on patients, providers can use this time to conduct other value-added activities that could also generate additional revenue for the division. Additionally, leveraging a dialysis CHT to assist with the virtual rounding is a more cost effective alternative than utilizing an RN. Throughout observations it was clear that the current methodology for who assists with virtual rounding in the unit came down to availability between the RN and CHT resources. An opportunity exists to establish the expectation that a CHT or other less costly resource should be assisting with the rounding process, allowing for the more expensive (RN) resource to conduct other work: understanding that this may not be able to occur 100% of the time given the complex nature of caring for this patient population.

An additional advantage of utilizing telemedicine rounding is the ability for a provider to connect with the unit using this pathway at any time. Oftentimes with the dialysis patient population you have frequent missed appointments or scheduling conflicts that could disrupt patient care. Using telemedicine in the unit allows for providers to connect with the staff and patients seamlessly and as needed. This also adds value for dialysis billing, which is dependent on the number of times a provider rounds on that patient each month. Using telemedicine creates a billable communication pathway that optimizes provider time and division reimbursement.

An additional factor in utilizing telemedicine to round on dialysis patients is the quality of care they receive compared to when rounded on in-person. For the purposes of this study the project team assumed that the quality of care provided in both mediums was similar, however, additional research on the topic would lend an insight into how the quality of care compares in both settings. Only when you consider these patient quality outcomes would it be reasonable to make a more concrete recommendation on the level of telemedicine utilized for rounding on this patient population.

8.0 Conclusions, Recommendations and Public Health Implications

TDABC is an effective tool in simplifying the cost measurement of a process down to the time needed to conduct the process and comparing that to the cost of each resource utilized. In this case study virtual dialysis rounding was found to be between 25-35% less costly than in-person dialysis rounding at Mayo Clinic. For Mayo Clinic, continuing to leverage this tool to help manage the dialysis patient population at their sites in Minnesota, Wisconsin, and Iowa, will help contribute to increased provider satisfaction and reduce expenses related to travel. The level at which virtual rounding is utilized should be dependent on the quality of care a patient receives in the virtual setting when compared to in-person. If no significant quality disparities are found upon further investigation, virtual dialysis rounding could grow from its current 50% utilization for patient visits to 75% or even 100% over time. The Covid-19 pandemic has brought a normalcy to telemedicine use across healthcare, and patient comfort level with virtual interactions with providers will continue to grow in correspondence with its utilization.

The public health implication for implementing virtual dialysis rounding at health systems across the country are wide ranging. The dialysis patient population is highly acute, and this makes them an expensive population to care for. Utilizing a cost-effective rounding tool like telemedicine to reduce the costs associated with hemodialysis will give organizations an opportunity to reallocate these resources to developing additional innovative care pathways to the treatment of ESRD.

Appendix A Stages of Chronic Kidney Disease (CKD)

STAGES OF CHRONIC KIDNEY DISEASE		GFR*	% OF KIDNEY FUNCTION
Stage 1	Kidney damage with **normal** kidney function	90 or higher	90-100%
Stage 2	Kidney damage with **mild loss** of kidney function	89 to 60	89-60%
Stage 3a	**Mild to moderate** loss of kidney function	59 to 45	59-45%
Stage 3b	**Moderate to severe** loss of kidney function	44 to 30	44-30%
Stage 4	**Severe** loss of kidney function	29 to 15	29-15%
Stage 5	Kidney **failure**	Less than 15	Less than 15%

* Your GFR number tells you how much kidney function you have. As kidney disease gets worse, the GFR number goes down.

Figure 5. The stages of CKD are numbered from 1-5 based upon glomerular filtration rate (GFR). Stage 5 being the most severe at a GFR less than 15 which is considered to be kidney failure

Source: National Kidney foundation

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