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CQI Process Improves Peritoneal Dialysis Adequacy

Worldwide, dialysis adequacy has emerged as a key issue. It has been recognized that inadequate dialysis may result in the retention of uremic toxins, which can, among other things, suppress appetite and result in malnutrition and morbidity. In January 1996, an Ad Hoc Committee on Peritoneal Dialysis Adequacy concluded that: 1) the dialysis prescription must be individualized; 2) by doing so, the suggested clearance guidelines can be achieved in almost all patients; 3) a wide range of regimens are available for individualizing the prescription; and 4) well-prescribed peritoneal dialysis (PD) is an excellent therapy for the majority of patients. According to the 1997 NKF-DOQI™ Clinical Practice Guidelines for Peritoneal Dialysis Adequacy, the delivered dose for CAPD should yield a total Kt/V_{urea} of at least 2.0 per week, and a total creatinine clearance (C_{Cr}) of at least 60 L/week/1.73 m^2. Many dialysis centers across the U.S. have implemented a continuous quality improvement (CQI) process to help improve dialysis adequacy. RenalWest Home Dialysis in Phoenix, AZ, improved their program's dialysis adequacy to the point where 80% of their patients met targeted adequacy markers within a 6-month period. Nebraska Health Systems/Clarkson Kidney Center in Omaha, NE, increased their understanding of PD adequacy by establishing a routine protocol for determining adequacy and by offering education on adequacy studies for all unit members. Satellite Dialysis Centers in Modesto, CA, discovered that 39% of their patient population had dropped out of PD. They implemented a CQI process to help patients achieve their adequacy targets and reduce PD dropout. As the recommendations of the Ad Hoc Committee gain widespread popularity, improving dialysis adequacy will become more achievable through the implementation of proven CQI processes.

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Worldwide, dialysis adequacy is emerging as a key issue. It has been recognized that inadequate dialysis may result in the retention of uremic toxins, which can, among other things, suppress appetite and result in malnutrition and morbidity.

Two aspects of assessing the adequacy of the dialysis prescription include the minimally acceptable prescription and the optimal prescription. The minimally acceptable prescription avoids the more overt symptoms of uremia and ensures acceptable short-term therapy outcomes. The optimal prescription provides long-term clinical outcomes, i.e., lower morbidity and mortality, better patient rehabilitation, and improved quality of life.[1]

The differences in cause-specific mortality among patients treated by peritoneal dialysis (PD) or hemodialysis (HD) may be due to the technical differences between the two modalities and/or differences in patient compliance, medical care, and dose of dialysis. As a result of studies showing a relationship between dialysis dose and mortality, the prescribed dose among the U.S. hemodialysis population has increased substantially.[2] A similar relationship has also been found among PD-treated patients and has stimulated an interest in increasing the dialysis dose in this population as well.[3]

Differences in case-mix severity among these two patient groups might also play a role in patient outcomes, although previous

studies have shown relatively small differences in comorbidity between PD- and HD-treated incident patients.[4] Overall, the mortality rate of both HD and PD patients during the first year of end-stage renal disease has been shown to be very similar.[5]

There has been a progressive improvement in first-year survival for each successive year's incident cohort since 1985. A possible explanation for the decline in mortality is that changes have been made in the way that the dialysis therapy is practiced.[6] In particular, during this period the renal provider community has given increasing attention to the dose of dialysis that is delivered to the hemodialysis patient.[6] In addition, there have been changes in the dialysis equipment being used, including a shift from cellulosic to synthetic hemodialysis membranes and improved connection devices for peritoneal dialysis. The use of recombinant human erythropoietin has also continued to increase during this time period.[6]

As improvements in delivered care continue to spread throughout the community of renal providers, we may see continued improvements in patient survival across the nation.[7]

