Implementing Recova® to Adjust Estimated Dry Weight in an Outpatient Hemodialysis Clinic

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Implementing Recova® to Adjust Estimated Dry Weight in an Outpatient Hemodialysis Clinic

by

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Bachelor of Science in Nursing, University of Missouri- St. Louis, 2017

A Dissertation
Submitted to The Graduate School of the University of Missouri-St. Louis
in partial fulfillment of the requirements for the degree

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with an emphasis in Adult Gerontology Nurse practitioner

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Abstract

**Problem:** The purpose of this project is to implement the Recova® tool to adjust estimated dry weight supporting interdisciplinary team management of fluid overload in dialysis patients. Fluid overload can lead to high rates of morbidity and mortality. A total sample of 26 hemodialysis patients in an outpatient clinic located in a metropolitan city in a midwestern state was included in the project. Data collected shows there was poor knowledge familiarity with how fluid should be managed in patients suffering from chronic kidney disease. The nurses utilized the Recova tool for a period of 8 weeks to help aid in estimated dry weight adjustments in the clinic.

**Methods:** The quality improvement project used an observational descriptive design. The IHI module of change PDSA cycle was the framework used for the study.

**Results:** A total of 26 hemodialysis patients (N=26) treatment data for a period of 8 weeks was analyzed. The results of the monthly means (January (M=.16, SD=1.85), (February (M=.58, SD=2.5) and March (M=.40, SD=2.6) indicated a decrease in post-weight variances from estimated dry weights when compared to baseline data. However, the results were not statistically significant evidenced by \( p < .05 \). Results indicated that there were improvements in clinical quality scores which were evident by an overall decrease in previously high clinical quality scores.

**Implications for practice:** Having a standardized validated decision aid tool, recognized, and used by staff in outpatient settings is crucial to fluid management and prevents fluid overload, hemodynamic instability, and hospitalizations.
Implementing Recova® to Adjust Estimated Dry Weight in an Outpatient Hemodialysis Clinic

In 2017, rates of chronic kidney disease (CKD) were approximately 9.1% and resulted in 1.2 million deaths globally (Stenberg, 2020). For individuals with CKD, kidney function gradually decreases over time. As a result of kidney function decline, dialysis and transplantation have emerged as the treatment options for CKD. While it has its risks, dialysis remains the preferred treatment option for most patients with CKD. During the hemodialysis (HD) process, the patient’s blood is circulated outside the body in a machine. The part of the machine called the dialyzer acts like an artificial kidney that cleans and removes fluid from the blood. Then the blood is returned to the patient’s body. This is done either at a dialysis facility or home. The term dialysis generally refers to hemodialysis and there is no difference between these two terminologies.

Fluid overload remains an essential consideration for hemodialysis patients. Fluid overload can lead to prolonged hospital stays and possible morbidity (Canaud et al., 2019). Different factors can affect fluid balance in dialysis patients. These factors include dietary intake components of salt, free water, and glucose (McIntyre et al., 2017). Fluid overload is associated with impaired oxygenation. When compared to other organs, the kidney has a lesser amount of oxygen reserves (ScienceDaily, 2007). Additionally, CKD is associated with less capillary blood flow, which can further reduce oxygenation (ScienceDaily, 2007). In fact, fluid overload is the most common and insidious risk factor in CKD and End-Stage-Renal-Failure (ESRD) patients (Ekinci et al., 2018). Subsequently, the management of fluid overload in dialysis patients is the greatest challenge.
In dialysis patients, poor fluid management can lead to hemodynamic instability (Zoccali et al., 2017). Moreover, fluid is critical to the heart’s health, indicating the relationship between fluid ingestion/management and cardiovascular disease. Poor fluid management can lead to a state called hypohydration that has detrimental effects on cardiovascular health (Watso et al., 2019). Cardiovascular disease is amongst the leading causes of mortality and morbidity in patients with CKD, with cardiac failure occurring in 25-30% of hemodialysis patients (McIntyre & McIntyre, 2017).