Defining Adequacy of Dialysis

Current-day practices have been shifting away from minimally acceptable dialysis prescriptions to achieving optimal dialysis dose. To do this, kinetic modeling is being used to evaluate the delivered dose and to adjust prescription levels accordingly. In both hemodialysis and peritoneal dialysis, there is an increasing awareness of the need to adjust prescriptions in order to maintain adequate clearances as residual renal function declines.[8]

With a larger number of patients now being placed on continuous ambulatory peritoneal dialysis (CAPD), the issue of adequate therapy is becoming even more significant. In the past, residual renal function and peritonitis have conspired to mask the magnitude of the problem of inadequate therapy. Since this is no longer the case, the need to quantify and individualize the therapy prescription has become even more pronounced.[9]

An Ad Hoc Committee on Peritoneal Dialysis Adequacy was convened in January 1996 by Baxter Healthcare Corporation in order to develop a consensus statement including clinical recommendations for improving PD adequacy. The committee's focus was on defining clearance targets and guidelines for achieving adequacy, rather than on all of the parameters, such as nutrition, that comprise PD adequacy.

The committee—consisting of invited experts from the U.S. and Canada—recommended that peritoneal dialysis prescriptions be tailored "to provide the most dialysis that can be delivered to the individual patient, within the constraints of social and clinical circumstances, quality of life, lifestyle, and cost."[9] The committee concluded that:

- The PD prescription must be individualized. There is no standard, one-size-fits-all prescription.
- By individualizing the prescription, the clearance guidelines suggested by the Ad Hoc Committee on Peritoneal Dialysis Adequacy can be achieved in almost all patients, even those with no residual renal function.
- A wide range of PD regimens are available to assist in individualizing prescriptions and achieving adequacy guidelines.
- Well-prescribed PD is an excellent therapy for the majority of patients. The challenge to individual practitioners is to make prescription management an integral part of everyday patient care.[10]

Today, based on the 1997 NKF-DOQI™ Clinical Practice Guidelines for Peritoneal Dialysis Adequacy, the delivered dose for CAPD should yield a total Kt/V_{urea} of at least 2.0 per week, and a total creatinine clearance (C_{Cr}) of at least 60 L/week/1.73 m^2.

Theoretical constructs predict that a weekly peritoneal Kt/V_{urea} between 2.0 and 2.25 will provide adequate dialysis, assuming:

- no residual renal function;
- full equilibration of plasma and dialysate urea;
- target serum urea nitrogen concentration between 60 and 80 mg/dl;
- normalized protein catabolic rate between 1.0 and 1.2 g/kg/day.

Studies show that outcomes are superior with doses of PD that are higher than previously accepted (weekly Kt/V_{urea} of 1.7) and support the previously mentioned figures as targets to achieve that will correlate with acceptable outcomes.[11]

CASE STUDIES

RenalWest Home Dialysis

RenalWest Home Dialysis, Phoenix, AZ,[12] improved their program's dialysis adequacy to the point where 80% of their patients met targeted adequacy markers by the end of December 1995. (*Note:* Today's targets are higher.)

Data collected every 6 months at the center highlighted the fact that 30% of the program's 188 PD patients were failing to meet targeted adequacy parameters, thus affecting patient well-being and nutrition. Their objective was to improve adequacy of dialysis from 70% to 85% of the program's patients by meeting targeted adequacy parameters of Kt/V >1.7, and a creatinine clearance of >50 L/week normalized to 1.73 m^2 body surface area.

Data Collection

The CQI team analyzed adequacy data over a 1-year period regarding the top five potential causes of their problem. Their goals were to:

- Examine compliance in patients who failed to meet adequacy targets.
- Review the staff education process for adequacy.

continued on page 80

continued from page 77

- Evaluate how the prescription modeling tool was being used.
- Determine the percentage of patients who had physician approval to maintain current dialysis prescriptions even though they failed target parameters.
- Evaluate the emphasis given to adequacy testing during patient training.

Data Analysis

An average of 15–20% of patients who failed adequacy targets in the program were non-compliant to prescribed therapy. Patients failed to reach specified adequacy markers when they failed to bring in their specimens and/or allowed 6 months to elapse between the performance of adequacy testing. This led to delays in prescription changes resulting in underdialyzed patients for longer periods of time.

Patients' understanding of the importance of testing might influence their compliance. Many patients had not had PET or PFT testing performed.

Solution Selection

A force field diagram (also called solution analysis)[i] was used to identify restraining and driving forces. Each solution was evaluated to determine the number of restraining forces that it would influence. Staff training and education influenced all seven of the identified restraining forces. Group training in the patient's own language, social work resource programs, and use of an automated PD cycler (Home Choice, Baxter Healthcare) each influenced the restraining forces.

The team concluded that patient compliance could be influenced through staff training. A 60-day period was identified as necessary to implement an action plan and to ensure enough time for the interventions to influence adequacy results and demonstrate a decrease in the percentage of patients failing adequacy targets.

Implementation Plan

It was agreed that staff education would be accomplished while revising the patient training manual. Research to prepare the adequacy section of the manual would provide reinforcement of adequacy theory. The patient care staff ended up changing the adequacy modeling programs for purposes of ease-of-use, support, and updated software. The team decided that some reeducation on adequacy could be accomplished along with education on the use of the new computer modeling method.

Nursing inservices would target the importance of membrane testing and the use of dwell time and volume to enhance dialysis adequacy. Dietitians would review the computer modeling method's monitoring of nutritional markers, and PD adequacy measurements were taken by looking at the percentage of patients who did not have prescriptions adjusted after failing to meet adequacy targets. A higher percentage of PD patients meeting adequacy targets after implementation of the plan was expected.

Testing the Solution

From a select test group of patients reflecting 10% of the patient population, baseline data on Kt/V, creatinine clearance, current dialysis prescriptions, and residual renal function were collected. With these data, the primary care nurses would be able to manage the patients' prescriptions, with physician approval, based on information gained through adequacy training and competency testing. The same data were collected and reviewed at the end of a 6-month period to determine whether the patients' adequacy levels met the program's criteria.

Results

A 6-month time frame was used to evaluate test group data, allowing for:

- staff evaluation of the prescription;
- physician approval;
- implementation of the prescription;
- the patient to reach a steady state on the prescription;
- a follow-up evaluation for adequacy of the prescription.

Overall, the results demonstrated that staff training and education impacts patient compliance to prescribed therapy and improves the adequacy of the dialysis.

Nebraska Health Systems/Clarkson Kidney Center

Nebraska Health Systems/Clarkson Kidney Center, Omaha, NE,[13] realized the importance of determining whether their patients were being adequately dialyzed and, if not, improving their dialysis prescriptions. Dialysis adequacy studies were not routinely performed unless patients were showing clinical symptoms of inadequate dialysis and/or had significant changes in their monthly chemistries.

[i] Solution analysis, also called "force field" analysis, is a tool that enables centers to analyze selected root causes in greater detail. It is used to define exactly why a problem or issue exists and to identify potential solutions to overcome those problems. It also helps determine possible next steps in the process. The time to use force field analysis is during the brainstorming process, to identify all possible issues that could be a part of the solution. Force field analysis is performed diagrammatically by identifying the most significant root cause and then a list of contributors to that root cause. This list can also be used to identify "Restraining Forces" that keep a problem at its current unresolved level. The next step is to brainstorm for possible solutions. It is important to identify at least one solution for each cause. Some of the solutions, or "Driving Forces," will impact more than one barrier. Determine all possible solutions for each cause and draw an arrow from each possible solution to all of the causes it impacts. Each restraining force should have at least one driving force to counteract it. After identifying solutions through solution analysis, it is necessary to determine which solution(s) should be implemented based upon a number of agreed-upon criteria. These criteria should include, but are not limited to: the solution with the highest potential impact, the solution that is easiest to fix/measure, ease of implementation, cost, practicality, speed of implementation, and the team's ability to implement the solution.