Secondly, fluid overload is associated with increased hospitalization translating to increased costs for both hospitals and patients. Statistically, among 350,000 ESRD patients, approximately 280,000 acute episodes per year were due to fluid overload. More than 80% required hospitalization totaling around USD 1.7 billion annually (Ekinci et al., 2018). Moreover, these acute episodes result in frequent hospitalizations among ESRD patients. Additionally, Plantinga et al. (2018) noted, more than 1/3 of these hospitalizations resulted in readmissions within 30 days after discharge. The top readmission diagnosis was pulmonary edema, congestive heart failure, and fluid overload (Plantinga et al., 2018). The above-presented statistics show the need to ensure fluid balance in dialysis patients, considering it is both detrimental and costly.

Lastly, fluid overload and poor fluid management result in decreased quality of life. Since critically ill patients are usually at risk for many other conditions, it is essential to evaluate the volume status of fluid overload and its management. If not carefully assessed and managed, it could result in more adverse outcomes for the patient leading to several complications such as tissue breakdown, delayed wound healing, and cardiac failure. Therefore, if fluid overload remains untreated, it negatively impacts the patient’s
quality of life in different ways to the degree that the patient is always uncomfortable and cannot participate in or enjoy life normally.

Stenberg, et al., (2020) developed and validated a multifactorial decision aid tool that incorporated bioimpedance spectroscopy (BIS). In a clinical setting, bioimpedance spectroscopy has been used to measure the amount of extracellular and intracellular fluid in a patient's body. This decision aid tool known as Recova® is a new approach for fluid management in hemodialysis for the determination of dry weight. Your normal weight is your dry weight, which is the amount of water in your body without any added fluid. Extra water in your body can be dangerous since it puts extra strain on your heart and lungs (National Kidney Foundation, 2020). The tool’s implementation has had a positive effect on the fluid status symptoms (Stenberg et al., 2020). While several studies found that a tool/approach to test and manage fluid status in hemodialysis patients effectively is needed, the Recova® tool developed and validated by Stenberg, et al., (2020) has become a major recommendation in the literature.

In a Midwest urban hemodialysis clinic, there is no current standard practice tool that integrates BIS for the measurement of dry weight that can be used during nursing assessment. Studies have evaluated the potential benefit of BIS-guided treatment in both uncontrolled and randomized controlled trials (RCTs). Another study found that after BIS-guided dry weight adjustment, 76% of patients were within or near their target weight (Van der Sande, et al., 2020). The significance of clinical evaluation is still highly emphasized.

The purpose of this project is to implement the use of the Recova® tool to adjust estimated dry weight supporting interdisciplinary team management of fluid overload in
dialysis patients. Recova® is a decision tool that standardizes the process of recording, scoring, and responding to changes in routinely measured physiological parameters and incorporates bioimpedance in target weight determination. The purpose of Recova® is to enable early recognition and adequate response to fluid status alteration in HD patients (Stenberg, et al., 2020). The primary aim of this project is to decrease post-weight variances from estimated dry weights by implementing the Recova® tool in 50% of patients between January 2022 and March 2022. The secondary aim is to decrease clinical quality scores indicating an improvement in fluid management. Primary outcome measures include post-weight variances deducted from estimated dry weights weekly and monthly clinical quality scores. A study question was composed to guide the literature review, in an outpatient hemodialysis clinic in a Midwest urban community how does the implementation of the Recova® tool improve the fluid management and clinical quality scores?

**Literature Review**

A search of the literature was conducted to identify the current evidence on the implemented performance measurement tools supporting interdisciplinary team management of fluid overload in dialysis patients. The search focused on identifying systematic reviews, peer-reviewed journals, retrospective cohort studies, randomized controlled trials (RCT), and meta-analyses as the best evidence for the study. The search was conducted in CINAHL, EBSCO, PubMed, and Google Scholar databases. The keywords used included fluid management, hemodialysis, end-stage renal failure (ESRD), and chronic kidney disease (CKD). The Boolean searches had the use of ‘AND’ and ‘OR.’ The search on each database yielded more than 1,500 articles from 1/1/2016 to
31/12/2020 except for one reference published in 2011, but essential to the study. Apart from this one study, no other study before 2016 was included. This resulted in 55 studies for review. After reviewing abstracts and inclusion criteria and appropriateness, six journal articles were selected for inclusion in this review.

It is becoming more common to use different methods not only for research purposes but also in daily practice to improve the assessment of HD patients’ fluid status. Therefore, this review focuses on a critical analysis of the pros and cons of these different methods used in volume overload monitoring. Trends from the research revealed that fluid overload is dangerous and a significant cause of diverse conditions. Furthermore, the articles highlight the need for and importance of fluid volume, and hemodynamic management in this population of patients. Fluid overload is a serious condition resulting in hospitalization, in HD patients. The literature found that a consensus of studies supports interventions at dialysis facilities that can reduce risk (Plantinga et al., 2018; Zoccali et al., 2017).

Plantinga et al. (2018) analyzed the post-hospitalization dialysis facility care processes and the hospital readmissions amongst HD patients in a retrospective cohort study. The purpose of the study was to examine the association of post-hospitalization processes of care at hemodialysis facilities with pulmonary edema-related and other readmissions. Hospitals and dialysis facilities are ordinarily accountable for 30-day hospital readmissions amongst the HD patients in the U.S. The authors looked at the association of post-hospitalization care processes at the facilities with diverse readmissions and pulmonary edema-related readmissions. Data were obtained from the electronic medical records (EMR) data linked with the national registry data. The data
were retrieved from 19 settings that included Wake Forest Baptist Health (n = 16 clinics) and Emory Healthcare (n = 3 clinics), and the United States Renal Data System (USRDS). Plantinga et al. (2018) examined unique patient index admissions (n = 1056; 2/1/10-7/31/15) followed by ≥three in-center hemodialysis sessions within ten days among patients treated at the 19 dialysis facilities.

Findings showed, 17.7% of patients were readmitted; amongst them, 8% had pulmonary edema-related readmissions. The results demonstrated that some interventions carried out at the dialysis facility during the post-hospitalization period were associated with reduced readmission risk, while others may provide a potential existing means of identifying patients at higher risk for readmission (Plantinga et al., 2018). The study was able to correlate post-care processes in lowering the risk of pulmonary edema; one main process that made the most impact was a decrease in EDW of ≥0.5 kg after admission which decreased the risk by 40%. Limitations for the study were the lack of the use of a defined/direct research participant; therefore, the recommendation was to conduct the study again using purposeful sampling and recruiting participants directly from the population under study.

A comprehensive survey revealed that 78% of HD clinics in Great Britain lacked a policy for managing fluid balance (Zoccali et al. (2017). The purpose of the study was to investigate the relationship between chronic exposure to fluid overload (FO) and mortality. Thirty-nine thousand five hundred sixty-six patients were enrolled in the yearlong study. Participants were treated in the NephroCare-FMC dialysis center network operating in 26 countries in Europe, the Middle East, Africa, and Latin America. The study used a correlational study design to determine the relationship between two
variables. The researchers used three discrete systolic BP (Syst-BP) categories (<130, 130–160, and >160 mmHg) to analyze the risk for mortality in patients with ESRD with chronic fluid overload. The highest risk of mortality was seen in patients with high blood pressure (>160 mmHg) and low blood (<130 mmHg) pressure readings. There was also a moderate risk seen with normal blood pressure (130–160 mmHg). The study’s results showed that sustained fluid overload is a primary cause of heart failure, hypertension, and mortality in ESRD patients. An increased risk of 62% in overhydrated patients lead to mortality in the analyses in comparison to patients who were not fluid overloaded. The article is in response to the fact that controlling the high prevalence of fluid overload in ESRD patients is still an unmet clinical need. Thus, it necessitates the need for policies aiming to optimize the control of fluid overload and mortality. The limitations of the study lie in the purely observational nature of the study/observations. A recommendation for future studies is to ascertain the effectiveness of treatment policies that account for fluid status monitoring and policies accounting solely for pre-dialysis BP measurements.