The objective of the CQI process implementation was to increase the knowledge and understanding of dialysis adequacy for peritoneal dialysis patients. The CQI plan established a routine protocol for determining whether or not a patient was adequately dialyzed. Home dialysis unit coordinators became more proficient in performing and evaluating adequacy studies.

Root Cause Analysis, Solution Analysis, and Solution Analysis Matrix

Root cause analysis identified many factors contributing to the problem and helped to organize them so that the team could readily see the relationship between those factors and the current process. Solution analysis[i] and brainstorming assisted in showing which solutions would work well to resolve the problem. A solution analysis matrix was used to rate possible solutions based upon likelihood of success.

Solutions

Two priority solutions were identified:

- Set up an educational offering on dialysis adequacy for unit members.
- Develop a patient tracking flow sheet that would include the collection of data on all current patients to determine who had previously undergone adequacy studies, as well as the results of those studies.

Data Collection

Unit members collected data on their primary patients and discovered that an important clinical need had not been met: Only 35 of 80 current patients had been quantitatively evaluated for their dialysis adequacy at any point in their therapy. Unit members realized that they needed to understand the entire adequacy modeling report in order to make necessary changes in patient dialysis prescriptions.

Home dialysis unit coordinators attended an educational inservice that reviewed peritoneal dialysis adequacy, including Medicare's standards, and the results of their patients' collected data. Twelve of the 35 patients were identified as having had prescription changes made with no retesting. Nine patients were identified who were just below Medicare standards for Kt/V and creatinine clearance. Prescription adjustments for these patients were evaluated.

CQI Action Plan

An action plan was developed, assignments were made, and a progress report session was scheduled. All PD patients would have dialysis adequacy studies performed on a routine basis, including a peritoneal equilibration test (PET), dialysate urea and creatinine clearance studies, and evaluation of residual renal function.

The home dialysis nurses identified 10 patients from the TARGET Report[ii] who could be retested for dialysis adequacy. These patients were selected based on the fact that they were 1) still on peritoneal dialysis, and 2) could be retested.

In addition to these 10 patients, the unit coordinators prioritized their primary patients for the scheduling of adequacy studies. Using the Medicare-recommended minimum guidelines for Kt/V (≥1.7/week) and creatinine clearance (≥50 L/week/1.73m^2 BSA), quantitative parameters for reaching dialysis adequacy were chosen. Baxter's Prescription Management Decision Tree for PD Adequacy and the patient modeling component of the PD Adequest Program were used to assist with making dialysis prescription changes.

Future Steps

The CQI team determined that routine adequacy tests would be performed on all patients every 6 months. The PET would be repeated if membrane changes were suspected. New PD patients would have their initial PET and adequacy studies performed approximately 1 month after completion of training. Adequacy studies would be repeated after therapy changes were completed upon agreement of the home dialysis unit coordinator and medical director on an individual basis. Patients who showed other clinical signs of inadequate dialysis might have their adequacy studies rechecked more frequently than the every-6-month schedule.

The center's adequacy program (PD Adequest, Baxter Healthcare) will continue to be a major source for tailoring individual patient therapies and evaluating dialysis adequacy. Quarterly summaries of the population's adequacy results will be generated and presented to the team, and then shared with the rest of the kidney center. Expansion of this study to assess and improve other patient outcomes is planned.

Satellite Dialysis Centers

The CQI team at Satellite Dialysis Centers, Modesto, CA,[14] discovered that 39% of their total patient population dropped out of peritoneal dialysis either due to death or a switch to in-center hemodialysis. They examined the common problems of these patients and identified all possible causes for death or return to in-center hemodialysis. They discovered that these patients had either albumin levels of less than 3.0 g/L, a Kt/V <1.7/week, or a creatinine clearance of less than 50 L/week. Adequacy of dialysis was selected as an improvement opportunity because the outcomes are measurable within a short period of time. The goal for all identified patients was set at 75% achievement of adequacy targets.