Furthermore, Ekinci et al. (2018) analyzed the effects of volume overload and the current approaches for assessing fluid status in patients with renal disease. The study’s purpose was to evaluate volume overload, its effects on patients with renal diseases, and current methodologies measuring volume status in the body. The article recognized volume overload as a critical and foremost independent prognostic factor that determines the outcome of hemodialysis patients. It underpins the significance of measuring the fluid status of patients to avoid volume overload. A systemic review was conducted and some of the current techniques reviewed encompassed biomarkers, ultrasonography, relative blood volume monitoring, bioimpedance, echocardiography, esophageal and/or
suprasternal Doppler, pulmonary artery catheterization, and blood viscosity (Ekinci et al., 2018). Each of these techniques had advantages and limitations. The research results indicated that volume overload and congestion are serious problems that caused morbidity and mortality in (HD). It is essential to maintain dry weight in HD patients and avoid volume overload (Ekinci et al., 2018). The limitation of the study was it incorporated fragmented evidence and had no defined inclusion criteria for the selected articles. Recommendations for future studies included the need for more randomized control studies to compare the objective methods.

To identify a relationship between fluid overload and a decrease in the quality of health in CKD patients use of recommended guidelines in HD facilities helps to facilitate an effective fluid management process. The article by Canaud et al. (2019) investigated fluid and hemodynamic management challenges and opportunities in hemodialysis patients, an essential aspect of dialysis adequacy. The aim of the study focused on challenges and opportunities of fluid and HD management in patients through use of qualitative analysis.

The study acknowledged that the optimal management of fluid and sodium imbalance in dialysis patients is made possible by adjusting salt and fluid removal through dialysis and salt intake restrictions and the fluid gain between the dialysis sessions. The approach represents the conventional approach made possible by the adjustment of ‘dry weight’ based on clinical judgment and other complementary tools, such as dialysate sodium prescription adaptation (Canaud et al., 2019). The results indicated that renal replacement therapy has improved tremendously, but the problems lie in restoring extracellular volume homeostasis, achieving adequate blood pressure control,
and preserving the hemodynamic equilibrium of dialysis patients. The limitation lies in the lack of data for analysis and verification of the results.

McIntyre et al. (2017) acknowledge that three components affect fluid balance in dialysis patients, which include free water, salt, and glucose. In all patients, the high levels of water intake and the increased salt intake were key contributors to fluid overload. The purpose of the resource is to explain the linkage between fluid overload and cardiovascular disease in renal patients and offer guidance on the adjustment of dietary intake. Moreover, it aims at presenting a guideline/program for the management of salt and fluid. The article is in response to the challenges experienced by the 21st century’s renal team. The study does not involve participants/settings but uses patients and professionals as participants at the program’s center. The authors used a descriptive qualitative, research design to obtain information regarding the phenomenon’s status and describe its conditions/variables. The results indicate that the use of monitoring relative blood volume changes during dialysis, to ensure that patients are adequately hydrated, reduces their risk of developing hypotension and hemodynamic instability on dialysis. The limitation of the study is the lack of quantitative data to verify/support the results.

A critical article for the project is an article by Stenberg (2020) in which the author investigates the current practices and new approaches for fluid management in hemodialysis. The purpose of the systematic review was to contribute to reduced prevalence of fluid overload and intradialytic symptoms in hemodialysis patients, by providing the team – the patient, the dialysis nurse, and the nephrologist – with a tool that facilitates communication and enables informed decision-making in dry weight determination. The goal was to develop a management tool for determining dry weight
accordingly on multiple complementary approaches. Consequently, the authors aimed at reducing the prevalence of fluid overload and the interdialytic symptoms in HD patients by proposing a tool capable of facilitating communication and ensuring informed decision-making in the determination of dry weight.

The review used five different studies that had different participants/settings. Study I used 48 Swedish and Danish HD units’ treatment-related data from 99 stratified HD patients at 33 units. Moreover, the study used cross-sectional, mixed methods, descriptive statistics, and qualitative content analysis. Study II used 24 renal care professionals from 11 HD units. The study used explorative with a qualitative approach. Study III included part I, which had 64 HD patients, and part II had 11 HD patients that had elevated BNP levels. The study used prospective, observational, with cross-sectional part and a longitudinal follow-up. Study IV had part I and II whereby Part I used an interprofessional core development group and a multi-professional group of stakeholders, and part II incorporated 19 British and Swedish HD nurses. The study used inductive development and interrater reliability analysis. Study V used 49 HD patients from two cohorts. The study used prospective intervention implementation (Stenberg, 2020)

The results show that there is wide variation in routines for dry weight determination at Swedish and Danish hemodialysis units; Nurses’ authorization to adjust the dry weight of hemodialysis patients is associated with improved fluid status, and the barriers to use of BIS among healthcare professionals are insufficient credibility, lack of awareness, insufficient knowledge, limited self-efficacy, lack of structure, and contradictory regulations (Stenberg, 2020). Moreover, the results indicated that a decision aid for early recognition and correction of volume alterations in hemodialysis patients
(i.e., Recova®) was developed. The tool is based on multifactorial symptom assessment and incorporates BIS in dry weight determination. The implementation of Recova® at two hemodialysis units increased the monthly frequency of BIS measurements and dry weight adjustments (Stenberg, 2020). The limitation for the thesis is that most of these studies are that the samples used were relatively small, and most participants were recruited from the same facility, such as a hemodialysis center, which might be an issue in the generalization of the study.

This proposed quality improvement project will use Plan-Do-Study-Act (PDSA) as a guiding framework for implementing the proposed tool (IHI, 2021). It is a valuable tool for documenting a test of change, emphasizing the concepts of planning, doing, studying, and acting. When implementing a change, the tool enables going through the four steps to guide the thinking process, break tasks into steps, and further evaluate, improve, and test the outcomes (IHI, 2021). Overall, the four-stage problem-solving model improves the change process.

Methods

Design

This quality improvement project used a descriptive, observational design. Quantitative data was collected via prospective chart review. Data collected was post-weight variance (PWV), estimated dry weight (EDW), and clinical quality score (CQS) in conjunction with demographics: gender, race, and age.

Setting

This project took place in an outpatient hemodialysis clinic located in a metropolitan city in a midwestern state. This clinic of thirty-eight patients is part of a
larger healthcare organization that provides care for people living with chronic kidney disease. The clinic staff consists of a manager, two nurses, and five certified clinical hemodialysis technicians.

Sample

This proposed project used a convenience sample of patients with a diagnosis of chronic kidney failure who are receiving care in the hemodialysis clinic. Because the clinic is held accountable to CQS, focusing specifically on patients needing fluid management in the fluid management dashboard is vital to the success of the implementations. Therefore, inclusion criteria for the sample was patients identified as permanent patients in the outpatient hemodialysis clinic, aged 18 years and older, with a diagnosis of chronic kidney failure that was identified in the fluid action groups on the fluid management dashboard. Exclusion criteria was patients aged 18 years and younger, transient patients, patients with a diagnosis of acute kidney failure, and patients not included in the fluid management dashboard action groups. Patients younger than 18 years, and patients who do not have a diagnosis of chronic kidney failure served by the clinic were also be excluded.

Approval Process

Formal, written approval was sought and obtained from the participating clinic’s healthcare system Chief Medical Office (CMO) on October 27, 2021. The project protocol was evaluated and determined not to be human subjects’ research. Approval for this project was obtained from the University of Missouri-St. Louis (UMSL) Institutional Review Board (IRB) before implementation.

Data Collection/Analysis
All medical records of patients seen in the dialysis clinic from October 1, 2021, through March 31, 2022, were included in the data analysis. A unique alphanumeric identifier was created and applied to each patient for de-identification purposes. The identifier was a combination of the patients first and last initials and date of birth (eight digits -month/day/year), generating a unique ten-digit identifier. Additional demographic variables collected included age, gender, and race/ethnicity by using a numerical scale for recording purposes. A master list of coded identifiers and patient names was stored in a password-protected file on the primary investigator’s clinic-provided laptop.

Post weight variances deducted from EDW and CQS along with EDW were collected via chart review for patients seen in the clinic from October 1, 2021, through December 31, 2021, before the Recova® implementation. Prospective data collection from patients seen in the clinic after the Recova® implementation from January 2022 through March 2022, included EDW and post-weight variances weekly to assess the effects of Recova® on HD patient fluid management.

October 1, 2021, through March 31, 2022, monthly CQS data was also recorded. Data were analyzed using SPSS for descriptive statistics and an independent samples T-test was performed.