[ii] A Baxter-generated report from PD Adequest™ data, which is a computerized PD prescription model that helps develop PD prescriptions using clinical judgment on adequacy as a program input. TARGET stands for Treatment Adequacy Review for Gaining Enhanced Therapy outcomes.

Root Cause Analysis

Using a root cause analysis, the team identified the top three issues of patient dropout as:

- low Kt/V and creatinine clearance
- exit site infection
- surgeon's technique

Data Collection

Data collection substantiated the need to reassess dialysis prescriptions on 11 patients in order to reach the adequacy target. After identifying those patients who did not meet these targets, regimens were modeled through use of an adequacy program (PD Adequest, Baxter Healthcare). Regimens were chosen that would achieve adequacy targets and fit each patient's lifestyle. From 24-hour adequacy tests, results were analyzed using this program, and the Kt/V and creatinine clearance were documented. Patients' current regimens with actual Kt/V and creatinine clearance levels were assessed and compared with the predicted Kt/V and creatinine clearance in order to determine possible noncompliance.

Solution Selection

The following solutions were considered:

- Provide patients with statistical proof of consequences of adequate/inadequate dialysis.
- Reinforce the benefits of achieving the adequacy goal to patients, i.e., prolonged life expectancy, improved appetite, increased sex drive, and the ability to feel better and maintain as normal a lifestyle as possible while on dialysis.
- Increase fill volume gradually if patient is reluctant to increase volume immediately.
- Offer patients regimen choices such as CCPD, APD, and Home Choice (Baxter Healthcare) when appropriate in order to free up the patient's time during the day.

In a 5-month period of time, it was anticipated that patients would show improvement in adequacy. The home dialysis unit coordinators spent time discussing adequacy issues with patients and answering questions. Patients were encouraged to visit their nephrologist once a month, at which time the physician would reinforce the changes made on the patient's prescription and discuss the benefits of reaching adequacy targets.

Benefits of Adequacy Improvement

Patient benefits from adequacy improvement include feeling better, being able to maintain a normal lifestyle as much as possible, and decreasing the chance of hospitalization. Additionally, physicians don't have to spend extra time following up with patients in the hospital, the costs of medical care are decreased, and the number of patients leaving PD is reduced.

Developing an Implementation Plan

The home dialysis unit coordinators began discussing adequacy issues with individual patients over the telephone prior to the patient's scheduled visit to the unit. Topics of discussion included the consequences of adequate/inadequate dialysis, computer modeling, and the choice of regimens available to achieve the adequacy target. Nurses divided the responsibilities of patient supply delivery and inventory management, gathered statistics and developed a form to share information with the patients, and used the computer program to model patients.

Weekly meetings were held to follow up on action plan implementation. Upon completing the action plan, patients received new supplies and began their new prescription. Their Kt/V was checked after 1 month into the prescription change, and Kt/V results were, as expected, higher.

CONCLUSION

Continuous quality improvement process implementation is instrumental in helping dialysis centers improve adequacy in their peritoneal dialysis patients. As recommendations from the January 1996 Ad Hoc Committee on Peritoneal Dialysis Adequacy and the 1997 NKF-DOQI Clinical Practice Guidelines for Peritoneal Dialysis Adequacy gain widespread popularity, improving dialysis adequacy will become more achievable, and more manageable, with the help of a CQI process.

Once patients are identified, adequate clearances delivered by PD can be achieved in almost all patients if the prescription is individualized according to the patient's body surface area, amount of residual renal function, and peritoneal membrane transport characteristics.

The future of adequacy improvement is moving from only specifying a single clearance or Kt/V target to providing the most dialysis that can be delivered to the individual patient, within the constraints of social and clinical circumstances, quality of life, lifestyle, and cost.

PD practitioners are challenged to make prescription management an integral part of everyday patient management, including assessment of peritoneal membrane permeability, measurement of dialysis and residual renal clearance, and adjustment of the dialysis prescription when indicated.[10] This can be facilitated with implementation of a CQI process in the dialysis center.

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continued on page 99

continued from page 82

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