**Procedures**

The use of a new tool to help with fluid management of patients with chronic kidney failure treated in the clinic was identified by the healthcare organization and was led by the Doctor of Nursing Practice (DNP) candidate. A focused meeting was held with the clinical quality manager and the director of operations at the hemodialysis clinic. Stakeholders identified core problems with fluid management resulting in poor clinical
quality scores (CQS) in this outpatient hemodialysis clinic during this meeting. Additionally, poor management of estimated dry weights was one of the causes identified on the fluid management dashboard. This dashboard is used to provide trends and treatment-specific details to improve fluid-related outcomes. The decision was made to implement the Recova® tool in the outpatient hemodialysis unit to improve management of estimated dry weights ultimately improving the CQS.

The decision was made to upload the Recova® Tool into the fluid management dashboard for implementation of the tool. Before implementation, the RN staff were educated on Recova® which consists of three parts: Symptom Scoring (Appendix A), Thresholds and Triggers (Appendix B), and a Decision Aid Algorithm (Appendix C). Nurses used these tools weekly to address estimated dry weights and complete a survey (Appendix D). Weekly EDW and PWV and the monthly CQS were collected and recorded. Patients were provided with pamphlets that to aid in their knowledge about fluid management.

Results

Demographics of the sample

Medical records reviewed from January 17th, 2022, through March 12th, 2022, included twenty-six patients 26 (N=26) that met the criteria for the quality improvement project. Summary statistics were calculated for Gender, Age, and Race. The patients’ ages ranged from 33-86 years; for female participants, with the average age at 60.5 years. For males, the average age was 59.5 years. There were more females (n=17, 65.4%) than males (n=9, 34.6%) in the data set and all sample participants were African American (n=26, 100%). The summary statistics can be found in Table 1.
**Statistical Analysis**

IBM SPSS Statistics Version 27 and Intellectus statistics was used for statistical analyses of the obtained data. All data sets were regarded as nonparametric. A paired-samples t-test was conducted to compare the monthly EDW means values. The results of the monthly means (January (M=.16, SD=1.85), (February (M=.58, SD=2.5) and March (M=.40, SD=2.6) indicated a decrease in post-weight variances from estimated dry weights when compared to baseline data. However, the results were not statistically significant evidenced by \( p < .05 \) (see Table 2).

Similarly, the mean value for the post weight variances of all months were analyzed. The results of the means were as follows: January (M=.742), (February (M=.314) and March (M=.502). The results indicated a decrease in post weight variances for all three of the months from the baseline data after the Recova® tool was implemented (see Figure 1). Interestingly, in the month of March, a slight increase was noted in the post weight variances and perhaps this is suggestive of a special cause effect that may have influenced data outcome for that month.

The frequency of weekly EDW changes were monitored during data collection. Wilcoxon’s non-parametric test was used to analyze the frequency of changes made to EDW (see Figure 2). Results indicated an increase, weekly, in the number of changes made to patients’ EDWs by the nurses. The increase in frequency is perhaps suggestive of the nurse’s compliance in using the Recova® tool which might also imply a closer monitoring with appropriate implementation of interventions for patients.

The secondary outcome measure of the study was to analyze clinical quality scores to determine if there was a clinical improvement noted in score levels after the
implementation of the Recova® tool (see Figure 3). Results indicated that there were improvements in clinical quality scores which were evident by an overall decrease in previously high clinical quality scores.

**Discussion**

The Recova® tool is a standardized validated quality measure tool that is clinically effective for fluid management in chronic kidney disease patients. The tool was implemented in an outpatient hemodialysis clinic to support the nurses with improving their clinical assessment and management of fluid overload for individuals diagnosed with CKD. The EDW changes were monitored over a period of 8 weeks and results showed that there was an increase in EDW changes made by the nurses and decreased post-weight variances from EDW. Although the mean value of the EDW from the post weight variances were not statistically significant, the decreased post weight variances from EDW after implementation of the tool may be suggestive of an improved fluid management in CKD patients.

Additionally, CQS were documented for 6 months; 3 months pre and post implementation of the project. The secondary outcome of the study aimed to identify if there was an improvement in clinical quality scores after implementation of the Recova® tool. The clinic had an average CQS of 40 however after the tool was implemented, the average CQS was noted to be 35. There was a decrease in previously higher clinical quality scores after the tool was implemented which may also be suggestive of an improvement in the overall quality of care delivered to CKD patients in the outpatient hemodialysis clinic. A decrease in CQS supports a clinical improvement during the study.
Furthermore, the number of patients identified in the fluid action groups monthly decreased from January-March supporting monthly improvements, as seen in Figure 4.

**Limitations**

A major limitation identified during the study was the homogeneity in the race demographic. All patients that participated in the study were African Americans. The lack of heterogeneity in the sample size limits the generalizability of the results to other ethnic groups. The small sample size and short period of time to implement the study also contributed to the limitations.

Prior to the initiation of the study, education was delivered to staff at the site of implementation. Surveys completed by the nurses indicated common barriers that hindered the compliance in the use of the tool during clinical assessment of patients. Common barriers reported by the nurses include poor knowledge and familiarity with the tool, inadequate time to use the decision aid, disruption in attendance, changes in staff, increased workload, and the unwillingness to fully commit to a study for a period of 8 weeks. Due to the few number of nurses in the clinic, bias is also probable.

A survey questionnaire was provided to the nurses to obtain their feedback on the Recova tool and assess usability. The limitation of the survey has to do with the inability to corroborate the primary reason for the EDW changes made due to a lack of the process that illustrates how the nurses utilized the decision tool during their assessment.

Symptom assessment was a limitation to the study because the decision aid relies on symptoms scoring to initiate the intervention. Reported symptoms are typically subjective and differ from one patient to the next. In the same regard are the clinical assessments made by nurses hence posing a limitation to the study.
**Implications for practice**

Chronic kidney disease is a major health problem affecting the lives of many patients. The disease can be adequately managed in outpatient settings when appropriate measures are utilized. The collaboration of an interdisciplinary team (nurses, technicians, and physicians) is essential to maintain the quality of care delivered to patients and improve proper management of the disease process. More notably, having a standardized validated decision aid tool, recognized, and used by staff in outpatient settings is crucial to fluid management and prevents fluid overload, hemodynamic instability, and hospitalizations. The study addressed proper management of fluid in CKD patients by analyzing the EDW changes made from post weight variances in an outpatient hemodialysis clinic.

Future recommendations include conducting the study over a longer implementation period. Since one of the common barriers to using the Recova® decision aid tool was a lack of competence and familiarity with the tool, it might be beneficial to implement competency evaluations after the completion of training and prior to the utilization of the tool. Furthermore, a redesign of the survey questionnaire might be advantageous to future PDSA cycles if it indicates an outline in the process of how nurses utilized the decision tool during their assessment. Lastly, the use of an electronically incorporated tool as opposed to manual documentation of data scores might be more user friendly, effective and has the potential to reduce the likelihood for human errors.

**Conclusion**

Recova® was implemented to aid in improving fluid management in an outpatient hemodialysis clinics. Clinical improvements were noted after the implementation of the
tool in the hemodialysis outpatient clinic. Improvements were seen in both clinical quality scores, and decreased post weight variances. There was also an increase in the frequency of EDW changes which was suggestive of a closer monitoring of patients and a potential compliance in using the decision aid tool. The major barriers that contributed to the lack of initiative in utilizing the tool consistently were identified through the completed survey questionnaires. The implementation of a decision aid tool in outpatient hemodialysis clinic may strengthen interdisciplinary collaborations, improve awareness of patients’ clinical status and reinforce prompt interventions that result in better health outcomes.
References


## Appendix A

### Symptom Score

<table>
<thead>
<tr>
<th>Symptoms of fluid depletion (0-8 points)</th>
<th>Symptoms of fluid overload (0-8 points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Recumbent</td>
</tr>
<tr>
<td>2</td>
<td>Two cushions</td>
</tr>
<tr>
<td>1</td>
<td>Sitting</td>
</tr>
<tr>
<td>0</td>
<td>Weak</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
</tr>
<tr>
<td>Blood pressure increase</td>
<td>Unexpectedly low weight gain</td>
</tr>
<tr>
<td></td>
<td>Chronic coughing (new)</td>
</tr>
<tr>
<td>Muscle cramps (calf)</td>
<td>BP increase after UF</td>
</tr>
<tr>
<td>Symptomatic IDH and ≥ 20 mmHg sBP decrease</td>
<td>Severe</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td>Dizziness, symptomatic hypotension</td>
<td>Requiring saline infusion or stopped UF</td>
</tr>
<tr>
<td></td>
<td>Requiring position change</td>
</tr>
<tr>
<td></td>
<td>Thirst directly after HD</td>
</tr>
</tbody>
</table>

FO: fluid overload; HD: hemodialysis; IDH: intradialytic hypotension, sBP: systolic blood pressure; FD: fluid depletion
Appendix B

*Thresholds and Triggers*

<table>
<thead>
<tr>
<th>SVS Score</th>
<th>Response</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Evaluation of target weight (DW) every second week</td>
<td>Bioimpedance measurement 2 – 4 times/year for assessment of hydration status and nutritional status</td>
</tr>
<tr>
<td>1 – 4</td>
<td>Target weight should be questioned</td>
<td>Inform registered nurse, who must assess the patient, and decide whether initiation of DW change is required or if symptoms may be explained by other known conditions (such as heart failure or advanced chronic obstructive pulmonary disease). Perform Bioimpedance measurement and evaluate according to decision aid. Repeat measurement at three occasions or until target weight is achieved.</td>
</tr>
<tr>
<td>5-6 or 3 in a single parameter</td>
<td>Target weight should be adjusted</td>
<td>Inform clinician for assessment. Perform Bioimpedance measurement without delay and evaluate according to decision aid. Repeat on three occasions or until achievement of target weight goal.</td>
</tr>
<tr>
<td>7 or more</td>
<td>Immediate need for evaluation of hydration status and target weight adjustment</td>
<td>Registered nurse to immediately inform the clinician</td>
</tr>
</tbody>
</table>
Appendix C

Recova® - Decision Aid

Instructions

Firstly, identify the patient’s predominant symptoms (according to RECOPA Symptom Score) then code the patient’s symptoms and results from BIS measurement (i.e. will OH remain despite planned ultrafiltration?) and follow the arrow from the circled letter A, B, C or D

1. Target:
   - Symptoms closer to 0
   - Consider accepting: OH 2 to 4 L post HD
   - FO? Repeat BIS measurement!

2. Target:
   - Symptoms close to 0
   - Decrease target weight with 0.5 – 1 kg/week

3. Target:
   - Symptoms close to 0
   - Decrease target weight with 0.5 – 1 kg/week

4. Target:
   - Symptoms closer to 0
   - Consider accepting: OH = 0 to 2 L post HD, as correction to OH = 0 may cause hypotension.
   - Firstly, treat malnutrition and inflammation

Table 1

*Summary Statistics Table for Interval and Ratio Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>n</th>
<th>SE_M</th>
<th>Min</th>
<th>Max</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1.65</td>
<td>0.49</td>
<td>26</td>
<td>0.10</td>
<td>1.00</td>
<td>2.00</td>
<td>-0.65</td>
<td>-1.58</td>
</tr>
<tr>
<td>Age</td>
<td>60.19</td>
<td>13.38</td>
<td>26</td>
<td>2.62</td>
<td>33.00</td>
<td>86.00</td>
<td>-0.29</td>
<td>-0.52</td>
</tr>
<tr>
<td>Race</td>
<td>3.00</td>
<td>0.00</td>
<td>26</td>
<td>0.00</td>
<td>3.00</td>
<td>3.00</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.* '-' indicates the statistic is undefined due to constant data or an insufficient sample size.

Table 2

*Monthly EDW mean*

<table>
<thead>
<tr>
<th>Months</th>
<th>Mean(SE)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>.16(.36)</td>
<td>0.330431</td>
</tr>
<tr>
<td>February</td>
<td>.58(.49)</td>
<td>0.122227</td>
</tr>
<tr>
<td>March</td>
<td>.40(.51)</td>
<td>0.221068</td>
</tr>
</tbody>
</table>
Figure 1.

Profile Plot of Monthly Post Weight Variances
Figure 2.

*Weekly EDW Adjustments*

![Weekly Frequency of Estimated Dry Weight Changes](chart1.png)

Figure 3,

*Clinical Quality Scores*

![Clinical Quality Scores](chart2.png)
Figure 4.

Average Patients in Fluid Action Groups